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18TH INTERNATIONAL CONFERENCE ON COCHLEAR IMPLANTS AND OTHER IMPLANTABLE TECHNOLOGIES – CI2026, 10–13 MAY 2026, WARSAW, POLAND

Keynote Lectures

Free paper 0521

Acoustic and electric hearing: Together or apart

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The preservation of low-frequency (LF) hearing using the round window cochlear implantation technique developed by Skarżyński et al. (2003) has enabled the integration of residual acoustic hearing with electrically evoked hearing within the same ear.

Speech discrimination studies in patients with partial deafness combining acoustic LF hearing with electric stimulation in the mid- and high-frequency ranges have demonstrated substantial improvements in word recognition. Performance increased from an average of 40% preoperatively (acoustic hearing alone) to 90% after 12 months of implant use in quiet conditions, and from 5% to 65% in noisy environments. These outcomes represent unprecedented auditory benefits compared to traditional cochlear implant (CI) candidates, who achieve, on average, 68% in quiet and 38% in noise. We hypothesized that this remarkable improvement is attributable to preserved access to temporal fine structure (TFS) cues in the implanted ear via retained LF hearing.

Further research on combined acoustic and electric hearing has demonstrated additional auditory benefits in patients with Single Sided Deafness (SSD) following CI in the deaf ear, when electric hearing is integrated with a normal-hearing (NH) contralateral ear. These benefits include improved speech perception in noise, enhanced sound localization, and reduced subjectively reported listening difficulties. In particular, our research has focused on binaural integration effects, specifically binaural redundancy and binaural squelch. We hypothesized that speech perception benefits in noise due to binaural integration depend on access to interaural differences, particularly fine interaural time differences (ITDfine), conveyed by the temporal fine structure of the acoustic signal. This hypothesis was tested in a unique group of patients with preserved LF hearing in the implanted ear and normal or near-normal hearing in the contralateral ear. This configuration allowed isolation of the contribution of preserved LF hearing in the implanted ear to binaural integration, assuming full binaural cue availability from the NH ear. When comparing "CI on" versus "CI off" conditions, significant improvements in speech perception were observed for redundancy (in quiet and noise) and squelch. Importantly, when preserved LF hearing in the implanted ear was masked, these integration effects disappeared. These findings confirm that bilateral acoustic LF hearing – enabled by hearing preservation in the implanted ear – provides additional benefits through binaural integration mechanisms, likely mediated by access to fine interaural time differences ITDfine.

An additional source of benefit in the electric-acoustic stimulation (EAS) may be the tonotopically aligned electrical stimulation. In children with single-sided deafness (SSD), we demonstrated integration of auditory input from the CI and the NH ear, resulting in improved speech recognition in noise. This integration may be enhanced by using sufficiently long electrode arrays that closely replicate the cochlea's natural tonotopic organization.

We further investigated tonotopically optimized stimulation in partially deafened patients with preserved LF hearing. Using OTOPLAN-based estimation of electrode position, individualized frequency allocation (tonotopic fitting) was applied to optimize the combination of acoustic and electric hearing. Speech discrimination results indicate that individualized EAS fitting strategies – balancing residual frequency gaps and place–frequency mismatch – provide significant auditory benefits in this population.

Overall, our findings support the importance of preserving access to temporal fine structure cues and implementing tonotopically aligned electrical stimulation in cochlear implant users to maximize auditory outcomes.

Free paper 0139

Auditory brainstem implant in pediatric non-tumor patients

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This study aimed to evaluate the effectiveness of ABI in pediatric patients with congenital non-tumor hearing loss and elucidate the role of cortical plasticity in hearing and

speech development. A prospective cohort study was conducted involving 136 consecutive pediatric cases who received ABI at a tertiary university-based referral center from January 2019 to May 2025. The mean age at the time of surgery and postoperative follow-up were 3.44 ± 1.52 years and 36.4 ± 14.4 months (3–60 months), respectively. The average percentage of elicited electrodes (eABR%) during the operation was 75.63 ± 10.39%. Hearing and speech outcomes improved steadily after activation. Younger age at implantation (<3 years), less severe inner-ear malformation, and higher intraoperative eABR% (≥60%) were significantly associated with better hearing and speech outcomes. Mismatch negativity (MMN) responses were evoked in all children after 12–18 months of ABI using. Cortical functional connectivity developed simultaneously after activation, particularly within the bilateral temporal/frontal lobes. MMN amplitude and brain functional connectivity may serve as cortical indices for predicting long-term outcomes.

Free paper 0543

Benefits of genetic testing for cochlear implant patients

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Despite advancements in cochlear implantation (CI) technology over the past 40 years, variability in post-implantation performance remains a significant challenge. Electric-acoustic stimulation (EAS) systems have become a standard treatment option for patients with residual hearing who require CI. Genetic disorders are the leading cause of congenital and early-onset sensorineural hearing loss and also contribute substantially to late-onset hearing loss. Over the past two decades, remarkable progress has been made in identifying genes responsible for deafness, with more than 150 genes currently associated with non-syndromic hearing loss. Patients with various deafness-related gene mutations have demonstrated satisfactory auditory performance following CI/EAS, suggesting that identification of the genetic background may help predict post-CI/EAS outcomes. Identifying the causative genes is also crucial for determining the affected regions within the cochlea. When the intracochlear etiology is associated with a specific genetic background, there is potential for improved CI performance. Furthermore, advances in genetic diagnosis now allow for the selection of electrode arrays of optimal length based on the progression of hearing loss. This keynote lecture summarizes the genetic backgrounds of patients undergoing CI/EAS and presents detailed clinical data and outcomes from representative cases.

Free paper 0709

Beyond access to sound: Current challenges in children with SSD using cochlear implants

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Cochlear implantation in children with single-sided deafness (SSD) reliably restores audibility in the implanted ear. However, in the presence of a normal-hearing (NH) contralateral ear, restored access does not necessarily translate into consistent gains in speech perception, binaural integration, listening comfort, or optimal developmental trajectories. In the setting of early asymmetric input, cortical reweighting and aural preference toward the NH ear may already be established, raising fundamental questions about how restored input is incorporated into the developing auditory system.

These challenges, which form the focus of this keynote, emerge at every stage of the child's clinical journey. At the candidacy evaluation stage, clinicians must evaluate the benefit of amplification, while isolating the NH ear. Counseling families regarding outcomes is complex as clear predictive associations between age at implantation, degree of aural preference, etiology, and long-term functional outcomes are still lacking. After implantation, programming requires optimization of MAP parameters, including electrical levels, frequency allocation, and rate of stimulation, while addressing timing and frequency mismatches between ears. Rehabilitation must then balance between two goals: strengthening auditory function in the implanted ear and promoting spatial hearing and bilateral integration. Finally, questions persist regarding optimal follow-up intervals and best practices for tracking functional outcomes and neural change.

From a translational perspective, critical gaps remain. While cochlear implantation in paediatric SSD is a rational and increasingly adopted intervention, the field remains in an active learning phase. We do not yet fully understand which children will achieve durable binaural integration, nor can we reliably predict sustained device use into adulthood, particularly as no cohort implanted in early childhood has yet reached long-term adult outcomes. Bridging these gaps through rigorous research is therefore essential to move beyond restoring access to sound and toward ensuring lifelong functional benefit.

Free paper 0187

Changing trends in technique and technology in cochlear implant surgery

J.M. Hans

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When cochlear implant started, posterior tympanotomy was the only technique available for the approach to the round window. As we started doing children we realized that the inherent problems of cochlear rotation, high jugular bulb, interior sigmoid sinus, low lying dura, etc. made approach through posterior tympanotomy difficult and sometimes impossible. Raising the tympanomeatal flap as in stapedotomy was an alternative for easier approach to the promontory and the round window. Alternate techniques became a necessity. Veria is one such technique. The three important parts of the receiver stimulator are the electronics, the magnet and the electrode. More has to be done to make it inert and a passive device so that it never fails and revision surgery anytime in the lifespan of the patient is very easy and possible.

Free paper 0269

Cochlear implant services matter a lot for adult CI users

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Purpose: To explore the views of adults with CI on the services they received after cochlear implantation, and what they would have liked.

Material and methods: An online survey was developed with both quantitative and qualitative questions; it was piloted and reviewed by CI wearers, and distributed globally via the member groups and individuals of CIICA, the CI International Community of Action.

Results: 1238 respondents participated in the survey, representing 40 countries. Their ages ranged from 18 to 91 years, with 10% under 30 years of age and the largest percentage (47%) between the ages of 55 and 75. Most (94%) reported a bilateral hearing loss, but only (37%) used two implants. There was a wide range of the number of fitting/mapping/programming sessions the respondents received per year, and a greater range of the number of rehabilitation sessions received. There was greater dissatisfaction with rehabilitation sessions than fitting/mapping/programming sessions. While the first implant was usually funded by public money, ongoing provision of spares, accessories, and batteries was commonly funded personally, and comments revealed that many had not realised this financial commitment at the outset. The most common factor in making the decision to receive a cochlear implant was the individual's own decision because of their hearing loss. 78% wore their implant all the time, and 72% were very satisfied with their implant.

Conclusions: (1) Lifelong services and funding is vital – considerable amount of personal funding particularly for spares and repairs. Access to CI services needs to be built into plans for ear and hearing care. (2) Awareness of the benefits of CI and referral criteria should be increased amongst those deaf and deafened, professionals, the general public, and public health decision makers. (3) CI Users made their own decisions: we need to ensure they have the right and accessible information to make informed choices. (4) While satisfaction rates are high, the analysis of the qualitative data is revealing a more complex picture, which will provide a report to influence future policy and practice.

Free paper 0749

Cochlear implantation in patients with syndromic hearing loss

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Sensorineural hearing loss is a common feature of many genetic syndromes, and cochlear implantation (CI) has become an effective rehabilitation option for patients with severe-to--profound hearing loss in this population. However, syndromic cases present challenges related to associated anatomical, neurological, medical, and developmental conditions.

Many syndromes associated with hearing loss – such as Usher, Waardenburg, Pendred, Jervell and Lange-Nielsen, Susac, Roberts, Alport, branchio-oto-renal (BOR), keratitis-ichthyosis-deafness syndrome (KID) may involve additional abnormalities affecting the inner ear, auditory nerve, cognition, vision, balance, or cardiac function.

Between 2010 and 2025, patients who underwent cochlear implantation at a tertiary referral center were retrospectively reviewed, and syndromic cases were identified. The most common syndromes were KID syndrome and Usher syndrome. Particular attention was given to the preoperative evaluation of syndromic patients, including detailed medical, radiological, and multidisciplinary assessments. Families were thoroughly counseled regarding the postoperative course, expected benefits, and potential complications of cochlear implantation.

Outcomes in syndromic patients who were implanted early were comparable to those of non-syndromic patients; however, lower success rates were observed in those who underwent late implantation. These findings highlight the importance of early intervention. In addition, all syndromic candidates should be evaluated individually by a multidisciplinary team. Since additional disabilities can affect the rehabilitation process, rehabilitation strategy should also be tailored accordingly.

Free paper 0257

Cognitive impact of hearing loss in absence of language

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Hearing loss in childhood has far-reaching medical, social and educational consequences. Currently, access to hearing is, as a rule, provided in the second and the third year of life, which allows the acquisition of spoken language, but is still too late for unlocking the full developmental potential of the brain. While bilaterally children implanted in the first 24 months perform at age-appropriate level at 5.0–7.5 years, earlier implantation within this time provide better outcomes. The connectome model of deafness suggests the impact of deafness on cognitive function.

We evaluated cognitive functioning in 229 age-matched, normal-hearing (NH) children and 127 children with hearing impairment (HI) and cochlear implants using a parent questionnaire (LEAF). Consistent with previous reports, children with hearing loss significantly underperformed in sustained sequential processing, processing speed, working memory, reading skills, written expression, novel problem-solving, mathematical skills, and comprehension and conceptual learning (two-tailed Wilcoxon test, $p < 0.05$). They did not differ from NH children in visual-spatial organization, factual memory, or attention ($p > 0.05$). A generalized linear model (GLM) with the LEAF composite score as the dependent variable and duration of deafness and group (NH vs HI) as predictors confirmed a significant effect of group on the mean score. Speech recognition data were additionally available for 63 HI children. Bivariate and multivariate (GLM) analysis did not confirm an influence of speech comprehension on cognitive functions.

Pharmacologically-induced deafness in rats (in absence of language) showed increased impulsiveness, increased play fighting, deficits in conceptual learning, increased forgetting, together with alterations of neuronal activity in prefrontal cortex. In combination, this evidence suggests that hearing loss directly affects cognitive function.

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Free paper 0316

Difficulties in cochlear implant surgery

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Introduction: CI surgery has become common practice for rehabilitation of hearing loss patients. The growing number of indications led to more centers and surgeons approaching this kind of management.

Objective: Review the challenges associated with CI surgery and reasons that contribute to this situation.

Material and methods: All patients operated in our CI center were reviewed with interest to the complications and difficulties encountered during their surgical management.

Results: Wrong electrode insertion, severe gusher, and abnormal anatomic landmarks inside the middle ear can become the most difficult tasks to solve for the CI surgeon. Ossification, stapes footplate fistula, and vascular malformations of the temporal bone can also contribute to the surgical burden.

Conclusions: CI surgery is routine in cases with normal anatomy. It becomes challenging in the face of inner ear malformations, anatomic abnormalities of the temporal bone, and previous pathologic conditions of the middle ear and cranial cavity. Good operative indications and good otologic skills are required for the management of some CI patients. They should be referred to certain experienced CI centers.

Free paper 0579

Evolution of bone conduction implants in India

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The evolution of bone conduction hearing devices in India mirrors advances in otologic surgery, implant design, and audiological rehabilitation. This presentation reviews the surgical and audiological trajectory of bone conduction systems in the Indian context, from conventional external vibrators to contemporary implantable technologies.

Early management relied on headband-mounted and spectacle-based bone vibrators, often limited by feedback and patient compliance. The introduction of osseointegrated percutaneous systems marked a major surgical milestone. To date, cumulative Indian experience includes approximately 250 BAHA Connect implants and 200 BAHA Attract systems, reflecting a transition from percutaneous to transcutaneous approaches aimed at reducing soft-tissue complications while maintaining functional gain.

With refinement in surgical technique – including tissue preservation methods and minimally invasive approaches – implant survival has remained high with reduced skin-related morbidity. The adoption of active transcutaneous systems has further expanded options, with approximately 150 OSIA-2 implants and nearly 200 Bonebridge cases performed, demonstrating growing acceptance of magnet-based and active bone conduction solutions. Limited early experience with Sophono (4 cases) and Ponto (8 cases) reflects phased technological adoption.

More than 200 patients have been on BAHA Softband and SoundArc, underscoring the importance of preoperative simulation, candidacy assessment, and structured fitting protocols. Improvements in digital processing and objective verification have enhanced speech perception outcomes and

broadened indications to include chronic otitis media, congenital aural atresia, and single-sided deafness.

By examining surgical evolution alongside cumulative case volume, this talk highlights India's expanding expertise in bone conduction implantation and outlines future directions in patient selection, outcome optimization, and cost-conscious innovation.

Free paper 0406

Factors affecting the results of cochlear implantation. Evidence based data

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The indications for cochlear implantation have been significantly broadened with generally excellent result. However, these patients still have some difficulties in processing complex sounds, and in noisy environments. There are also different outcome measures in the references of the obtained results. The most important difficulties in comparing and improving the results of cochlear implantation are: individual differences and variability of outcomes, insufficient preimplant predictors of outcome, and the need to develop new strategies in cases of inadequate results.

In order to better quantify the results and outcome, and to give the most up-to-date parameters we must focus on evidence-based data on these facts. We have found, analysed, and presented totally 140 review publications on the cochlear implant results.

There is sufficient data on improvement of quality of life after cochlear implantation. The data on general factors of outcome, such as: hearing preservation, residual hearing, electrode diameter and position, implantation under 12 months, bilateral implantation, and multisensory integration are documented.

The data on specific factors affecting the outcome, such as: inner ear malformations, genetic etiology, additional disabilities, auditory nerve aplasia, auditory neuropathy, cognitive skills, single-sided deafness, and tinnitus are presented as well.

The complications of cochlear implantation, particularly the effect on vestibular system are documented. The insufficiency of adequate reference data concerning some particular aspects of cochlear implantation is emphasized.

This evidence-based approach should provide concise and sufficient data to a practicing surgeon, and important information to the patient and his family in order to give realistic expectations and to enable knowledge of current cochlear implant results, and to direct further studies in this field.

Free paper 0694

Factors that impact functional hearing preservation

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Preservation of functional residual acoustic hearing in combination with electrical stimulation (EAS, hybrid hearing) provides improved word understanding and better hearing in noise compared to electric speech processing only. The ability to preserve residual functional hearing better than 80% requires strategies such as use of flexible electrodes, real-time ECoG monitoring, robotic electrode placement. This presentation will provide our results using these strategies and will discuss newer developments such as dexamethasone eluting electrodes and zwitterion coating strategies that might improve overall functional hearing preservation in the future.

Free paper 0707

Family-centered early and timely intervention in babies and children

Pedro Brás da Silva

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Following the technological revolution brought about by cochlear implants since their inception, it is now generally agreed that a family-centered intervention approach is one of the most important variables for the development of babies and children with hearing loss who use hearing technology, specially cochlear implants. Furthermore, the Joint Committee on Infant Hearing (2019) establishes a set of best practices, from conducting the early hearing screening by the end of the first month of life, to confirming the diagnosis and ensuring intervention within the following two months, in order to guarantee early and timely intervention. During this period, it is crucial to involve the family at the heart of the intervention, as they need to be fully aware of all stages of the habilitation process, as well as well-informed in order to make the right decisions for their child. The most relevant data from the literature show that these variables are crucial for minimizing sensory and neuronal deprivation, allowing the child to reach typical developmental levels in all areas, particularly language and speech, in the shortest possible time.

This presentation aims to highlight the most recent research on evidence-based and informed practices, demonstrating and illustrating what is currently the consensus in research from various centers and hundreds of families and children with hearing loss.

Free paper 0471

Feasibility of focused multipolar stimulation: Nexa electrode-neural interface research guiding future innovation

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Introduction: Cochlear implant (CI) performance varies widely among recipients, partly due to limitations in spectral resolution caused by current spread with conventional monopolar stimulation. Focused Multipolar Stimulation (FMS) aims to reduce current spread and improve spatial selectivity, potentially enhancing speech perception and real-world listening outcomes.

Objective: Objective of this study was to assess the feasibility and potential benefits of FMS compared to standard monopolar stimulation in adult CI recipients, focusing on speech recognition and music appreciation.

Material and methods: FOCUS, a prospective, multicenter, repeated-measures feasibility study (ClinicalTrials.gov Identifier: NCT05003674), enrolled 19 adults (≥18 years) who were implanted with an investigational CI1032 CI and the CP1000 Smart sound processor (Nexa Electrode-Neural Interface Research System). Participants completed assessments under both FMS and standard monopolar Advanced Combination Encoder (ACE) programs.

Results: Feasibility findings suggest that FMS may improve spectral resolution and listening performance compared to monopolar stimulation, with potential benefits observed in music appreciation and speech understanding. Individual variability in response was observed, underscoring the need for further investigation to determine if specific patient characteristics are associated with greater benefit from FMS. Other feasibility studies (NEUROFI, SASC, and OFIT) are further assessing FMS and sound coding parameters to determine optimal performance and fitting strategies. As these are ongoing, detailed results will be presented at the conference.

Conclusions: FMS demonstrates potential as an alternative stimulation mode that may improve spatial selectivity and reduce current spread, and thereby contribute to enhanced CI outcomes. These preliminary findings warrant further investigation to further optimise the algorithm, confirm efficacy of FMS, and to explore how such approaches might guide future advancements in cochlear implant technology, including platforms such as the Nucleus® Nexa implant system.

Free paper 0355

From listening effort to well-being: Occupational outcomes in CI users

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Listening with hearing loss often requires sustained cognitive effort, particularly in noisy environments. Research shows that for individuals with normal hearing, momentary listening effort follows an inverted U-shaped relationship with sentence intelligibility: effort is greatest at moderate levels of intelligibility and decreases when speech is either very clear or nearly unintelligible. In contrast, for individuals with hearing loss, including CI users, listening effort decreases less substantially as intelligibility improves. This raises an important question: how does this influence of hearing loss on listening effort translate into real-life experiences of fatigue and well-being?

To address this, we examined the occupational well-being of 98 CI users and compared it with that of peers with hearing loss with or without hearing aids ($N = 52$) and with 54 individuals with typical hearing. The results showed that the occupational well-being and fatigue levels of CI users were comparable to those of their typically hearing peers. In addition, CI users reported better overall health, greater acceptance of their hearing loss, and more effective coping strategies than individuals with hearing loss without a CI. These findings highlight and challenge the current clinical emphasis on improving speech intelligibility alone.

Free paper 0430

Impedance, neural health and functional outcomes in robotic-assisted or manual cochlear implantation: A comparative study

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Introduction: Preservation of residual hearing, mainly the low frequencies, is the current main objective of cochlear implantation. New electrode arrays and the development of minimally invasive surgery have allowed electroacoustic stimulation. Over the past several years, motorized-assisted cochlear implant surgery aimed to improve the insertion process while respecting inner ear structures. We evaluated the potential impact of RobOtol® and OTODRIVE® on impedance changes over time, leading to potentially positive functional outcomes.

Material and methods: Cochlear implant surgery with a round window approach was performed under general anesthesia. MED-EL FLEX24 electrode arrays were inserted

manually and using RobOtol® and OTODRIVE®. All subjects underwent pure-tone audiometry tests before the surgery and at regular intervals up to 1 year after the surgery. Based on the pure-tone average, we divided the patients according to the degree of auditory preservation (full preservation ≤15 dB, partial preservation 15 dB to 30 dB, significant loss >30 dB). These different groups were compared in terms of impedance changes and auditory performance, specifically word recognition score. Neural health was evaluated by the difference of slopes of ECAPs induced by two interphase gaps electrical stimulation paradigm (30–10 μs).

Results: We found proportionally fewer patients who experienced significant low-frequency hearing loss after robotic insertion. Impedance changes at the apex of the electrode array after robotic surgery, with less overall variability, a continuous decreasing trend, and lower values in cases of complete residual hearing preservation. The speech intelligibility amelioration over time showed favorable evolution in patients with complete residual hearing preservation regardless of the insertion method. In the absence of auditory preservation, the positive evolution continued more than 6 months after robotic surgery but stagnated after manual insertion. The neural health assessed using ECAPs was shown to be higher when a motorized insertion was used. Furthermore, the comparison between RobOtol® and OTODRIVE® did not show any significant differences between the 2 systems.

Conclusions: Atraumatic electrode array insertion with consistent, slow speed and the assistance of a motorized insertion minimizes disturbances in the delicate neurosensory structures of the inner ear and leads to better auditory performance.

Free paper 0506

Inner ear drug delivery in combination with cochlear implants

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Cochlear implants (CIs) are the primary treatment for severe hearing loss. However, despite advances in electrode materials, implantation remains invasive and can cause trauma, inflammation, loss of residual hearing, and vestibular dysfunction. Foreign body reactions may lead to fibrosis, increasing electrode impedance and compromising device performance. Other aspects include performance limitations that may be related to a suboptimal interface between the CI electrodes and the neural structures.

The general aims of drug delivery in combination with cochlear implants are therefore to improve safety and performance of CI. More specifically, drug delivery with CI aims on (1) the reduction of insertion trauma in general, immune reaction, infection, degradation of auditory neurons and spiral ganglion cells, fibrous and bony tissue encapsulation/ossification, stimulation of non-auditory nerve structures, channel interaction, and (2) on the improvement of frequency spectrum, and frequency resolution, and dynamic range. Drug delivery in combination with CI might also be of importance for future developments like optical cochlear stimulation ("optical CI").

This keynote lecture provides an overview on drugs, drug delivery systems, pharmacokinetics, preclinical studies and clinical trials on drug delivery in combination with cochlear implants.

Free paper 0550

Latest advances in vestibular implants

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Vestibular implants have demonstrated a significant effect on improving the symptoms of patients with bilateral vestibular dysfunction (BVP). Much, though not all, of their mechanism of action is now understood. In our group of 21 patients with vestibular implants, we have observed the importance of identifying the challenges that arise after analyzing the first patients, and following up with them for more than 5 years. However, previous implant designs have been associated with a substantial risk of hearing loss, restricting their use to patients with severe pre-existing deafness. In this presentation, we focus on presenting the results of applying this system in two populations: one where gait and posture disturbances have a particular impact, such as patients with motor disorders who also have vestibular dysfunction; and the second, an analysis of preliminary results in a population with residual hearing, by using a new implant that delivers chronic electrical stimulation to the otolithic organs using a delicate intra-vestibular electrode, while avoiding cochlear insertion to preserve residual hearing.

In this lecture, we will present the latest results in patients with motor disorders and BVP ($n = 3$) with more than 1 year follow up, and a second study of patients with BVP and residual hearing with a follow up of 6 months ($n = 6$).

This research has been supported by the European Commission: H2020: European development of Bionics Vestibular Implant for bilateral vestibular dysfunction. H2020-FETOPEN-1-2016-2017. Proposal number: 801127 Proposal

acronym: BionicVEST (2018–2022), and HORIZON-EIC-2022-TRANSITION-01: European Development of a first commercial bionic vestibular implant for vestibular dysfunction – 2. Proposal number: 101112779. Proposal acronym: BionicVEST-2 (2022–2027).

Free paper 0175

Longitudinal analysis of transimpedances

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Introduction: Objective measurements are used to assess the integrity of cochlear implants (CIs). A commonly used method is the measurement of the voltage decay along the electrode array, which can be displayed either unnormalized as a voltage matrix or normalized to the stimulation current as a transimpedance matrix (e.g., Cochlear Ltd, Sydney). These measurements provide information about near-field impedance (direct vicinity of the electrode contact) as well as far-field impedance (return path to the reference electrode). For this reason, several studies have investigated voltage decay to draw conclusions about cochlear size and intracochlear electrode array position. While changes in standard clinical impedances with time are well known, the effect on transimpedances has not been sufficiently investigated.

Material and methods: A retrospective data analysis was conducted, including 20 CI users implanted with Nucleus devices (Cochlear Ltd). Transimpedances were measured using monopolar stimulation and recording mode (MP2) with a pulse width of 37 μs and stimulation levels between 100 and 110 current levels (CL). Patients with at least two available transimpedance measurements were included. The analysis comprised a qualitative inspection of the transimpedance matrices and a quantitative evaluation based on the percentage change of transimpedances over time in basal, medial, and apical cochlear regions.

Results: Over time, transimpedances increased. The largest changes in transimpedance were observed in the basal region, whereas transimpedance in the apical region remained constant over time. Changes observed particularly in the basal region may indicate cochlear fibrotic processes. In individual patients, an off-diagonal peak in the transimpedance matrices was observed over time. Detailed analysis of these cases revealed the presence of scalar dislocations.

Conclusions: Transimpedances changed over time. In the analysis and interpretation of transimpedances considering temporal aspects is important. The occurrence of transimpedance peaks may serve as an indicator of scalar dislocations or defects of the electrode array, such as electromagnetic coupling between wires.

Free paper 0198

Low-frequency hearing matters for CI users: The rationale for long electrode arrays with apical fine-structure stimulation

Paul Van de Heyning

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Introduction: Low frequencies (LF) <450 Hz contribute substantially to audibility in normal hearing, in particular speech-in-noise recognition (SPIN). Recently, the anatomical frequency allocation in the apical spiral ganglion (SG) was reported, offering new insights into localising LF at a cochlear angular depth (AD) between 540 and 680°.

Aim: To discuss whether and how cochlear implant (CI) users can perceive LF and whether they perceive similar LF benefits as normal hearing people. Four sets of experiments dealt with the following questions: (1) What is the auditory percept with long electrode insertion (>540°AD) with and without electrical temporal fine structure (TFS) stimulation? (2) What is the effect on speech-in-noise (SPIN) and music appreciation with apical TFS stimulation? (3) What is the consequence for tonotopical frequency allocation?

Material and methods: *Aim 1* – pitch-matching experiments in single-sided deafness (SSD) CI users. *Aim 2* – Bilateral profound hearing unilateral CI users, comparing SPIN and music appreciation with different coding strategies. *Aim 3* – Effect of anatomy-based fitting (ABF) on speech recognition and music appreciation, including sound simulations. Long- and medium-flexible lateral wall electrode CI arrays (FLEX24, FLEX28, FLEXSOFT; MED-EL) with combined CIS and FS4 coding strategies were used in the experiments.

Results: Electrical pitch percepts corresponding to pure tones from 100 to 300 Hz could only be elicited by applying corresponding low-rate electrical stimulation (TFS) on electrodes beyond 540° angular insertion depth. Higher frequencies are provided by the envelope-based coding strategy, CIS (continuous interleaved stimulation). Using long electrode arrays with apical TFS improved SPIN and music appreciation. ABF further enhanced this effect.

Conclusions: Electric CI stimulation between 540° and 720° AD with TFS, and allocations to the natural tonotopic regions over the full length of the SG (ABF), yield clear LF perception with improved SPIN, and improved music quality. This supports long electrode arrays (FLEX26, FLEX28, FLEXSOFT, and FLEX34) with apical TFS. This apical TFS is combined with basal CIS.

Free paper 0048

Management of single-sided deafness in children: Clinical practice, challenges and future directions

Zdeněk Čada

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This keynote lecture will discuss our comprehensive clinical experience with both pre- and postlingually deaf children diagnosed with single-sided deafness (SSD) who have undergone cochlear implantation. Our cohort consists of patients rigorously selected according to detailed audiological, developmental, and psychosocial criteria to ensure optimal candidacy and meaningful long-term outcomes.

We will present longitudinal results focusing on speech perception in quiet and noise, spatial hearing abilities, and broader functional measures, including communication development and quality-of-life indices. Particular emphasis will be placed on the real-world benefits of cochlear implantation for paediatric SSD, highlighting how early intervention can mitigate auditory deprivation, support binaural integration, and enhance everyday listening performance.

In addition, we will address evolving candidacy considerations, parental expectations and decision-making processes, and structured follow-up protocols essential for maximizing outcomes. By synthesizing clinical evidence with practical insights, this presentation aims to contribute to the expanding knowledge base on paediatric SSD and reinforce the role of cochlear implantation as a viable and effective treatment option.

Free paper 0163

Measuring cochlear implant sound quality: What matters to users?

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Introduction: Although cochlear implants (CIs) effectively enable speech understanding, they often fail to provide natural sound quality. Speech recognition – the current benchmark for CI success – shows inconsistent and often weak associations with quality of life and device satisfaction. Recent evidence suggests that perceived sound quality may be a stronger predictor of hearing-related quality of life than speech recognition. Yet audiologists lack evidence-based methods for improving CI sound quality, in part due to a lack of effective measurement tools. Existing patient-reported outcome measures (PROMs) emphasize speech understanding, listening effort, and functional abilities – not the subjective experience of sound quality. Therefore, a dedicated CI sound quality PROM developed using CI recipients' experiences is needed. This study: (1) identified patient-derived sound quality domains through qualitative interviews; (2) compared identified domains against existing PROMs to evaluate content coverage gaps.

Material and methods: Twenty-five post-lingually deafened adults with unilateral CIs completed semi-structured interviews using grounded theory methodology within the first month post-activation and again at 6–12 months post-activation. Two independent coders analyzed transcripts and developed a codebook through consensus. Patient-derived themes were mapped onto measurable constructs and compared against existing PROMs.

Results: Initial interviews identified eight sound quality domains: *Perception* (qualitative descriptors of sound), *Adaptation* (acclimatization over time), *Speech*, *Music*, *Environmental Sounds*, *Binaural Integration*, *Technology* (device settings and accessories), and *Physical Factors* (microphone placement effects). Comparison with existing PROMs revealed that four domains are not addressed by current measures: *Perception*, *Adaptation*, *Technology*, and *Physical Factors*. Analysis of 6–12-month follow-up interviews is ongoing and will characterize sound quality change patterns during the first year of CI use.

Conclusions: Half of the eight identified sound quality domains are not represented in existing PROMs. Follow-up interviews will provide valuable information regarding sound quality changes in the first year after CI activation. Findings provide the foundation for developing a comprehensive CI sound quality PROM. Future steps include item development from the identified domains, content validation with clinicians and CI users, and psychometric validation with a multi-site consortium. A validated sound quality PROM will be essential for developing and evaluating interventions to improve CI sound quality outcomes.

Free paper 0265

Power stapes vibroplasty in otosclerosis: Indications, technique, and outcomes

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Otosclerosis is a frequent cause of progressive conductive or mixed hearing loss in adults, resulting from abnormal bone remodeling that leads to fixation of the stapes footplate and impaired ossicular chain mobility. Standard treatment options include hearing aids and conventional stapes surgery, which are effective in many patients but may provide insufficient benefit in selected cases.

Power stapes vibroplasty is an alternative surgical option for patients with otosclerosis who are poor candidates for,

or dissatisfied with, conventional stapes surgery or amplification. Typical indications include mixed hearing loss, limited cochlear reserve, suboptimal speech understanding, or intolerance of hearing aids. The technique combines routine stapes surgery with the implantation of an active middle ear device, such as the Vibrant Soundbridge.

Surgically, before a standard stapedotomy is performed, a floating mass transducer is attached to the short process of the incus. This configuration allows active mechanical stimulation of the ossicular chain and cochlea, effectively augmenting the impaired middle ear mechanics. The approach preserves inner ear structures while enhancing sound transmission.

Clinical experience and example cases demonstrate that power stapes vibroplasty can achieve reliable reduction of the air–bone gap and substantial improvements in speech perception after device activation. Outcomes suggest both objective audiometric gains and meaningful functional hearing benefits, with a favorable safety profile when performed by experienced otologic surgeons.

In conclusion, power stapes vibroplasty expands the therapeutic spectrum for otosclerosis and represents a valuable option in carefully selected patients, particularly when conventional strategies fail to meet hearing expectations. This lecture will detail patient selection, methods, risks, pearls, and pitfalls of this surgical alternative for combined hearing loss in otosclerotic patients.

Free paper 0020

Robotic CI surgery: Keyhole procedure or only partial electrode insertion into the cochlea?

Marco Caversaccio

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In the last 15 years, different robotic systems for CI surgery are coming to clinical applications with different success. Robot assisted systems usually offer the potential for more precise and less traumatic cochlear implantation by minimizing manual variability and allowing controlled electrode insertion. Protecting cochlear structures and achieving hearing preservation has become a key focus in CI surgery. To date, several robotic systems have been developed for CI surgery, including HEARO (Cascination, Switzerland, and MED-EL, Austria) ROSA (Zimmer, France) for keyhole procedure, and iotaSOFT (Iotamotion, USA), RobOtol (Collin ORL, France), and OTODRIVE (Cascination, Switzerland, and MED-EL, Austria), especially for partial minimal invasive insertion of the electrode with the purpose for hearing and structure preservation. During the keynote lecture, the analysis of the actual different systems with PRO and CONS will be discussed.

Free paper 0558

Safety and efficacy of DB-OTO gene therapy in children with OTOF-related deafness: The CHORD trial

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Introduction: Genetic deficiency of otoferlin (*OTOF*) disrupts synaptic transmission by the auditory sensory hair cells, causing congenital deafness. Children with OTOF-related deafness are typically treated with cochlear implants. DB-OTO is a gene therapy based on a dual adeno-associated virus 1 (AAV1) which delivers human *OTOF* complementary DNA regulated by a hair cell-specific promoter. Here, we present the results from the CHORD trial (NCT05788536) evaluating the safety and efficacy of DB-OTO in pediatric participants with profound OTOF-related deafness.

Study design: The CHORD trial is an ongoing, open-label, single-arm, first-in-human registrational study. Twelve children with profound deafness carrying biallelic *OTOF* pathogenic variants received an intracochlear DB-OTO infusion (7.2×1012 vector genomes/ear) unilaterally or bilaterally. The primary efficacy endpoint was the achievement of average thresholds ≤70 decibel hearing level [dB HL] by behavioral

pure tone audiometry (PTA) at Week 24, a clinical standard that generally allows for natural acoustic hearing without the need for cochlear implants. The key secondary endpoint was the presence of auditory brainstem response (ABR) at a 90 decibel normal hearing level click stimulus. Incidence and severity of adverse events were a primary safety endpoint. Laboratory, limited vestibular, and immunogenicity testing were also performed.

Results: Following a single DB-OTO administration, 11 of 12 participants (92%) with profound deafness at baseline were able to hear for the first time. Nine of 12 participants (75%) achieved clinically significant hearing improvements ($P < 0.0001$), enabling natural hearing, meeting the primary and key secondary endpoints, and obviating the need for cochlear implants. Six of 12 participants (50%) were able to detect soft speech without assistive devices (≤45 dBHL), and 3 of 12 participants (25%) achieved complete normalization of hearing sensitivity (≤25 dBHL) by Week 24 as measured by average PTA. Preliminary data from 1.5 years of follow-up indicate sustained or improved hearing, as well as improvements in speech and language development. No DB-OTO--related adverse events were recorded.

Conclusions: In this first-in-human gene therapy trial for deafness, DB-OTO resulted in significant hearing improvements in participants with *OTOF*-related deafness. DB-OTO administration enabled natural acoustic hearing for the first time, and normalized hearing sensitivity in some participants.

Free paper 0137

Surgical placement possibilities, audiological benefit, and quality of life following Bonebridge implantation in children

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This study's primary goal was to evaluate how the smaller size of the BCI602 transcutaneous bone conduction implant affects surgical placement possibilities in children compared to its precursor model, the BCI601. Additionally, audiological benefits, quality of life, and surgical safety of the implant system were investigated in a retrospective cohort of 21 patients. Computed tomography imaging data of the previously implanted patients were examined using a surgical planning software to determine which locations on the skull were feasible for placing the floating mass transducer of the respective implant version. Audiological outcomes in terms of sound field audiometry, speech recognition threshold, and speech recognition in noise were assessed.

The Speech, Spatial, and Qualities of Hearing Scale (SSQ12) and the Assessment of Quality of Life 6 Dimensions (AQoL-6D) questionnaires were used to assess subjective benefit in terms of hearing and quality of life. Evaluation of placement options revealed that placement of the BCI602 in the transmastoid plane was possible in 100% of the children, as well as in 89.5% of the cases with the BCI601 variant when using lifts. Likewise, it would be possible to place the BCI602 in 100% of patients superior to the temporal line. For the older BCI601 version, this would be possible only in 58% of cases. With the implant, audiological performance as well as subjective benefit scores improved significantly in the study population. The pediatric cohort reports significant audiological benefit, significantly improved quality of life, and low complication rates. Its combination of high safety, significant audiological benefits, and easy placement of the BCI602 makes the Bonebridge a comfortable and effective option for hearing rehabilitation in children.

Free paper: 0756

The re-wiring brain: Optimizing neuroplasticity in cochlear implants

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Despite early implantation and advances in cochlear implant technology, not all children perform well with cochlear implants. In a study of 41 young college-age adults with cochlear implants, we found that early implantation leads to cortical auditory maturation, decreased cross-modal plasticity from vision and less listening effort compared with those who were later implanted. Using measures of cognitive fluidity (including executive functioning, processing speed, working memory, inhibitory control, episodic memory and non-verbal intelligence) we found that early access to oral language via the cochlear implants benefitted cognitive development, while early access to sign language may have served as a scaffold for early cognitive development in later implantation. However, both early and late cochlear implanted young adults showed lower performance on cognitive measures such as working memory and processing speed compared to college students with typical hearing suggesting that even early implantation may not be enough for optimal outcomes.

One way to enhance outcomes for implanted children whose language is below expected levels may be to provide supplemental rehabilitation therapy. In 39 children with low language levels, we provided 6 months of additional listening and spoken language therapy. We found evidence of enhanced neuroplasticity as well as significantly improved language scores. In particular, we found that implanted children with multiple disabilities benefitted from additional therapy such that they showed similar improvements in their language development trajectories and underlying cortical potential biomarkers compared to implanted children with isolated hearing loss. Overall, we find that neurocognitive plasticity can be optimized through supplemental rehabilitation in conjunction with early implantation and that cortical potentials are useful clinical objective markers for tracking such improvements in individuals.

Free paper 0227

Tips and tricks for managing legacy CI devices

Meredith Holcomb

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The expanding population of cochlear implant (CI) recipients implanted with earlier-generation internal devices presents growing clinical challenges for contemporary CI programs. Legacy CI patients frequently demonstrate changes in speech perception, sound quality, and listening effort over time, which may reflect a combination of neural adaptation, device limitations, and evolving communication demands. Evidence suggests that targeted reprogramming, appropriate technology upgrades, and, in select cases, cochlear reimplantation can significantly improve outcomes; however, indications and workflows remain variable across centers.

This session will present evidence-informed, clinically practical tips and tricks for managing legacy CI patients through a coordinated audiology/surgery approach. Audiologic strategies will emphasize programming supported by published outcomes, including streamlined behavioral measures, selective use of objective data, and feature optimization when modern processing options are unavailable. Surgical perspectives will review current literature on device longevity, failure rates, and speech perception outcomes following reimplantation, with practical guidance on identifying candidates who may benefit from further surgical evaluation versus continued audiologic optimization. Counseling strategies will be discussed to align patient expectations with realistic, evidence-based projections of benefit and risk. Emphasis will be placed on reproducible clinical workflows, shared outcome metrics, and effective surgeon–audiologist communication to support consistent, data-driven management of legacy CI patients.

Free paper 0256

Towards photoacoustic implants: LDV measurements of skin vibrations during bone conduction stimulation at the mastoid

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With bone conduction hearing systems that work under the skin, it is not possible to quantify output and sound quality (THD, attenuation) using conventional measuring devices such as artificial mastoids (e.g., Brüel & Kjær) or skull simulators (e.g., Interacoustics). Measurements with surface microphones (forehead/nose) only provide results at levels above the hearing threshold of people with normal hearing or show high interindividual variations.

Although psychoacoustic measurements (using in-situ hearing threshold or loudness comparison) can be used to estimate the output, this depends on the subjective assessment of the test person. Statements about sound quality (e.g., when more complex sounds than sine tones are played) can only be made subjectively or cannot be quantified and compared with each other.

Laser Doppler vibrometry has already been used for objective and contactless/non-invasive examination of the output of bone conduction hearing systems (often on cadavers). However, there are no studies on skin vibrations in the hearing threshold range of people with normal hearing and no quantitative data from living persons. This study aims to create a reference data set for stimulation with a bone conduction hearing system that can be used for objective and quantitative comparison.

This presentation introduces a systematic approach to objectively measuring skull vibration, which is the first step towards objectively measuring photoacoustic stimulation.

Free paper 0564

Unlocking the cochlea with Synchrotron Phase-Contrast Imaging

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Synchrotron Phase-Contrast Imaging (SR-PCI) has allowed for unparalleled three-dimensional views of the temporal bone. Using this visualization of peripheral axons, ground truth angle-frequency measurements were made. Using an approach designed to minimize perceptual error in frequency estimation, an individualized frequency function was determined to relate angular depth to frequency within the cochlea. Novel deep learning strategies were then employed to automatically segment the cochlea, determine total angular length, and frequency map individual cochlear implant electrode contacts.

Free paper 0096

Use of fNIRS technology in clinical management of cochlear implants in adults and children

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Many existing challenges for clinics that manage patients before and after cochlear implantation might be addressed using fNIRS technology. These challenges include:

1. Variability in outcomes for adults with post-lingual deafness. Being able to predict outcome in individuals, and targeting appropriate therapy to those who will need and benefit from it, would lead to more efficient clinic time and potentially overall improved outcomes. Many fNIRS studies have shown that brain changes dues to deafness contribute to this variation in outcome.

2. Difficulty knowing whether an infant with a hearing aid needs referral to a cochlear implant clinic. Currently, many candidacy policies require evidence of significant language

delay before referral of these infants, thus imposing a detrimental delay in appropriate intervention. Using fNIRS we can determine whether an aided infant can discriminate between different speech sounds, thus providing clinical evidence of the efficacy of the infant's hearing aid for their language development.

3. Lack of a fully objective method of programming a cochlear implant. This problem also leads to delays in appropriate intervention for infants, causing clinics to delay implantation until the infant is old enough to perform behavioral tests.

In this talk, I will discuss the evidence supporting how fNIRS technology addresses these challenges, and present case studies illustrating how the additional of fNIRS information can improve management of patients before and after implantation.

Oral Presentations

Free paper 0634

23 years experience of Combined Atresia/ Microtia Clinic

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At the Royal Children's Hospital in Melbourne we have to look after a large number of patients with atresia and microtia. For contemporary treatment of children with these conditions a combined clinic was required. In 2003 an interdisciplinary approach shared between the departments of Otolaryngology and Plastic Surgery was established to accommodate the needs for these patients. This clinic also incorporates a team of audiologists from Hearing Australia, the primary provider of all hearing devices of all sorts for patients up to 26 years of age and a clinical coordinator. This concept allows a team consultation of the parents and children as well as the coordination of fitting of age adequate hearing solutions and surgical interventions required. We report about our experience, results and the treatment algorithm developed for children with microtia and atresia, which has changed according to the availability of modern implants and technologies in both hearing restoration and cosmetic augmentation options. A combined atresia/ microtia clinic in a tertiary hospital allows for pooling of surgical and audiological expertise, teaching opportunities, streamlined treatment and best patient care in these sometimes very complex cases.

Free paper 0487

A guide for adult cochlear implantation practice: A consensus paper of the Saudi Otorhinolaryngology Society

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Aim: Adult cochlear implant candidates are a large proportion of the total candidates. The aim of this study is to develop an evidence based guide regarding adult cochlear implantation in Saudi Arabia that is supported by the consensus agreement of the experts in the field.

Material and methods: In this study, a task force of experts was involved to determine the important aspects of cochlear implantation practice in adults. The task force discussion guided a literature review, which resulted in drafting the provisional statements. A modified Delphi method was then utilized to determine the agreement level for these statements within the SORL Society cochlear implant practitioners, including audiologists and otologists.

Results: This study started with fifteen preliminary statements that, after core committee meetings and one round of voting, resulted in the formulating 20 final statements. The final statements reached an average of 95.9% agreement level (±4.6%). Two statements did not reach consensus with agreement levels of 77% and 70%.

Conclusions: This consensus paper presents the most agreed upon practice for adult cochlear implantation in adults in Saudi Arabia. The high agreement levels among cochlear implant practitioners reflect a strong endorsement of the formulated statements, underscoring their relevance and applicability in real world settings. This guide will serve as a valuable resource for clinicians, aiming to standardize practices and improve outcomes for adult cochlear implant candidates. Future efforts should focus on the integration of emerging evidence to adapt this guide to the practice of cochlear implantation.

Free paper 0311

A new fitting strategy for BB-user: Clinical feasibility

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Introduction: Bone conduction implants provide an essential hearing solution for individuals with conductive or mixed hearing loss who cannot benefit from conventional air conduction hearing aids. The transcutaneous Bonebridge system is widely used in this population, yet its clinical outcomes

depend heavily on the fitting strategy applied to the audio processor. While traditional fittings rely on formulas originally developed for air conduction hearing aids, a newer prescriptive method – DSL BCD – has been proposed to better match the characteristics of bone conduction devices. However, its performance in BB users has not been systematically evaluated. This study aimed to compare the audiological and subjective outcomes of the new DSL BCD fitting formula with the standard DSL v5 approach, and with each patient's own fine tuned clinical fitting.

Material and methods: A total of 22 individuals aged >5 years were included. New BB users were enrolled prospectively, while experienced users were retrospectively. All participants were tested under three conditions: standard fitting (DSL v5), new fitting (DSL BCD), and the patient's individualized fitting. Audiological assessments included sound field pure tone thresholds (PTA4), word recognition scores (WRS) in quiet at 45 and 65 dB SPL, and speech reception thresholds (SRT) in noise using the Oldenburg Sentence Test. Subjective outcomes were collected using a custom preference questionnaire. Statistical analyses incorporated repeated measures ANOVA and non parametric tests with Bonferroni correction.

Results: The new fitting formula produced significantly better audiological outcomes than the standard fitting. Mean aided PTA4 thresholds improved from 41 ± 7 dB (standard) to 32 ± 5 dB (new). WRS at 45 dB increased from 22 ± 30% (standard) to 71 ± 19% (new), while a ceiling effect was observed at 65 dB. Speech in noise performance improved from –2.29 ± 1.97 dB SNR (standard) to –4.11 ± 1.53 dB SNR (new). Subjectively, 85.7% of participants preferred the new fitting, citing clearer sound, improved loudness, and better speech understanding.

Conclusions: The DSL BCD fitting method demonstrated superior objective and subjective outcomes compared with the standard DSL v5 approach and performed comparably to individualized fine tuned fittings. These findings support the DSL BCD formula as a promising first fit strategy for Bonebridge users, warranting further validation in larger and long term clinical studies.

Free paper 0373

A new surgical technique to achieve deeper insertions with preformed electrode arrays

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Introduction: Pre-formed electrode arrays usually do not achieve deeper insertion depths and cover just the first turn of a cochlea. The electrode tip appears to lock and does not move any further, with the middle section of the electrode array being pushed out towards the lateral wall. There are two reasons for this shallow placement. Firstly, due to the pre-formed shape of the array, the insertion force is not applied along the array, but is pushed to the side. Secondly, the anatomy and profile of the scala tympani varies. There is often a sudden vertical jump in the scala tympani between the first and the second turns. Pre-formed electrode arrays usually stop at the bottom of this jump and cannot proceed any further.

Aim: The objectives of this study were to develop an insertion technique that can overcome the jump's restriction and to achieve a deeper insertion depth.

Material and methods: Intra-op fluoroscopy was used to observe the electrode array's movement during insertion. The position where the electrode array's tip touches the bottom of the cochlea jump was determined. A pull back and rotation maneuver was then performed that first frees the electrode array tip and then lifts it up to let the array slide up the cochlea jump. A series of objective measures (impedances, nerve responses) were carried out to measure the change of position. Post-op programming levels were compared to standard insertion with the same kind of electrode array.

Results: The pull-back-rotation maneuver could be successfully applied and an approximately 50 degrees deeper electrode array insertion depth could be achieved. The deeper insertion led to higher eCAP responses and lower programming levels.

Conclusions: Deeper insertion depths are also possible for preformed electrode arrays. The pull-back-rotation maneuver appears to be a promising improvement over the standard surgical technique and should be applied in all patients. The maneuver requires practice and may be supported in future by objective measures that will guide the surgeon and give feedback about the insertion depth.

Free paper 0138

AAV mediated gene therapy in *OTOF* mutation-related deafness

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Introduction: Mutations in the *OTOF* gene are among the most common causes of auditory neuropathy. Gene replacement therapy using adeno-associated virus (AAV) vectors has been extensively studied, with multiple human clinical trials conducted; however, efficacy remains an area for improvement.

Objectives: To evaluate gene therapy in 4-week-old humanized OtofQ829X/Q829X mice and adult cynomolgus macaques. Additionally, patients older than 1 year with confirmed OTOF mutations and click ABR thresholds >80 dBnHL were recruited for clinical assessment.

Material and methods: We designed an AAV2 capsid protein (Cap)–encoding library with a random nine–amino acid sequence insertion in the capsid to develop an in vivo directed evolution approach. The library was injected into mice, and sequencing of the cochleae for the viral genome revealed

enrichment of peptide motifs. A novel dual-AAV-mediated gene therapy system was developed using an engineered inner hair cell–tropic AAV capsid, WM04. AAV-WM04-OTOF was injected via the round window membrane (RWM) in adult mice, monkeys, and human patients. Hearing recovery was assessed starting two weeks post-injection.

Results: *Preclinical Models:* WM04-OTOF successfully reversed deafness in OtofQ829X/Q829X mice with a single RWM injection. Therapeutic doses caused no significant systemic toxicity or interference with normal hearing in mice or nonhuman primates. *Clinical Trial:* A single-arm, single-center trial (ChiCTR2400091517) was initiated for DFNB9 patients with biallelic OTOF mutations. The first patient demonstrated hearing recovery within two weeks of a single injection.

Conclusions: The WM04-OTOF gene therapy system represents a promising therapeutic strategy for patients with DFNB9, with effective hearing restoration, minimal systemic toxicity, and robust preclinical and clinical evidence supporting translation to broader applications. This research lays the foundation for standardized and systematic clinical translation of gene therapy for DFNB9.

Free paper 0105

Active bone conduction hearing implant (BCI Bonebridge®) for children and adolescents with congenital single-sided deafness (SSD)

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Introduction: Congenital single-sided deafness (SSD) in children and adolescents can be not suitable for a cochlear implantation. If hearing cannot be primarily restored, the only alternative is to transfer the acoustic signal to the contralateral normal hearing ear (CROS). One possible CROS-option is a bone conduction implant (BCI). However, improving communication for children and adolescents with SSD by a BCI can become a significant challenge. Here, we report on our experience in children and adolescents with SSD using an active bone conduction hearing implant (BCI) as a CROS device.

Results: Since 2012, 92 BCI implants (Bonebridge®) have been fitted for various conditions and ages in our institution. Nine children and adolescents have received an implant for SSD. The age at implantation varied between 7 and 17 years. The average follow-up period was 7 (2–10) years. We did not observe any complications or implant failures. The implant fitting was individually adapted to the subjective loudness impression of the contralateral hearing ear. Hearing outcome was tested by pure tone and speech audiometry in aided versus unaided condition. Hearing improvement was achieved in all cases under testing conditions. However, in our experience, subjective long-term benefit is best measured by processor wearing time. The wearing time of the implant was very variable, ranging from 4 to 13 hours, and significantly reduced during puberty in some adolescents.

Conclusions: The Bonebridge® BCI for SSD improves communication and has been widely accepted by users. However, the level of amplification must be adjusted according to the wearer's perception of loudness. Acceptance of the device can vary greatly depending on the wearer's age, particularly during puberty.

Free paper 0568

Adaptation and cross-cultural preliminary validation of the Music-Related Quality of Life Measure for Pediatric and Neurodivergent Populations (PN-MuRQoL)

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Introduction: Music supports well-being in children with hearing loss, yet no standardized pediatric self-report measure captures music-related quality of life (QoL). The adult Music-Related Quality of Life (MuRQoL) measure is a psychometrically robust tool, yet its text-heavy nature and abstract phrasing render it developmentally unsuitable for many children and neurodivergent individuals. This study presents the systematic adaptation and pilot testing of the PN-MuRQoL, designed to retain the original instrument's multidimensional framework while reducing cognitive load to ensure accessibility for pediatric and neurodiverse populations. This study aims to describe the development methodology and preliminary pilot outcomes of the PN-MuRQoL for pediatric hearing-impaired and neurodivergent populations.

Material and methods: Adaptation followed a theory-driven, user-centered approach across four phases. Items were simplified using concrete language. To enhance engagement, minimalist visual supports were created for each item. The response format was adapted from a 5-point to a 3-point Likert scale (*Never*, *Sometimes*, *Always*) with an "I don't know" option to align with the cognitive capacities of children aged 5–18. The pilot version was tested in English, Turkish, and Italian. Participants included 40 children ($n = 20$ in the first round; $n = 20$ in the verification round), including users of cochlear implants or hearing aids, and peers with typical hearing. Qualitative feedback sessions assessed item comprehension and information retrieval.

Results: Pilot feedback confirmed the utility of visual aids while identifying items requiring refinement. Revisions addressed socioeconomic bias and "double-barreled" phrasing; additionally, an item regarding auditory fatigue was removed due to poor comprehensibility. The finalized 14-item instrument, covering Perception and Engagement domains, comprises four thematic categories: Perception of Music Elements, Music Recognition and Quality, Music Listening Activity, and

Participation in Music Events. Verification rounds supported strong acceptability and feasibility, with no comprehension issues emerging in the final verification round.

Conclusions: The PN-MuRQoL is a feasible and developmentally appropriate PROM for children with hearing loss and neurodivergent populations. By incorporating visual supports and simplified response scales, it captures the multidimensional impact of music on QoL. Once fully validated, the instrument will serve as a diagnostic tool to prioritize personalized music-related rehabilitation goals. Large-scale psychometric validation is underway.

Free paper 0093

Adoption of the iotaSOFT robotic-assisted cochlear implantation system: Initial experience and early outcomes

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Objectives: To evaluate the outcomes of robotic-assisted cochlear implantation (RACI) using the iotaSOFT Insertion System in an academic practice that has recently adopted this system during cochlear implant surgery. All patients were assessed for changes in auditory outcomes, including CNC word scores and AzBio sentence scores. For patients with residual hearing, preoperative and postoperative hearing were compared.

Material and methods: Retrospective review of the first 50 patients undergoing iotaSOFT RACI at a single institution. Patients were divided according to implant type. Preoperative audiograms, CNC, and AzBio scores were recorded. Residual preoperative hearing was defined as a threshold of 80 dB or better at 500 Hz. Intraoperative challenges and the learning curve for the first 50 cases related to technology use were documented. Early postoperative data included audiograms, CNC, and AzBio scores recorded at 1 week, 1 month, and/or 3 months after implantation. Hearing preservation was defined as postoperative audiogram thresholds within 30 dB of preoperative thresholds at 125, 250, 500, 750, and 1000 Hz.

Results: The implanted electrodes included the following: Cochlear – 18 CI622, 2 CI1022; MED-EL – 19 FLEX28, 3 FLEXSOFT; Advanced Bionics – 8 SlimJ. Of the 50 patients implanted, 29 (58%) had residual hearing preoperatively. Early results show hearing preservation in 73% (8/11) of patients with Cochlear 622/1022 electrodes and 40% (2/5) for Advanced Bionics. Lower hearing preservation rates of 25% (1/4) were observed with MedEl. Early auditory outcomes demonstrated improvement of 33% in AzBio scores and 31% in CNC word scores among patients with residual preoperative hearing. Twelve of 22 MED-EL implants required manual manipulation following robotic insertion, compared to 1/20 for Cochlear and 1/6 for Advanced Bionics.

Conclusions: The iotaSOFT RACI System helped preserve hearing, with the best initial outcomes for Cochlear 22 recipients. Lower preservation in MED-EL cases was likely due to the use of pre-measured electrodes that often prevented full insertion without manual force after robotic insertion. Changes in electrode choice, surgical techniques, and the iotaSOFT PLUS Drive Unit have improved preservation across manufacturers. Future studies will report these findings and compare them with those of patients implanted with manually placed similar electrodes.

Free paper 0554

Advancing the first pluripotent stem cell derived regenerative therapy for neural hearing loss: A first in human randomised trial

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Introduction: Rinri Therapeutics has developed a first in class regenerative cell therapy, Rincell-1, consisting of otic neural progenitor cells capable of differentiating into mature auditory neurons. The therapy aims to restore hearing in individuals with neural hearing loss, defined as dysfunction of the auditory nerve, including the spiral ganglion neurons and/or their synaptic connections.

Material and methods: CTA approval for a multicentre, open-label randomised first in human (FIH) trial was sought on the basis of reproducible and functional in vivo efficacy data and a compelling regulatory safety dataset, including toxicology and biodistribution. Clinical development focused on a safe and minimally invasive surgical approach, establishing an audiological test battery to evaluate efficacy and an MRI safety monitoring strategy delivered without CI magnet removal. A non-interventional pilot study has also been conducted at trial sites.

The trial aims to assess safety of a single dose of Rincell-1 as an adjunct to cochlear implantation(CI), compared with a CI alone, in adults eligible for unilateral CI who have either presbycusis, or post-synaptic auditory neuropathy. These populations were selected based on their recognised neural hearing loss, clinical need and potential treatment benefits.

Ten participants per cohort will be randomised in a 3:2 ratio, and followed-up for 52 weeks post-surgery, with regular monitoring of health and audiological outcomes. Daily objective measurements of cochlear health (ECAPS, Impedances) will be taken to establish clinical proof of concept and efficacy.

Results: Rinri has progressed from its foundational basic science to successfully generate a strong preclinical safety and efficacy data package and clinical strategy, culminating in CTA approval granted from the UK MHRA in 2025. The pilot study evaluated feasibility, identifying and resolving challenges delivering a complex, novel therapeutic in CI centres. The FIH trial is on target to dose first patient in 2026, with reporting projected 27 months after recruitment start.

Conclusions: A paradigm shift is on the horizon where Rincell-1, provided either alongside CI or as a stand-alone therapy, will be able to offer a truly transformative change in the way that hearing loss is treated, as the first treatment for neural hearing loss.

Free paper 0394

Age-related effects on speech perception, rehabilitation pace, and long-term stability in older cochlear implant users

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Introduction: With demographic ageing, the number of older adults eligible for cochlear implantation (CI) is steadily increasing. Although cochlear implantation yields substantial improvements in speech perception and quality of life in older adults, evidence suggests that age at implantation may influence the level of benefit achieved. It remains unclear whether rehabilitation progresses more slowly in older recipients and whether CI outcomes remain stable over long-term follow-up, particularly in the oldest users. These questions are especially relevant given recently broadened candidacy criteria that place greater emphasis on preoperative speech perception. This study, therefore, examined the relationship between age at implantation, postoperative speech perception outcomes, rehabilitation pace, and long-term outcome stability in a large cohort of adult CI users.

Material and methods: A retrospective cohort study was performed at a tertiary CI center in the Netherlands, including 709 postlingually deaf adults implanted between 2002 and 2025. Speech perception in quiet was measured using standardized Dutch monosyllabic word tests at 65 dB SPL. Linear regression was used to assess the association between age at implantation and 1-year postoperative phoneme scores, adjusting for preoperative performance and pure-tone average (PTA). Nonlinear mixed-effects models evaluated age effects on rehabilitation rate and asymptotic performance during the first year, and linear mixed-effects models examined long-term speech perception stability (≥1 year) in relation to age at implantation and time since implantation.

Results: Older age at implantation was associated with lower 1-year postoperative phoneme scores ($\beta = -0.41$ per year, $p < 0.001$), independent of preoperative scores and PTA. Rehabilitation followed an asymptotic exponential trajectory: age reduced the asymptotic performance level but did not affect the rate of improvement. Long-term analyses showed no effect of time since implantation or interaction with age, indicating stable speech perception outcomes even in recipients implanted at advanced ages.

Conclusions: Cochlear implantation provides durable speech perception benefits in older adults. While higher implantation age is associated with lower maximal performance, it does not slow rehabilitation or compromise long-term stability. These findings support timely referral and implantation in older adults and underscore the importance of age-appropriate counseling to align expectations with achievable outcomes.

Free paper 0238

Alginate coating of cochlear implant electrodes significantly reduces insertion forces in human temporal bones

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Introduction: High insertion forces during cochlear implant (CI) surgery are associated with an increased risk of intracochlear trauma, potentially leading to the loss of residual hearing. Research has shown that alginate hydrogel coating can minimize insertion forces in artificial cochlear models. To assess whether the force-reducing effect is not limited to the artificial cochlear model used in previous studies, but might be transferable to the in vivo situation, this study investigates the impact of alginate coating on human temporal bones (TBs), which are better suited to simulate in vivo conditions.

Material and methods: Four fresh-frozen human TBs were implanted using a total of eight straight lateral wall electrode arrays (EAs). The specimens were precisely aligned along the insertion trajectory of the test bench tangential to the basal turn using 3D printed adapters based on initial cone-beam CT (CBCT) scans. Two EAs were assigned for each TB, with each EA inserted in both coated and uncoated states to avoid the influence of conditioning effects and sequence bias. Automated insertions were performed at a constant speed of 0.1 mm/s using a test bench with integrated force measurement. 2D-CBCT scans were performed after all insertions to verify final insertion depths and align EA positions. Microscopic imaging was used between and after the trials to assess coating integrity.

Results: All EAs were completely coated, achieving an average layer thickness of 98 µm ± 54 µm. Insertions were terminated upon strong buckling, resulting in an average insertion depth of 20.8 mm ± 1.5 mm, corresponding to an insertion angle of 363° ± 45°. The alginate hydrogel coating significantly reduced peak insertion forces by 46.3% ± 21.5% and the insertion work by 35.9% ± 24.1% ($p < 0.05$).

Conclusions: Alginate hydrogel coating significantly reduced the insertion forces in all human TB specimens and maintained its structural stability throughout the insertion process. This proves the efficacy of the applied layer, while the final insertion depth remained unaffected. These findings highlight the clinical potential of alginate coatings as a promising strategy for soft CI surgery. Future research should focus on biocompatibility assessment to facilitate clinical translation.

Free paper 0423

Alterations in cochlear biomechanics and their relationship to hearing preservation after cochlear implantation

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Introduction: This study aimed to investigate whether changes in cochlear biomechanics affect hearing preservation outcomes after cochlear implantation.

Material and methods: Seventeen adult patients were implanted with cochlear electrodes of different lengths using a round window approach. Intracochlear acoustically evoked potentials were recorded via the implanted electrode array. A 500 Hz tone pip was presented through insert earphones and responses were registered by the evoked potential recording system. Postoperative computed tomography (CT) images were obtained and analysed. Audiometric thresholds measured preoperatively were compared with those obtained during postoperative testing.

Results: In nine participants, the highest response amplitude to the 500 Hz stimulus corresponded to the expected 500 Hz excitation region identified on postoperative CT. In the remaining eight patients, deviations suggestive of altered basilar membrane biomechanics were observed. In these cases, the largest 500 Hz responses were located either more apically (1 subject) or more basally (7 subjects) than anticipated. The degree of low-frequency pure-tone average deterioration was comparable between patients with tonotopically consistent responses and those with altered biomechanics. No statistically significant differences in hearing loss were identified between the two groups.

Conclusions: The results suggest that alterations in basilar membrane biomechanics do not necessarily adversely affect hearing preservation following cochlear implantation.

Free paper 0628

An EABR paradigm for assessing inner ear malformations in cochlear implantation

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Introduction: Children with prelingual profound sensorineural hearing loss (SNHL) and inner ear malformations (IEM), including cochleovestibular nerve anomalies, present complex and challenging cases during cochlear implantation. Intraoperative objective assessments, such as the electric auditory brainstem response (eABR), provide crucial information on auditory pathway integrity during surgery.

Objectives: To evaluate a novel intraoperative eABR paradigm in children with IEM and compare the findings with those from children with normal inner ear anatomy.

Material and methods: Nineteen cochlear implant candidates (11 with IEM, 8 with normal anatomy) underwent implantation following comprehensive preoperative imaging and audiological evaluation. Under general anesthesia, intraoperative eABR was recorded using three stimulation paradigms, namely: external promontory (ePEABR), internal promontory (iPEABR), and intracochlear (iEABR). The presence, latency, amplitude, and threshold of Waves III and V were analyzed.

Results: ePEABR responses were observed in 45.5% of IEM and 37.5% of normal cases, with elevated thresholds and frequent artifacts. iPEABR responses were detected in all patients, showing consistent latency patterns. iEABR elicited robust responses in all patients. Latencies shortened and amplitudes increased as stimulation approached the cochlear nerve. Conclusions and significance: Intraoperative iPEABR is feasible and provides valuable objective information on auditory pathway function in children with IEM, supporting surgical decision-making during cochlear implantation.

Free paper 0184

Analyzing the relationship between hearing loss and physical activity: A scoping review

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Introduction: Hearing loss affects nearly one in five individuals worldwide and is associated with adverse cognitive, social, and overall health outcomes. Physical activity, a modifiable lifestyle factor known to improve cardiovascular health, may influence hearing outcomes through shared vascular mechanisms affecting cochlear function. This study aims to qualitatively review the existing literature to identify recurring patterns in the relationship between physical activity levels

and hearing loss and the impact of hearing loss treatment, such as cochlear implantation, on physical activity.

Material and methods: Relevant literature was identified through comprehensive searches conducted by a medical librarian in PubMed, CINAHL, Web of Science Core Collection, and the Cochrane Database of Systematic Reviews. The search process adhered to PRISMA-Searching (PRISMA-S) guidelines. Inclusion and exclusion criteria were determined prior to completing the literature search. Data extraction was performed using RedCap.

Results: A total of 101 studies were included, the majority of which were observational cross-sectional and cohort studies involving adult and older adult populations. Hearing loss was most assessed using pure-tone audiometry conducted without hearing aids and categorized as normal (<25 dB), mild (26–40 dB), or moderate to greater (≥40 dB), while some studies relied on self-reported hearing measures. Physical activity was evaluated using a range of objective tools (e.g., accelerometry, Short Physical Performance Battery) and self-reported measures, including activities of daily living, instrumental activities of daily living, and leisure-time physical activity questionnaires. Overall, findings were heterogeneous, with several studies reporting an association between lower physical activity levels and greater hearing impairment, whereas others found no significant association.

Conclusions: Existing evidence suggests a complex and heterogeneous relationship between physical activity and hearing loss. While many studies indicate that lower physical activity levels are associated with greater hearing impairment, findings remain inconsistent, highlighting the importance of future longitudinal studies to better understand the relationship and guide the impact of cochlear implantation for hearing and overall health.

Free paper 0161

Anatomical feasibility of robotic keyhole access to the semicircular canals for vestibular implantation

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Introduction: Vestibular implants have emerged as a promising treatment for patients with severe bilateral vestibulopathy. A major limitation to their clinical implementation is the difficulty of achieving accurate and minimally invasive surgical access to the semicircular canals.

Objective: To investigate the anatomical feasibility of robotic, image-guided keyhole drilling to access the three semicircular canals for vestibular implantation.

Material and methods: High-resolution computed tomography datasets from 30 ears were used to simulate drill trajectories to the superior, lateral, and posterior semicircular canals. Trajectories were assessed based on surgical accessibility, safety margins to critical anatomical structures, and insertion angles compatible with electrode placement. Entry points were jointly optimized to fit within a single cortical mastoidectomy.

Results: Anatomically safe access to all three semicircular canals was achievable in all cases. The lateral and posterior canals demonstrated consistently favorable access and insertion angles. Access to the superior canal required steeper approach angles, which nevertheless remained within acceptable limits. In every case, three viable trajectories could be planned from a single 15-mm retroauricular mastoidectomy site.

Conclusions: Robotic keyhole access to the semicircular canals is anatomically feasible across diverse patient anatomies. These results support the clinical viability of minimally invasive, image-guided vestibular implantation techniques.

Free paper 0507

Anatomy based cochlear implantation

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Using anatomy-based fitting, we can determine the place-specific map with individualized center frequencies for each electrode contact that is a closer match to the natural pitch-place of the cochlea. The primary objective of this study is to evaluate the tonal presentation across the electrode array and to calculate the semitone difference between each adjacent pair of contacts according to their anatomy-based map. The secondary objective is to determine the distancing of the contacts that would result in an equal semitone difference with a uniform tonal presentation. A total of 167 ears were included in this retrospective study. The frequencies across the electrode arrays were found to be unequally presented. The semitonal condensations were higher in the apical inter-contact spaces compared to the basal inter-contact spaces, being 3.0–2.3 semitones/mm (Kruskal Wallis test, $p < 0.000$). The anatomy-based spacing of the electrode contacts was larger in the basal inter-contact spaces compared to the apical inter-contact spaces, ranging from 1.92 to 1.48 mm. In conclusion, the current electrode designs do not have uniform tonal representation throughout the electrode array. There is a more condensed tonal presentation in the apical electrodes than in the basal electrodes, resulting in a lower tonal resolution in the apical region.

Free paper 0601

Anatomy-based fitting and its impact on auditory outcomes and music perception: A within subject analysis in cochlear implant users

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Introduction: Tonotopic or anatomy-based fitting (ABF) aligns each cochlear implant (CI) electrode with the frequency range corresponding to its anatomical location. This study aimed to compare ABF with standard fitting (SF) in terms of speech tests and subjective outcomes, as well as music perception using the Meludia platform in a within-subject study.

Material and methods: Twenty-one adult CI users implanted with Synchrony ST FLEX28 participated. Speech tests (disyllables in silence) and sound quality (HISQUI19) were assessed after nine months with either ABF or SF, followed by one month with the alternate fitting. Nine participants completed music tasks on Meludia's "Discovery" level, evaluating Spatialization (differentiating between lower and higher notes), Stability (perception of stability or instability), Melody (ascendant or descendant), and Density (presence of one or multiple simultaneous sounds). Each task consists of 5 levels of difficulty. Subjective music perception was assessed using MuRQoL and the Munich Music Questionnaire (MuMu).

Results: Participants had a mean age of 45.4 ± 17.9 years. Ten began with ABF, eleven with SF. Speech discrimination scores were similar for ABF and SF (66.2 ± 20.0% vs 70.4 ± 16.8%, $p = 0.201$), as were HISQUI19 scores (82.6 ± 27.1 vs 81.1 ± 23.9, $p = 0.847$), indicating moderate sound quality. In Meludia's Density task, ABF yielded significantly better scores at the first level (1.78 ± 0.44 vs 1.33 ± 0.50; $p = 0.046$), with a trend toward improvement across all levels (1.6 ± 0.42 vs 1.3 ± 0.55; $p = 0.174$). Six subjects completed MuRQoL, showing slightly higher musical activity scores with ABF (3.3 ± 0.6 vs 3.1 ± 0.9, $p = 0.686$); 67% scored better with ABF. Seven completed MuMu, with 57% reporting music sounded more natural, pleasant, clearer, and less tinny/reverberant with ABF.

Conclusions: ABF and SF yielded comparable speech and sound quality outcomes. However, ABF showed advantages in processing multiple simultaneous sounds, particularly in identifying middle and low-frequency components. Further research is needed to confirm ABF's benefits in speech and broader musical perception.

Free paper 0596

Anatomy-based fitting enhances spectral resolution and harmony perception in inexperienced cochlear implant users

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Objective: The objective of this study was to assess the effect of anatomy-based fitting on speech and music perception in inexperienced cochlear implant (CI) users.

Material and methods: Newly implanted patients with a bilateral severe-to-profound sensorineural hearing loss (SNHL) were included at the University Hospital Brussels, the Antwerp University Hospital and the University Hospital Vienna. Patients were randomized in two study arms at the activation of the audioprocessor: patients randomized in the control group were fitted with a conventional logarithmic frequency distribution, whereas patients in the intervention group were fitted with an anatomy-based frequency distribution. Pure-tone audiometry (PTA), speech perception in quiet (SPIQ), speech perception in noise (SPIN) and the level of self-perceived auditory benefit (HISQUI19) were assessed. Furthermore, patients performed a phoneme categorization task to investigate spectral resolution and a harmonic interval perception task to assess the perception of harmony. Tests were performed at 1 week, 1 month, 3 months and 6 months post-activation of the audioprocessor.

Results: Fifty-six newly unilaterally implanted patients were included of which 30 patients were fitted with an anatomy-based fitting (ABF) and 26 patients with a conventional fitting. No statistically significant effect of fitting was found for PTA, SPIQ, SPIN and self-perceived auditory benefit. The phoneme categorization task showed that the slope of the psychometric function was significantly steeper and the intercept was significantly lower in patients with ABF at three months and six months post-activation compared to patients with a standard fitting, indicating a clearer phoneme boundary discrimination in patients with ABF. Furthermore, patients with an anatomy-based frequency distribution showed a more distinct pattern for pleasantness of harmonic intervals in comparison to patients with a conventional frequency distribution.

Conclusions: Our longitudinal multicenter study demonstrated a better spectral resolution and a more distinct pattern for pleasantness of harmonic intervals in newly implanted patients with ABF in comparison to patients with a standard fitting.

Free paper 0189

Application of P1 response threshold of cortical auditory evoked potential in rehabilitation evaluation of young children with cochlear implant

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Objective: To explore the application value of P1 response threshold of cortical auditory evoked potential (CAEP) in evaluating the rehabilitation effect of cochlear implant in young children.

Material and methods: Thirty-three young children after cochlear implantation were divided into groups according to hearing age: Group A (hearing age 1~<2 years old) 10 people; Group B (hearing age 2~<3 years old) 13 people; Group C (hearing age 3~<4 years old) 10 people. The subjective assessment was carried out using the assessment tool for hearing-impaired children. Criteria and methods for assessing auditory and language ability of hearing-impaired children and objective electrophysiological examination was carried out using CAEP to evaluate the rehabilitation effect. SPSS 25.0 software was used for statistical analysis.

Results: The results of subjective assessment of auditory ability and language ability in each group showed an increasing trend with the increase of auditory age. In this study, the P1 response threshold of CAEP in CI implanted children had a significant positive correlation with the 2k Hz hearing threshold after intervention, and the P1 response threshold of CAEP was negatively correlated with many items in subjective auditory ability and language ability assessment.

Conclusions: The P1 response threshold of CAEP has a stable correlation with the results of speech audiometry, which can effectively and objectively evaluate the postoperative rehabilitation effect of young children with cochlear implantation.

Free paper 0618

Argentinian program of ABI in children

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The ABI is a biomedical device that generates auditory sensations in patients with severe cochlear malformations or absence of the cochlear nerve. These patients are contraindicated for cochlear implants, or the results of such implants are very limited. At CIC Diamante, we began performing ABI surgery in 2007. We currently have 21 pediatric patients with ABI. 61% of our patients presented with other associated handicaps, the most frequent being: developmental delay, genetic syndromes, visual problems, among others. The most frequent radiological diagnoses were: Michel aplasia, rudimentary otocyst, and cochlear or cochlear nerve aplasia.

Regarding the audiological **Results:** We used the Geers CAP (1994). All patients had a preoperative CAP of 0. The average post-ABI CAP was 2.9, with a range of 1 to 6. The average free-field tonal thresholds were 35 dB, with a range of 25 to 55 dB. The benefit from the devices was measured using the MAIS and IT-MAIS scales, with an average score of 24.7/40. In 5/21 patients, we performed a cochlear implant prior to ABI, which had very limited results. 1/21 patient required revision surgery due to receiver/stimulator extrusion. 11/21 patients experienced non-auditory sensations, the most frequent being: cough, facial stimulation, nystagmus, dizziness, or paresthesia, among others.

The ABI may be an alternative for auditory habilitation in patients with profound bilateral hearing loss and severe cochlear malformations that contraindicate a cochlear implant. Results with the ABI are heterogeneous, and among the most important factors influencing the outcomes are: age at implantation, the presence of other disabilities, and the position of the electrode pad and number of active contacts.

Free paper 0179

Artificial intelligence-based noise reduction significantly improves speech perception in noise for cochlear implant users

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Introduction: Traditional hearing aid noise reduction algorithms do not improve speech perception in noisy situations for bimodal cochlear implant (CI) users with a CI in one ear and a hearing aid in the other. However, deep neural network (DNN)-based noise reduction has proven beneficial in improving speech understanding in noise for hearing aid users. This hearing aid technology could be leveraged in the bimodal CI population to further improve speech perception in noise. This study investigated the effectiveness of DNN-based noise reduction in the hearing aid used by bimodal CI patients in improving speech understanding in noise.

Material and methods: Bimodal CI patients were fit with a hearing aid equipped with DNN-based noise reduction in their non-implanted ear. Patients were provided with a standard hearing aid program and a DNN-based noise reduction program. Speech perception was measured using AzBio sentences in quiet and in co-located multi-talker babble noise bimodally with both a standard and DNN hearing aid program. CI alone performance was also assessed. All testing was performed in a soundbooth, and sentences were presented at 60 dB SPL from a single loudspeaker at 0-degrees azimuth.

Results: The DNN program in the hearing aid significantly improved bimodal performance in noise, with sentence recognition scores reaching 79% compared to 60% with the standard hearing aid program (a 19% average benefit, $p < 0.001$). When compared to the CI-alone condition in multi-talker babble, the DNN hearing aid program offered a 40% bimodal benefit, significantly higher than the 21% bimodal benefit obtained with the standard program.

Conclusions: DNN-based noise reduction in a hearing aid significantly improves speech understanding in noise for bimodal CI users. Utilization of this technology by bimodal CI users offers a promising option to address patients' common complaint of speech understanding in noise.

Free paper 0753

Assessing clinical outcomes in cochlear implants using advance methods: fNIRS and CAEP

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Introduction: Assessing the clinical outcome following cochlear implants has always been a challenging field. Currently, it is not possible to accurately predict cochlear implant outcomes. Patients receiving cochlear implants display highly variable speech and language processing outcomes, although the basis for this is poorly understood.

Objective: To assess electrophysiological maturation and cortical activation and explore their relationship following auditory rehabilitation.

Material and methods: A prospective observational study was carried out at our centre, which evaluates cortical auditory maturation in pediatric cochlear implant recipients using two objective modalities: Cortical Auditory Evoked Potentials (CAEP) and Functional Near Infrared Spectroscopy (fNIRS). (1) fNIRS is a non-invasive neuroimaging technique that measures cortical activity through changes in blood oxygenation. It uses near-infrared light emitted through scalp-mounted optodes. Light absorption differences between oxygenated and deoxygenated hemoglobin are analyzed using the modified Beer-Lambert law. *Parameters measured*: ΔOxy-Hb (oxygenated hemoglobin), ΔDeoxy-Hb (deoxygenated hemoglobin), and ΔTotal-Hb (total hemoglobin). These reflect cortical metabolic activity and neuronal activation. (2) CAEPs are electrophysiological responses recorded from the auditory cortex following sound stimulation. Auditory stimuli such as speech (/da/) and tonal frequencies are presented, and cortical responses are recorded using scalp electrodes. *Key parameter* – P1 latency. This reflects neural conduction efficiency and maturation of central auditory pathways.

Results:

- Most participants showed P1 latency within expected developmental limits, indicating cortical maturation;
- fNIRS demonstrated bilateral cortical activation across stimuli;
- Significant inter-individual variability was observed.

Correlation findings:
- Speech stimulus – no significant correlation between P1 latency and cortical activation;
- Low frequency (500 Hz) – moderate negative correlation (significant on the left side);
- Mid frequency (1 kHz) – weak, non-significant correlations;
- High frequency (4 kHz) – weak, inconsistent, non-significant correlations.

Interpretation:
- CAEP and fNIRS assess different aspects of cortical function;
- Electrophysiological maturation does not directly predict cortical activation;
- Low-frequency processing reflects maturation, while high-frequency responses suggest compensatory cortical recruitment;
- Variability reflects differences in neuroplasticity, rehabilitation, and auditory experience.

Conclusions: Cochlear implantation leads to measurable cortical maturation and preserved cortical activation. However, the relationship between electrophysiological maturation and cortical activation is weak, frequency-dependent, and influenced by higher-order cortical processing.

Free paper 0349

Assessment of language development in children with prelingual onset of single-sided deafness

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Introduction: The absence of binaural hearing in patients with single-sided deafness (SSD) is associated with reduced ability to perceive speech in challenging acoustic conditions. In children with prelingual SSD, this limitation adversely affects incidental language learning and may consequently delay the development of language skills. These deficits may underlie the increased risk of school underachievement, emotional difficulties, and impairments in complex cognitive skills reported in the literature for this group of children.

Objectives: To assess the development of receptive and expressive language skills in children who had prelingual single-sided deafness.

Material and methods: 50 children diagnosed with SSD at the Institute of Physiology and Pathology of Hearing in Warsaw/Kajetany, Poland were included in the study. Receptive and expressive language skills were examined using

a norm-referenced test, the Child Speech Therapy Assessment Cards (CSTAC).

Results: In the test of receptive language skills, 46% of children with SSD received low scores, while 48% recorded low scores in the test of expressive language skills. Among children with normal hearing, the expected percentage of low scores is 30.85% for both receptive and expressive skills. Children with SSD demonstrated a significantly higher proportion of low scores in both receptive (χ^2 (2, $N = 50$) = 19.66; $p < 0.001$; $V = 0.63$) and expressive (χ^2 (2, $N = 50$) = 22.64; $p < 0.001$; $V = 0.67$) language skills compared to their normal-hearing peers.

Conclusions: The results showed that children with SSD are at risk of language delays. To minimize the potential consequences of such delays, appropriate early intervention – together with parental education, speech-language therapy, auditory training, and monitoring of language development – should be implemented.

Free paper 0492

Asymmetric sensorineural hearing loss: When to recommend Bimodal System Therapy?

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Introduction: Bimodal stimulation (BS), combining a cochlear implant (CI) in one ear and a hearing aid (HA) in the contralateral ear, is an established rehabilitation strategy for asymmetric sensorineural hearing loss. This approach exploits the complementary mechanisms of the two devices: the CI bypasses damaged hair cells through direct electrical stimulation of the auditory nerve, whereas the HA amplifies residual acoustic hearing. Current evidence supports significant benefits of BS in speech perception in noise compared with unilateral CI use. However, limitations persist, particularly regarding inter-device temporal synchronization and the perception of modulated noise.

Objectives: To provide an updated overview of the benefits and limitations of BS based on recent literature and to present the results of our clinical experience with advanced bimodal fitting formulas in adult patients.

Material and methods: A combined clinical study and systematic review was conducted. Eleven adult bimodal users (Naída CI Q70 with contralateral HA) were enrolled. Participants' personal HAs, fitted according to the NAL-NL1 prescription, were replaced with the Phonak Naída Link Ultra Power. Devices were programmed using both the conventional NAL-NL1 formula and the Adaptive Phonak Digital Bimodal (APDB) fitting algorithm developed by Advanced Bionics and Phonak. Speech intelligibility in quiet and in noise was assessed, comparing performance with patients' personal devices and with the Naída Link under both fitting conditions. Concurrently, a PRISMA-guided systematic review of studies published between 2020 and 2024 was performed to evaluate the benefits and challenges of BS, focusing on speech perception in noise, directional microphone technologies, and the impact of temporal mismatches between devices.

Results: The review confirms that BS provides significant advantages in speech perception in noise over unilateral CI, particularly in individuals with preserved residual hearing. Our clinical findings align with the literature, demonstrating improved performance in complex auditory environments with APDB compared to conventional fitting strategies, with clear gains in speech-in-noise outcomes.

Conclusions: Bimodal stimulation is an effective therapeutic option for asymmetric sensorineural hearing loss. Advanced fitting strategies and individualized programming are essential to optimize auditory outcomes. Further research is warranted to address technical constraints and refine patient selection criteria.

Free paper 0018

Audio processors satisfaction in CI users: Influence of device type, model, and user characteristics

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Introduction: Cochlear implants (CI) are currently used with external audio processors (AP), which can impose challenges and responsibilities on the user. Satisfaction with the AP is key for long-term device use and hearing rehabilitation success. This study aimed to establish a large reference cohort for the Audio Processor Satisfaction Questionnaire (APSQ). We also examined how processor type and hearing indication affect AP satisfaction. In addition, associations between these factors, APSQ scores, and daily CI use were analyzed.

Material and methods: In this retrospective study, data from 861 CI users were evaluated. APSQ results were analyzed using multivariable quantile regression. Associations with daily processor use were also examined using multivariate ordinal logistic regression. All models accounted for age, gender, hearing configuration, and processor type.

Results: Overall AP satisfaction was high (median APSQ score: 8.8 on a 0–10 scale). A small but statistically significant difference was observed between behind-the-ear (BTE) and off-the-ear (OTE) APs ($\Delta = 0.18$ points). This difference was attributable to two items related to the wearing of glasses and head coverings. Daily CI use was high, with 76% of participants using their AP for more than 12 hours per day. Longer daily use was significantly associated with higher APSQ scores. On average, SSD users had three hours shorter daily use compared to those with bilateral hearing loss. Compared to bilateral CI users, those with single-sided deafness (SSD) or bimodal configurations reported slightly lower satisfaction.

Conclusions: Differences in satisfaction between processor types and hearing configurations were statistically significant

but clinically small. Higher AP satisfaction was associated with longer daily CI use. The results provide a valuable reference dataset for future studies and device development. Continuous monitoring of user satisfaction supports individualized counseling, early identification of challenges, and optimized rehabilitation strategies based on factors influencing daily device use.

Free paper 0289

Audio reconstruction method for cochlear implants in partially deaf individuals

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Cochlear implants provide essential auditory perception for individuals with severe or partial hearing loss. However, the limited number of stimulation channels and the simplified spectral representation often result in reduced speech intelligibility. This work proposes a transformation-based reconstruction method to restore missing frequency components in individuals with partial deafness, focusing on spectral regions typically inaudible due to sensorineural impairment. In these patients, shorter electrodes are implanted to stimulate areas of the cochlea with damaged hair cells while preserving healthy cells.

Using the LibriSpeech corpus, audio recordings of spoken text are transformed into the frequency domain using several mathematical transformations, including the Fast Fourier transform, the digital cosine transform, the Walsh-Hadamard transform, and the discrete wavelet transform. The patient's natural hearing range is preserved, since only inaudible frequencies are sampled using regular and logarithmic strategies to simulate the limited channel resolution of cochlear implants (5–30 channels).

The sampled audio is encoded into spike trains using Izhikevich's spiking neuron model, decoded, and then reconstructed through inverse transforms. The reconstructed spectral components are merged with the naturally audible part of the signal to form a complete audio output. Speech intelligibility was evaluated using word error rate (WER) computed with an AI speech to text model, with optional human listening tests planned to validate perceptual quality beyond model based metrics.

The proposed approach enables a systematic comparison of transformation types, sampling strategies, and spike-based coding schemes for reconstructing missing spectral information in cochlear implant processing. The results provide insights into how transformation domain representations and neuromorphic coding can improve speech perception in partially deaf individuals, offering a potential path to even better synergy between natural hearing and cochlear implants.

Free paper 0195

Audiological outcomes, spatial hearing, masking release and localization ability and quality of life in children and adults with unilateral aural atresia and Bonebridge or Vibrant Soundbridge

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Introduction: Bone conduction devices (BCDs) and middle ear implants (MEIs) are established therapeutic options for the treatment of unilateral aural atresia. Due to their distinct stimulation pathways, the question of the optimal modality of care remains a subject of clinical interest. This study compares the audiological outcomes of the Vibrant Soundbridge (VSB, MED-EL) and the Bonebridge (MED-EL) regarding spatial hearing, sound localization ability, and subjective patient satisfaction.

Material and methods: A cohort of 24 patients (15.6 ± 5.2 years; 12 male/12 female) with unilateral aural atresia and at least one year of device experience was evaluated. Assessment procedures included the measurement of free-field hearing thresholds and speech perception in quiet (S0), as well as spatial hearing using the Oldenburg Sentence Test (OLSA) under three conditions: S0N0, ScNi (speech contralateral, noise ipsilateral), and SiNc (speech ipsilateral, noise contralateral). Furthermore, sound localization was examined using the Beephonix 180° setup, and subjective satisfaction was recorded via the SSQ12 (Speech, Spatial, and Qualities of Hearing) questionnaire.

Results: Preliminary data indicate comparable performance between both groups in free-field thresholds, speech perception in quiet (S0), and speech perception in noise under S0N0 and ScNi conditions. However, in the SiNc condition (speech directed to the implanted side, noise directed contralaterally), the MEI group demonstrated a significant advantage of 3.7 dB SNR over the BCD group. Regarding sound localization, no significant differences were observed, although a trend toward superior localization within the implanted hemisphere was noted for the VSB group. SSQ scores were similar across both groups.

Conclusions: Both therapeutic approaches provide comparable results in the majority of listening environments. However, MEIs offer a distinct advantage in specific noise-masking scenarios (SiNc), underscoring the physiological importance of side-specific stimulation. Further analyses involving a larger cohort are necessary to determine the long-term clinical relevance of this finding.

Free paper 0491

Auditory fatigue and listening effort in cochlear implant users: Beyond audiometric recovery

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Introduction: Cochlear implantation (CI) is the standard treatment for profound sensorineural hearing loss. However, improvements in aided thresholds and speech perception under controlled conditions do not necessarily translate into effective performance in complex listening environments, such as background noise or multi-talker settings. In this context, listening effort and auditory fatigue emerge as clinically relevant dimensions that may significantly affect cognitive functioning, social participation, and quality of life. Auditory fatigue should be viewed not as a simple consequence of hearing loss, but as the result of increased cognitive load required to compensate for degraded auditory input, even when audiometric outcomes appear satisfactory.

Objectives: To assess auditory fatigue in CI users and analyze its relationship with clinical variables, stimulation modality (unilateral, bimodal, bilateral), and timing of implantation. A secondary aim was to compare subjective and behavioral measures of listening effort to obtain a more comprehensive evaluation of rehabilitation outcomes.

Material and methods: Fifty-two adolescents and adults (11–40 years) with bilateral profound sensorineural hearing loss rehabilitated with CIs were enrolled at the Audiology and Vestibology Unit of the University Hospital "Federico II" of Naples. The protocol included aided free-field pure-tone and speech audiometry, the Ita-Matrix Sentence Test for speech-in-noise assessment, and the Vanderbilt Fatigue Scale for Adults (VFS-A). Outcomes were analyzed according to stimulation strategy, age at diagnosis, and timing of first implantation (early vs late).

Results: Eighty-seven percent of participants achieved optimal aided thresholds, while speech perception in noise showed greater variability. The mean Ita-Matrix score (+3.37 dB SNR) indicated relevant difficulty in speech understanding in noise and increased listening effort. VFS-A findings revealed predominant cognitive fatigue, reflecting substantial attentional demand. Higher fatigue levels were observed in unilateral and bimodal users, whereas bilateral – particularly simultaneous – implantation was associated with significantly reduced listening effort. Earlier implantation consistently correlated with lower fatigue levels.

Conclusions: Auditory fatigue represents a crucial outcome in CI rehabilitation, persisting despite favorable audiometric results. Early, simultaneous bilateral stimulation appears most effective in reducing listening effort. Combining subjective and speech-in-noise measures enables a more comprehensive, patient-centered evaluation of rehabilitative success.

Free paper 0208

Auditory outcomes by cochlear hypoplasia type (CH-I–IV) in pediatric patients

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Introduction: Cochlear hypoplasia (CH) represents a spectrum of IEMs characterized by varying degrees of cochlear underdevelopment and structural deformity. CH is classified into four subtypes (CH-I–IV) based on cochlear size, internal architecture, and associated vestibular abnormalities. These anatomical variations may influence cochlear nerve integrity and, consequently, auditory outcomes following cochlear implant (CI) or auditory brainstem implant (ABI) surgery. Understanding CH subtype–specific characteristics is essential for appropriate implant selection and outcome prediction in pediatric patients. The aim of this study was to evaluate auditory perception and early language development outcomes in pediatric patients with different CH types (CH-I–IV) who received CI and ABI.

Material and methods: The study included 35 pediatric patients diagnosed with CH who received either CI or ABI. Participants were classified into four groups according to CH types (CH-I, CH-II, CH-III, and CH-IV). Auditory perception abilities were assessed pre- and post-operatively using a standardized auditory test battery consisting of the Meaningful Auditory Integration Scale (MAIS), the closed-set Pattern Recognition Test (PPT), and the open-set Sentence Recognition Test (SRT). In addition, early language development was evaluated using the Early Language Development Test, Third Edition (TELD-3). Comparative analyses were conducted to examine auditory and language outcomes across CH subtypes.

Results: Post-operative assessments showed improved auditory perception in patients with cochlear nerve visualization on magnetic resonance imaging (MRI). These patients generally achieved higher auditory perception scores than those without clearly identifiable cochlear nerves. Open-set sentence recognition was more variable and limited in cases lacking cochlear nerve visualization, particularly in severe forms of CH types. A similar pattern was observed in early language development, with better receptive and expressive language outcomes in patients with a visible cochlear nerve. Notable inter-individual variability was observed within each group.

Conclusions: In patients with CH in whom the cochlear nerve is visualized on MRI, CI generally yields favorable outcomes. However, audiological outcomes vary according to the CH subtype and the use of CI or ABI. Therefore, each CI and ABI user should be evaluated and supported individually, taking into account their unique anatomical, audiological, and rehabilitative characteristics.

Free paper 0402

Automatic speech recognition and closed set responses as alternative response methods for sound booth free, remote, app-based speech in quiet testing in cochlear implant and hearing aid users

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Aim: Speech in Quiet (SPIQ) assessment places a substantial demand on clinical time and resources, particularly with the increasing number of hearing aid (HA) and cochlear implant (CI) users. Streaming SPIQ stimuli directly to the hearing device offers a more efficient alternative. The Mobile Research App (MRA) enables sound booth free SPIQ self testing. This study evaluated the reliability and validity of different response modalities in self administered, automatically scored SPIQ assessments performed outside the sound booth in adult CI and HA users.

Material and methods: In this prospective study, experienced CI and HA users completed repeated SPIQ assessments using Consonant–Vowel–Consonant (CVC) stimuli. Testing was conducted under standard audiologist led sound booth conditions (SOC) and during supervised in clinic self testing using the MRA. Stimuli were streamed directly to the users' hearing devices. Responses included typed open set orthographic input, multiple choice closed set selections, and spoken responses scored using automatic speech recognition (ASR). Open and closed set responses were automatically scored using the Self Scoring Speech Audiometry (SAM) algorithm. Test–retest reliability and agreement were analysed using Pearson correlations and equivalence testing.

Results: Thirty one CI users and thirty HA users completed the first protocol, and twenty CI users and twenty HA users completed a second protocol. Remote SPIQ testing via the MRA demonstrated strong test–retest reliability across all scoring methods ($r > 0.8$), with no significant differences relative to SOC testing. Open set SAM and ASR based scores closely aligned with clinician scoring. Agreement between open and closed set SAM scores was observed only when closed set alternatives were linguistically well defined and targeted common phoneme confusions.

Conclusions: Sound booth free, self administered SPIQ assessment using the MRA provides a reliable alternative to conventional sound field testing for CI and HA users. Automatically scored open set, closed set, and ASR based responses support efficient, low resource remote speech audiometry and may facilitate scalable telehealth based follow up.

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Free paper 0221

Awareness and acceptance of hearing rehabilitation in vestibular schwannoma patients with postoperative SSD

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Introduction: Vestibular schwannoma (VS) surgery frequently results in non-serviceable ipsilateral hearing, i.e., single-sided deafness (SSD), with relevant communicative and psychosocial impact. Although SSD-oriented rehabilitation (CROS/BiCROS, bone-conduction devices, cochlear implantation in selected cases) can improve functional outcomes, real-world awareness and acceptance remain uncertain. This study evaluated postoperative hearing handicap, information provision, and willingness to pursue hearing rehabilitation, and explored trends with demographic and clinical variables.

Material and methods: Fifty patients after VS resection were analyzed (27 women, 23 men; mean age 40.5 years). Tumor extent was documented by maximal diameter and Koos grade. Patients completed the Hearing Handicap Inventory (HHI) with additional items addressing whether they had been informed about hearing rehabilitation, which options they were aware of, and whether they were considering or using rehabilitation. Audiological parameters (PTA, SDS, AAO-HNS class) before and after surgery were extracted from records.

Results: The mean interval from surgery to questionnaire completion was 114.6 months. Postoperatively, AAO-HNS class D(non-serviceable hearing/SSD phenotype) predominated (38/42 with available data). On HHI, 55.3% (26/47) reported at least mild handicap, including 40.4% (19/47) with a significant handicap. Awareness of hearing rehabilitation was reported by 64% (32/50), while 28% (14/50) stated they had not been informed. The most commonly recognized SSD rehabilitation modalities were bone-conduction devices/BAHA ($n = 16$), cochlear implantation ($n = 11$), conventional hearing aids ($n = 11$), and CROS systems ($n = 9$). Active interest in, or current use of, rehabilitation was reported by 18%(9/50). Interest was more frequent among informed patients (8/9) and tended to coincide with higher perceived handicap (median HHI 34 vs 22). No consistent pattern emerged for age, sex, maximal tumor diameter, or Koos grade, although the small "interested" subgroup limits inference.

Conclusions: Long after VS surgery, SSD-associated handicap remains common, yet rehabilitation uptake is low. Information provision appears to be a key modifiable factor and may relate to greater readiness to consider SSD rehabilitation. Structured, repeated counseling on SSD-specific options should be integrated into long-term follow-up pathways.

Free paper 0338

Bacterial meningitis and cochlear implantation in adults: What we have learned over the years

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Introduction: Meningitis is a critical etiology for cochlear implantation (CI) due to the risk of labyrinthitis ossificans. Traditionally, the time interval between the infectious event and surgery has been considered the primary prognostic factor. This study evaluates a multifactorial landscape – including anatomical, surgical, and clinical variables – to determine which factors most reliably predict functional success in post-meningitic adults.

Material and methods: We conducted a retrospective descriptive study of 11 adult patients (12 ears, including one bilateral case). Data were systematically collected on: age at implantation, chronological interval since the meningitis episode, history of hearing aid (HA) use and preoperative performance, preoperative imaging findings (CT and MRI), and electrode array design (straight versus perimodiolar). Surgical findings regarding complete or partial insertion were recorded. Functional outcomes were measured using pure-tone and speech audiometry at 6, 12, and 24 months postoperatively.

Results: Cochlear ossification on preoperative MRI emerged as the fundamental prognostic factor, outweighing the chronological interval since the infection. Complete insertion was achieved in all cases except for two patients; notably, these two individuals had the shortest meningitis-to-implantation intervals in the entire series and both exhibited significant cochlear involvement on MRI. Conversely, excellent functional results (up to 80% word recognition at 65 dB) were achieved in patients with more than 50 years between meningitis and CI, provided the cochlea remained patent and the patients were consistent HA users during that period. No significant relationship was found between posterior labyrinth involvement and auditory outcomes. In cases of cochlear patency, functional performance was comparable between straight and perimodiolar electrode designs.

Conclusions: In post-meningitic adults, the degree of cochlear ossification is the primary determinant of CI failure and can occur with devastating speed, regardless of the Meningitis-to-Implantation Interval. Long-term neural viability allows for excellent functional outcomes even decades after infection, provided the cochlea remains permeable and the auditory pathway is maintained through consistent hearing aid use.

Free paper 0384

Beyond hearing restoration: Communication health as a framework for understanding cochlear implant outcomes

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Rapid technological progress in cochlear implants has substantially improved auditory outcomes; however, clinical evaluation still focuses primarily on audiometric measures. We would like to introduce the concept of communication health as a broader, interdisciplinary framework for understanding the real-life impact of cochlear implantation.

The concept of communication health will be presented as an integrative perspective encompassing biological, psychological, and social aspects of human functioning. Within this framework, cochlear implants are viewed not only as devices restoring auditory input, but also as key intervention supporting the rebuilding of communicative functioning.

A multidimensional model of communication health will be outlined, centered on its core dimension – biological, psychological, and social – which are further broadened by supportive and contextual perspectives. The model highlights how auditory restoration interacts with brain plasticity, cognitive processing, emotional regulation, and social participation. The shift from "hearing restoration" to "communication health restoration" may enable a more comprehensive evaluation of cochlear implant outcomes and place effective communication at the center of cochlear implant outcomes.

Free paper 0426

Bilateral cochlear implantation in a child with Warsaw breakage syndrome: Hearing restoration in a rare genetic disorder

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Introduction: Warsaw Breakage Syndrome (WABS) is an ultra-rare autosomal recessive disorder caused by pathogenic variants in the DDX11 gene, resulting in genomic instability. Clinically, WABS is characterized by microcephaly, growth retardation, developmental delay, and sensorineural hearing

loss (SNHL). Fewer than 50 cases have been reported worldwide, and evidence regarding cochlear implantation in affected children is extremely limited. Hearing loss in WABS can vary from sensorineural deafness with normal inner ear anatomy to cochlear malformations or cochlear nerve aplasia. Understanding the underlying mechanism of hearing loss in these patients is crucial for determining cochlear implant candidacy and optimizing auditory outcomes.

Case report: We report a 2.5-year-old male presenting with absent speech development and no response to environmental sounds. Comprehensive audiological evaluation, including otoacoustic emissions (OAE), auditory brainstem response (ABR), and auditory steady-state response (ASSR), demonstrated severe bilateral SNHL. High-resolution MRI of the temporal bones and internal auditory canals was performed to assess cochlear morphology and cochlear nerve integrity. The patient also exhibited syndromic features, including microcephaly and short stature, prompting targeted molecular analysis. Following multidisciplinary assessment, the patient underwent simultaneous bilateral cochlear implantation. Postoperative auditory-verbal rehabilitation was initiated to support language development.

Results: Imaging revealed anatomically normal cochleae and intact cochlear nerves. Genetic testing identified a homozygous pathogenic variant in DDX11, establishing a diagnosis of WABS. Bilateral cochlear implantation was performed without perioperative complications. During postoperative follow-up, the child demonstrated consistent auditory awareness, improved sound detection thresholds, and gradual gains in speech perception and expressive language. The SNHL was attributed to hair cell dysfunction, consistent with the known cellular consequences of DDX11 variants. Cochlear implantation effectively bypassed dysfunctional hair cells, enabling functional hearing and measurable communication improvements.

Conclusions: This case demonstrates that bilateral cochlear implantation is a safe and effective intervention in selected children with WABS. Early, comprehensive audiological assessment, advanced imaging to confirm cochlear and neural integrity, and precise genetic diagnosis are essential for timely intervention. Even in genetically complex disorders, cochlear implantation may lead to meaningful improvements in auditory function and communication. Syndromic conditions with profound hearing loss should not be considered absolute barriers to successful cochlear rehabilitation.

Free paper 0683

Bilateral real-time ECochG monitoring in CI surgery: Two pediatric cases with 2.5-year hearing outcomes

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Objectives: To assess the feasibility and effectiveness of real-time intraoperative electrocochleography (ECochG) using the AIM System during bilateral cochlear implantation (CI) in preserving hearing and cochlear integrity, and its correlation with long-term auditory outcomes.

Material and methods: This prospective, non-randomized study involved two pediatric patients with measurable preoperative hearing, undergoing bilateral sequential cochlear implantation at a tertiary pediatric referral centre. Real-time ECochG monitoring was performed throughout surgery using the AIM System, including ECochG sweeps and on-table automated audiograms. Electrode insertions were completed at 210 & 320 seconds with full monitoring continuing until closure (1440, 1590 seconds) in both-ears respectively. Intraoperative events, including electrode coiling and periosteal suturing, were correlated with ECochG amplitude changes. Hearing thresholds were tracked pre-operatively, intraoperatively, at switch-on, and at follow-up intervals through 30 months using both the AIM system's automated audiogram and conventional audiometry.

Results: In both cases, intraoperative ECochG-based audiograms showed hearing preservation with ≤15 dB threshold shifts from baseline across 250–1000 Hz, and measurable thresholds at 2000 and 4000 Hz. These results were sustained at switch-on, 3, 6, 12, 18, 24, 30 months. ECochG amplitude changes closely corresponded with specific surgical manipulations, providing actionable feedback to the surgeon. Both patients demonstrated stable auditory outcomes post-implantation, indicating effective structural and functional preservation.

Conclusions: Real-time ECochG monitoring with the AIM System is a reliable intraoperative tool in pediatric CI, enabling cochlear function monitoring and preservation. It aids surgical precision and correlates with excellent long-term auditory outcomes. These cases support the use of ECochG as a standard intraoperative adjunct in hearing preservation CI strategies.

Free paper 0247

Binaural audio frontend processing for cochlear implants inspired by the medial olivocochlear reflex

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Introduction: The "MOC strategy" is a binaural audio processing method for cochlear implants (CI) inspired by the medial olivocochlear (MOC) reflex. Although the MOC strategy can improve hearing for CI users, it requires a bilateral channel pairing for the contralateral control of the backend compression and, therefore, the same number of frequency channels and electrodes on both sides. This may limit its clinical applicability. As a step to overcome this difficulty, here, we present and test a version of the MOC strategy designed to operate at the front end (FE) rather than the back end of processing, referred to as the MOCFE.

Material and methods: The MOCFE strategy was implemented and tested in combination with a pair of functionally independent bilateral MED-EL FS4 audio processors. The hearing of bilateral CI users was compared for the MOCFE as well as for two reference strategies: the standard FS4 strategy and a backend MOC strategy. The MOCFE and MOC strategies were implemented with fast contralateral inhibition. Measures included (1) speech reception thresholds for sentences embedded in fluctuating and stationary noise, in unilateral and bilateral listening modes, and for three different speech levels; and (2) sound source localization in quiet and in noise. Five bilateral users of MED-EL CIs participated in the evaluations.

Results: (1) For speech intelligibility in fluctuating noise, the MOCFE was as beneficial (re FS4) as the backend MOC strategy, except for one specific spatial configuration (S–60N60), where the MOCFE produced no benefits while the MOC strategy did. (2) Neither the MOCFE nor the MOC strategies improved intelligibility in a stationary noise, possibly because they involved fast rather than slow contralateral inhibition. (3) The binaural MOCFE and MOC strategies tended to improve sound source localization slightly relative to the FS4 strategy.

Conclusions: The MOCFE can become a successful alternative to the MOC strategy, as it may be more easily implemented in clinical devices and applied to a broader range of clinical map configurations.

Free paper 0219

Bonebridge in very young children is safe and effective

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Introduction: Due to smaller bone thickness, very young children with conductive or mixed hearing loss or single-sided deafness were previously most commonly treated conservatively up to the age of 5 years before surgery took place with a bone-anchored implant.

Objective: The purpose of this study was to analyze whether the Bonebridge bone anchored implant can be already implanted without surgical risk but good outcome in acceptance and speech understanding in children below the age of 5 years.

Material and methods: In this study, 14 patients under 12 years of age were implanted with the Bonebridge. The youngest child was implanted at the age of 3.2 years. Preoperative workup comprised a CT scan, an MRI scan, pure tone audiometry, or alternatively ABR.

Results: All patients were successfully implanted and showed a good postoperative acceptance, hearing performance and speech understanding. No adverse events were registered. The children, their parents and the teachers at school and Kindergarten appreciated the constant use of the implanted hearing system in contrast to the softband application.

Conclusions: With adequate preoperative workup, this bone anchored hearing implants can be safely implanted in children under the age of 5 years and allows for an extension of indication criteria toward younger children.

Free paper 0293

Bonebridge, long term results, survival rate and complications

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Introduction: Bone conduction implants (BCI) were designed to improve the hearing in patients with conductive or mixed hearing loss, however can help to patients with single sided deafness. Cumulative survival rates and device failure incidences among Bonebridge (BB) users at two Latin

American implantation centers were presented. It highlights the importance of device survival and failure risk in long follow up.

Material and methods: 172 patients implanted with Bonebridge since its approval (2013) were included. A survival analysis of BCI at two tertiary centers were done, including device failure and medical failures. Kaplan-Meier survival curves and Cox regression estimated failure risk, stratified by age and device model. Log-rank tests compared survival across subgroups, assessing interactions between age and device type in cumulative survival outcomes.

Results: A total of 186 cases (172 patients) were included, with 14 undergoing bilateral surgery. The mean implantation age was 33.87 ± 18.29 years, with 18.02% pediatric cases. Most patients had conductive hearing loss, with Microtia (44.1%) and COM sequelae (37.1%) as leading etiologies. BB601 was the most used device (68.8%), primarily placed in the mastoid area (51.1%). The study observed three device failures, four extrusions, and eight lost follow-ups, with no significant survival differences between age groups or device types (Kaplan-Meier, Log-Rank Test, $p = 0.791$). Cox regression found no significant interactions between age and device type ($p > 0.05$)

Conclusions: Bonebridge implantation demonstrated high cumulative survival rates (96–98.4%) over a 10-year period, with no significant differences between age groups or device models (BB601 vs BB602). Device failures occurred within the first 43.2 months. Cox regression showed no significant interactions between age and device type as covariates for survival.

Free paper 0084

CI Planner – Development of a deep learning decision support system for automated inner ear anatomy classification

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Objective: To create a research radiological software program that could read temporal bone computed tomography (CT) as DICOM/ Nifti files, automatically locate the inner ear and crop a region around it, and classify inner ear malformation type (IEM).

Material and methods: Retrospectively, we evaluated 2053 patients from 3 hospitals and extracted 1200 inner ears CTs to import, crop, and for deep learning model training, testing, and validation. An automated cropping algorithm based on K-means clustering was created to crop the inner ear volume. Using crops as an input, we created a deep learning convolution neural network (3D-CNN) (5-fold cross-validation). Cochlear hypoplasia, ossification, incomplete partition type I, incomplete partition type III, and common cavity (data equally distributed) were selected. The cropping tool and the AI model were both verified and deployed in our own developed imaging software to showcase the analysis workflow.

Results: We developed software that can read CT scans, can crop a volume that contains the inner ear, and based on that it can make a classification. The cropping tool provided 95% accuracy. For the classification model, the area under the curve (AUC) is 0.86 (95% CI: 0.81–0.91) on. Accuracy, precision, recall, and F1 scores are 0.812, 0.791, 0.8, and 0.766, respectively.

Conclusions: We present development and validation for a possible fully automatized workflow for detecting IEM. The tool could carry good diagnostic accuracy during risk stratification, however, must be supervised by the decision-maker.

Free paper 0271

CIICA conversations: Advocacy for CI by CI-users and families

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Introduction: There is a huge global gap between the numbers of those who have cochlear implants and those who need them. CIICA, the Cochlear Implant International Community of Action, was established in February 2021 to help close this gap.

Objectives: The objective is for CIICA to provide the user and family voice to influence the Living Guidelines project, which is aimed at addressing the significant under provision of CI for adults. The guidelines will help ensure that those who need CIs have a consistent pathway for access to the right treatment.

Material and methods: HT Analytics, the Australian group employed to manage the project, published the guideline protocol on Prospero, which is an international register of systematic reviews. CIICA was asked to involve CI-users and families, providing opportunities to comment on its questions and its recommendations. To do to, four CIICA Conversations were held. CIICA Conversations are one hour long, with a maximum of 20 participants, are not recorded and are live captioned. The transcripts of the facilitated Conversations were analysed and following each conversation a summary of the issues which arose was made, and circulated for agreement.

Results: There were concerns that most research looks at clinic-based measures and not at how users might define their outcomes in everyday life. Some key themes for CI-users and families:

(1) CI needs to be part of the lifelong hearing journey; (2) Family and person-centered care is vital for the best outcome;

(3) Regular mapping and rehabilitation is necessary for progress and often not provided; (4) Ongoing funding is a major issue for CI users, which is often not made clear prior to C; (5) Peer groups have a key role prior to and after CI; (6) Outcome measures need to reflect functioning and changes in everyday life. For adult CI-users impact on quality of life is more important than speech perception.

Conclusions: Participants in the conversations were enthusiastic about the potential of the Living Guidelines to improve CI services and were enthusiastic about looking at how they could use the guidelines to improve awareness, access, and provision. They were keen to support their implementation and use them in advocacy work.

Free paper 0062

Clinical evaluation of AutoNRM (Automatic Neural Response Measurement) for automatic cochlear implant fitting

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Introduction: This study aimed to evaluate the safety and clinical effectiveness of AutoNRM (Automatic Neural Response Measurement), an automatic fitting system integrated into the Nurotron cochlear implant (CI) software platform, Nurosound. AutoNRM automatically measures thresholds of the electrically evoked compound action potential (ECAP) and generates an initial ECAP-based fitting map (ECAPMAP). Audiologists then fine-tune the settings in live mode to create a finalized map (LiveECAPMAP). The performance of LiveECAPMAPs was compared with behaviorally obtained maps (LiveBurstMAPs) generated through conventional psychophysical fitting.

Material and methods: Twenty CI users (6 males, 14 females; mean age 36.05 ± 14.85 years), all without cochlear malformations, were enrolled. ECAP recordings were obtained from electrodes 1 (apex), 4, 7, 13, 16, 19, and 24 (base). Based on ECAP thresholds, AutoNRM automatically generated ECAPMAPs. Audiologists performed loudness balancing and real-world listening checks to ensure comfort and safety. After a 30-minute adaptation period for each map (LiveECAPMAP and LiveBurstMAP), participants completed: (1) Aided hearing thresholds at 500, 1000, 2000, and 4000 Hz. (2) Speech perception testing using the Mandarin Speech Perception (MSP) battery: disyllabic word recognition in quiet; sentence recognition in quiet; sentence recognition in noise (10 dB SNR). (3) Subjective listening questionnaire: 11-point scale evaluating comfort, intelligibility, clarity, and overall preference. A strict double-blind design ensured that neither testers nor participants were aware of which MAP was being used.

Results: Aided thresholds did not significantly differ between LiveECAPMAPs and LiveBurstMAPs (31.81 ± 3.59 vs 32.36 ± 4.62 dB HL, Paired *t*-test, $p > 0.05$). Similarly, no significant differences (Paired *t*-test, $p > 0.05$) were observed in speech perception performance: disyllabic words in quiet: 69.66 ± 21.84% vs 73.36 ± 19.96%; sentences in quiet: 66.59 ± 25.05% vs 67.31 ± 22.12%; sentences in noise: 54.56 ± 33.81% vs 55.33 ± 33.65%. Subjective ratings of comfort, speech intelligibility, clarity, and overall listening quality also showed no significant differences between MAP types.

Conclusions: AutoNRM enables reliable ECAP-based automatic generation of initial cochlear implant fitting maps. Its clinical outcomes are comparable to those obtained with conventional psychophysical fitting, supporting its safety, reliability, and utility for efficient initial fitting in adult CI users.

Free Paper 0427

Clinical–surgical profile and early auditory outcomes in a multicenter cochlear implant registry (2019–2025)

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Background: In cochlear implantation, surgical approach, intraoperative findings, and electrode selection are central to counseling and early postoperative expectations. Multicenter real-world data can contextualize contemporary practice and early outcomes in routine care.

Aim: To characterize cochlear implantation practices across multiple centers, focusing on surgical approach, intraoperative findings, and electrode utilization, and to describe early postoperative audiometric outcomes and patient-reported outcome (PRO) measures in routine clinical care.

Material and methods: Descriptive analysis of consecutive cochlear implant (CI) surgeries performed between December/2019 and March/2025 across participating centers. Data are reported as n [%] and median (Q1–Q3). Exploratory comparisons used the chi-square test.

Results: A total of 1.627 CI surgeries were included; 60.4% were aged ≥11 years, and 39.6% were aged ≤10 years. Implantation was right-sided in 52.1% and left-sided in 47.9%. Residual hearing was documented in 6.3%, and normal inner-ear structures in 90.0%. Facial nerve monitoring was used in 54.0%. Cochlear access was predominantly via the round window (69.5%) and extended round window (21.3%), totaling 90.8%; cochleostomy accounted for 7.6%. Electrode placement was reported as satisfactory in 96.2%, and 94.7% of cases had no atypical intraoperative impedance measurements. Perioperative corticosteroids were administered in 65.8%. Electrode utilization was dominated by two models: 622 (39.6%) and 632 (27.7%). Among available measurements, open-field pure-tone average (PTA; 0.5/1/2/4 kHz) was 31.3 dB HL (26.3–37.5) at 3 months and 28.8 dB HL (26.3–36.3) at 12 months, consistent with clinically meaningful early access to sound in routine follow-up. Patient-reported outcome (PRO) capture remained a key practical challenge: COSI assessments were available for 36.6% of cases, and PRO completeness differed significantly across high-volume centers (χ^2, $p < 0.001$), indicating variability in postoperative workflows rather than isolated patient factors.

Conclusions: Across centers, cochlear implantation was characterized by predominant round-window approaches, high

rates of satisfactory electrode placement, and stable intraoperative profiles. Early open-field audiometric outcomes among available measurements were favorable. Marked variability in PRO capture across high-volume centers highlights an immediate, clinically relevant opportunity to standardize postoperative pathways and documentation, thereby strengthening routine outcome monitoring and cross-center comparability.

Free paper 0516

Clinical longterm results of a flexible dexamethasone--eluting cochlear implant electrode

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Introduction: Cochlear implantation should be minimally invasive to preserve cochlear structures, aiming for optimal outcomes with the cochlear implant. Flexible electrodes of different lengths allow hearing preservation today. By optimizing surgical technique and applying drugs intracochlear, the immune reaction can be reduced, supporting preservation of intracochlear structures and potentially allowing for regeneration.

Objectives: The current electrode design is augmented with dexamethasone to achieve a prolonged drug exposure along the scala tympani, dampening the immune reaction after cochlear implantation and supporting hearing preservation.

Material and methods: In a first-in-human study, nine patients with residual hearing received a cochlear implant with a dexamethasone-eluting electrode (FLEX28 DEX). Safety, electrode impedance, unaided pre-and postoperative hearing thresholds, speech intelligibility in noise, and surgeon's feedback were evaluated up to 9 months post activation. Patients' impedances and hearing thresholds were followed-up in clinical routine up to 24 months.

Results: Surgeons found handling and insertion properties of FLEX28 DEX identical to non-eluting FLEX28. No serious device or procedure-related adverse events occurred. Study results (9 months post activation) showed low and stable impedance values and good hearing preservation (pre- to postoperative hearing loss <15 dB) in most patients. Up to 24 months, impedance values of FLEX28 DEX increased slightly but remained lower compared to regular FLEX28. Patients with FLEX28 DEX showed stable hearing preservation up to 24 months post activation and good hearing preservation was achieved in half of the patients.

Conclusions: The use of FLEX28 DEX was safe and showed better hearing preservation compared to non-eluting FLEX28 up to 24 months post activation. Patients with residual hearing should be treated with FLEX28 DEX to further investigate and achieve hearing preservation for EAS.

Free paper 0620

Clinical outcomes of the Acclaim fully implanted cochlear implant

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The Acclaim® Fully Implantable Cochlear Implant (FICI) utilizes a piezoelectric sensor to harvest sound from the natural mechanical vibrations of the ossicles, effectively using the ear's own anatomy as a microphone. Unlike traditional systems with post-auricular processors, this device is powered by an internally implanted battery positioned in the chest, connected to the internal processor via a subcutaneous lead. This presentation details the clinical and technical results from the investigation of the Acclaim® Fully Implantable Cochlear Implant (FICI). We will provide a comprehensive analysis of the system's internal architecture, specifically focusing on the piezoelectric sensor calibration and the resulting system gain achieved by utilizing the middle ear's natural acoustics. Data regarding electrode impedances and the speech coding strategy parameters will be presented. Furthermore, we will evaluate the speech perception outcomes – including CNC word and AzBio sentence scores. These results offer critical insight into the efficacy of a 24/7 hearing solution and its ability to restore hearing for patients with varying degrees of hearing loss.

Free paper 0049

Clinical outcomes of unilateral cochlear implantation in children with hearing loss and common cavity inner ear malformation

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Objective: The aim of this study was to observe the clinical characteristics of cochlear implant mapping and postoperative aural rehabilitation performance in children with common cavity deformity (CCD) and Nurotron cochlear implants.

Material and methods: It was a retrospective study including a group of 10 pediatric recipients who was diagnosed with common cavity deformity through the preoperative imageological examination and a control group of 10 pediatric recipients who had similar basic clinical conditions but normal cochlear structures.

Results: T and C level of each electrode in the CCD group were higher than that of the control group at 3 months after swich-on and 6 months after swich-on ($P < 0.05$); meanwhile, the dynamic range of two groups showed no statistical significance ($P > 0.05$). At the same time, both T and C levels in CCD group at the time of 6 months after swich-on were significantly higher than at swich-on ($P < 0.05$), while the dynamic range of the two time points showed no significant difference ($P > 0.05$). Similarly, C level and dynamic range in control group at the time of 6 months after swich-on were

higher than that at swich-on ($P < 0.05$), while T level of the two time points showed no significant difference ($P > 0.05$). At 6 months after swich-on, the scores of CAP in CCD group were significant lower than that in control group($P < 0.05$), the scores of SIR in CCD group were lower than that in control group, but the difference was no significant ($P = 0.296$). However, both CAP and SIR scores in two groups at the time point of 6 months after swich-on were significantly higher than that at swich-on ($P < 0.05$).

Conclusions: Aural rehabilitation performance of the deaf children with common cavity malformation and Nurotron cochlear implant was poorer than that of children with normal cochlear structure, and higher T and C levels were needed in mapping. But there was still a significant progress in aural rehabilitation, hearing and speech performances in recipients with CCD at 6 months after swich-on. Nurotron cochlear implant was suitable for children with hearing loss and common cavity malformation.

Free paper 0136

Cochlea anatomic variation influences hearing preservation following cochlear implantation

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Variability in cochlear size is present between and within ears of patients receiving cochlear implants. This may influence interaction of a cochlear implant with the boundaries of the scala tympani such that a smaller cochlea could have a higher risk of low frequency hearing loss when a cochlear implant is placed. Alternatively (or in addition to), hydraulic forces could be much greater for a smaller cochlea as well. To help determine if anatomic differences between cochlea influence hearing preservation, 42 adult subjects with unaided thresholds ≤45 dB hearing level [dB HL] at 250 Hz were implanted with lateral wall electrodes of variable length (24, 28 and 31.5 mm). Pre-operative computed tomography (CT) scans were automatically segmented using deep learning to determine cochlear duct length (CDL), scala tympani (ST) volume and cross-sectional measurements at the most apical electrode (scala tympani height, width, diameter and cross-sectional area). Pre- and post-operative CTs were aligned to determine electrode contact position and angular insertion depth (AID). Low frequency pure tone average (LFPTA) change was calculated from unaided thresholds at 125, 250, and 500 Hz, preoperatively, at activation, and 6 months following surgery. A linear mixed model was performed to evaluate the influence of non-anatomic and anatomic variables on LFPTA change. This model demonstrated significant effects of non-anatomic variables including age ($p = 0.05$) and gender ($p = 0.01$). Interval ($p = 0.26$) did not affect LFPTA change, suggesting that progressive hearing loss after implantation is uncommon when accounting for anatomic variables. Of the anatomic variables, only scala tympani volume demonstrated a significant effect ($p = 0.005$). Metrics computed at the apical electrode including scala tympani height ($p = 0.71$), width ($p = 0.65$), diameter ($p = 0.56$) and cross-sectional area ($p = 0.14$), as well as CDL ($p = 0.80$) and AID ($p = 0.40$) did not significantly affect change in LFPTA. Together these data suggest that hearing preservation may be less affected by interactions of the electrode with the local environment of the walls of the cochlea, it may be more affected by the overall volume of the cochlea which suggests other indirect mechanisms of trauma such as hydraulic pressure as the electrode is inserted may predominate.

Free paper 0480

Cochlear and bone conduction implants in asymmetric hearing loss and single-sided deafness: Effects on localization, speech in noise, and quality of life

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Introduction: Single-sided deafness (SSD) and asymmetric hearing loss (AHL) impair spatial hearing and speech perception, often reducing quality of life. Cochlear implants (CIs) and bone conduction implants (BCIs) are rehabilitation options used in SSD and AHL to improve auditory perception and support functional integration in daily life. Objective: We aimed to evaluate hearing outcomes after auditory implantation in SSD and AHL patients, focusing on localization accuracy, speech-in-noise understanding, and perceived benefit.

Material and methods: In this longitudinal observational study, 37 patients (adults and children) received a CI or a BCI according to clinical indications. Outcomes included localization and spatial speech-in-noise assessment, and SSQ12 scores.

Results: In adult CI users, localization error significantly decreased from 81.9° ± 15.8° to 43.7° ± 13.5° ($p < 0.001$). In children, regardless of the implant type (CI or BCI), localization error improved from 74.3° to 44.8°, indicating a consistent spatial benefit. In adult BCI users, localization error decreased from 74.6° to 69.2°, but the improvement did not reach statistical significance. Tinnitus severity, measured on a 10-point VAS scale, decreased significantly in CI users (mean reduction: 2.8 ± 2.0, $p < 0.001$), while changes in BCI users were small and of limited clinical relevance. SSQ12B/C scores improved in all adult groups, with the largest gains observed in spatial hearing for CI users (2.1 ± 1.2) and in speech understanding for BCI users (1.6 ± 0.9); children reported high benefits across all domains. Head shadow yielded the most consistent benefit across all groups (up to 4.9 dB in adult CI users, 3.8 dB in adult BCI users, and 4.6 dB in children). Although binaural effects were smaller in BCI users, positive gains were observed, especially in pediatric cases. Correlation analysis showed that daily device use positively predicted SSQ12 improvement ($r = 0.57$) while longer deafness duration was associated with poorer localization outcomes ($r = -0.48$).

Conclusions: CIs and BCIs provide measurable benefits in SSD and AHL rehabilitation. Outcomes vary with age, device, and deafness duration, underscoring the need for early intervention and consistent auditory input.

Free paper 0335

Cochlear health in DFNA9

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Introduction: DeaFNess Autosomal 9 (DFNA9) is an autosomal dominant hereditary disorder caused by pathogenic variants in the *COCH* gene. These mutations induce the formation of aggregates that are toxic to the fibrocytes in the extracellular matrix, ultimately leading to degeneration of spiral ganglion neurons (SGNs). An important biomarker for evaluating the health and functioning of the SGNs, is the electrically evoked compound action potential (eCAP).

Material and methods: The aim of this study was is to evaluate the health of the SGNs in CI users with DFNA9 by studying their eCAP responses and impedances. Fifteen DFNA9 patients who received a MED-EL CI and 15 matched control CI subjects were included. Impedances and eCAP thresholds, amplitudes and AGF slopes were compared between both groups.

Results: The first results, regarding the difference in impedance between DFNA9 and non-DFNA9 patients, show a significant interaction between time and group in the middle and basal electrodes, indicating that electrode impedances were similar in the early phase after implantation between the two groups, but increased significantly more for the DFNA9 group up to one year after implantation. Secondly, the results show that the success rate to record eCAP responses is lower in the DNFA9 group: eCAPs were detectable in 75.5% of the intraoperative measurements (145/192) in comparison to 96.9% (186/192) in the group without DFNA9. ECAP absence in the DFNA9 group was observed across the entire electrode array, but more pronounced in the basal region (channels 11 and 12). Additionally, comparing the parameters of the AGF, the maximum eCAP amplitude was consistently smaller and the AGF slope consistently shallower for the DFNA9 group compared to the control group throughout the electrode array. Finally, the eCAP thresholds in patients with DFNA9 were higher compared to those in the control patients for all cochlear locations.

Conclusions: The results of this study reveal that both impedances and advanced eCAP measures consistently suggest a reduced excitability and neuronal health in our DFNA9 population. The increased impedances are likely to result from intrascalar aggregate and fibrosis formation seen in DNFA9, whereas the DNFA9 eCAP responses point towards the accelerated neural degeneration.

Free paper 0460

Cochlear implant failures: Our experience of explantations and re-implantations since 2003

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Introduction: Device failure occurs when the device characteristics fall outside the manufacturer's specification and/or result in a loss of clinical benefit. Failure of a cochlear implant may also be due to medical reasons such as infection. The incidence of failures from the published literature ranges from 3.6% to 13%. The purpose of this study was to identify the causes and evaluate the risk factors for cochlear implant failures and review explantations and reimplantations at our institution over the last twenty-three years.

Material and methods: A retrospective review of consecutive patients who underwent cochlea explantation with or without reimplantation at our institution between January 2003 and December 2025 was undertaken. In each case, the indication for explant/reimplantation was established. Subanalysis was conducted for adult and paediatric cohorts and by device manufacturer.

Results: A total of 177 patients were explanted over the study period. The overall failure rate was 8.5%, but this reduces to < 5% if Advanced Bionics V1 failures are excluded. This is in line with similar high volume institutions in the literature. 123 patients (69.5%) required explantation and reimplantation due to device (mechanical, hard or soft) failure. Infection ($n = 15$) and skin breakdown ($n = 6$) were the two most common medical causes for explantation. Rates of reimplantation in the paediatric (6.6%) and adult (6.9%) population were similar. However, among paediatric patients, mechanical device failure was proportionately higher (85%) compared with adult patients (62%). Explant rates were significantly different between manufacturers, with highest explant rates for devices manufactured by Advanced Bionics, skewed by the V1 failures cohort. Of note, in recent years there has been an increase in extrusions requiring revision surgery in particular for HiFocus™ SlimJ electrodes.

Conclusions: Cochlear implantation is a safe and reliable procedure in adults and children with low overall failure rates. Understanding the aetiological factors that predispose to explantation may guide pre-operative patient counselling of risk, surgical technique and device selection as well as post-operative care. Early identification of failing implants and appropriate support for patients and families requiring explantation is crucial due to the major impact a failing/ failed device may have on patients.

Free paper 0266

Cochlear implant stimulation and preserved high-frequency hearing in a case series of partial deafness: Possible expansion of CI candidacy

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Objective: New electrodes of novel designs and varying lengths have shown particular success in patients with high-frequency hearing loss (a "ski-slope" audiogram). However, in clinical practice, we have also observed another subgroup of patients whose preoperative hearing thresholds do not meet the audiometric criteria for partial deafness treatment (PDT). These patients retain residual hearing across low, mid, and high frequencies. Despite this broad range of hearing sensitivity, they do not achieve significant word recognition benefit from hearing aids. The aim of this study is to assess hearing preservation and the effectiveness of cochlear implantation in this new group of partial deafness patients.

Material and methods: Twelve patients aged 37–77 with preoperative thresholds of 80 dB HL or better at 125–1500 Hz and 70 dB HL or better at 2000–8000 Hz underwent unilateral cochlear implantation. Pure-tone audiometry (125–8000 Hz) was performed preoperatively and at 1, 12, and 24 months postoperatively. Overall hearing preservation (HP) was calculated using the HEARRING group formula, with additional separate analyses for low-frequency (0.125–1.5 kHz) and high-frequency (2–8 kHz) ranges. Word recognition scores (WRS) were evaluated in free-field using a monosyllabic word test preoperatively and at 12 and 24 months after implantation.

Results: One month after implantation, 84% of patients achieved complete or partial HP. Preservation was most successful in the high-frequency range, where 50% of patients achieved complete HP, compared to only 25% in the low-frequency range. A gradual deterioration in hearing thresholds was observed over time. At 24 months, mean WRS improved by 65 percentage points in quiet and 51 percentage points in noise relative to preoperative hearing aid performance.

Conclusions: The results demonstrate that functional residual hearing in the basal cochlea can be preserved following CI surgery, even in the region most susceptible to insertion trauma. The presence of functional high-frequency hearing should not be a primary reason to withhold cochlear implantation, particularly when hearing aids provide insufficient benefit.

Free paper 0653

Cochlear implantation in adults: Indian scenario – Insights and learning lessons

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Introduction: Hearing loss is a growing global burden, affecting 1.4 billion people worldwide (18.7% of the population) by 2017 and ranking as the third leading cause of disability. In India alone, disabling hearing loss rose from 76.5 million in 2008 to 100 million in 2018. While cochlear implants (CI) are well-established in pediatric care, adult implantation remains limited, largely due to lack of coverage, awareness, and referral pathways.

Objectives: To analyze adult CI outcomes within India, identify demographic and clinical trends, and compare adult vs pediatric surgical and rehabilitation demands.

Material and methods: A multicenter retrospective review of 1,104 CI procedures (January 2010 – January 2024) across four Indian centers identified 81 post-lingual adults (age ≥18) with ≥1 year follow-up. Demographic data, etiological factors, hearing aid use, and socio-economic status (Kuppuswamy scale) were analyzed. Outcomes were measured via speech discrimination scores (SDS) in quiet and noise at 3, 6, and 12 months; tinnitus and vestibular sequelae; and surgical complications.

Results: Patients ranged from 18 to 83 years (mean 52 years); 49.3% were from higher socio-economic strata ($p < 0.05$). Leading etiologies included idiopathic/post-viral (16%), presbycusis (14%), and meningitis (12%). While 78% had used hearing aids for >1 year, 22% received CIs after shorter or inconsistent trials, typically due to acute or progressive hearing loss (e.g. meningitis, sudden SNHL). Post operative improvements were substantial: mean SDS in quiet rose from 10.2% pre-operatively to 75.6% at 12 months; in noise, from 8.5% to 73.8% ($p < 0.001$). Tinnitus resolved or significantly improved in 95% of sufferers (mean THI fell from 54.1 to 12.6; Cohen's $d = 4.19$, $p < 0.0001$). Major surgical complications were rare (one grade 3 facial paresis, one implant-site infection); minor symptoms like taste alteration and post-auricular numbness were self limited.

Conclusions: Adult cochlear implantation in India is safe and yields meaningful auditory, communicative, and quality-of-life benefits. Rapid adoption is seen since 2020, though adults remain underrepresented (only 8.4% of total CIs). Broader inclusion of adults in national programs, increased clinician awareness, and optimized surgical and rehabilitation strategies are essential to meeting India's burgeoning adult hearing loss burden.

Free paper 0478

Cochlear implantation in anomalous inner ear anatomy: Surgical challenges and clinical outcomes

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Introduction: Cochlear implantation (CI) in children with inner ear malformations presents unique surgical challenges, including intraoperative cerebrospinal fluid (CSF) leaks and anatomical variations that may complicate electrode placement. Awareness of these potential difficulties during preoperative planning, intraoperative management, and postoperative follow-up is critical for optimizing outcomes.

Material and methods: We conducted a 5-year retrospective review of 492 cochlear implant procedures performed at our institute, identifying 64 patients with documented inner ear anomalies. Intraoperative challenges, including CSF leaks and anatomical variations, were recorded. Auditory and speech performance were evaluated one year post-implantation using standardized outcome measures.

Results: CSF leakage occurred in 50 patients (78.1%), with 32 patients (50%) experiencing significant CSF gushers requiring additional intraoperative management. Three patients necessitated subtotal petrosectomy for control of persistent CSF leaks. An aberrant facial nerve course was observed in one patient with an incomplete partition type I malformation. Overall, postoperative auditory and speech outcomes improved across all malformation types, with particularly favorable results in patients with incomplete partition type II deformities and enlarged vestibular aqueducts.

Conclusions: Inner ear malformations are present in approximately 20% of pediatric cochlear implant candidates. Successful implantation in this population requires careful preoperative anatomical assessment and readiness to modify standard surgical techniques. Despite these challenges, cochlear implantation provides substantial auditory and speech benefits in children with cochleovestibular anomalies.

Free paper 0727

Cochlear implantation in patients with chronic otitis media: Our experience

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Introduction: Chronic otitis media can lead to profound hearing loss or deafness. Patients who lose their hearing after acquiring language may be candidates for cochlear implants, but they need specialized care.

Objective: To evaluate the surgical technique and complications of mastoidectomy in cochlear implant candidates who have chronic otitis media.

Material and methods: A retrospective review was conducted at the CDA Cochlear Implant Centre. The study included 11 patients (10 men, 1 woman; ages 20–70) who met criteria for cochlear implantation and had active or past chronic otitis media. All underwent mastoid surgery with either immediate or staged implant placement.

Results: All 11 patients received their implants in two stages. Follow-up ranged from 1 to 8 years, with no complications or recurrence of cholesteatoma reported.

Conclusions: Cochlear implant recipients with chronic otitis media need individualized and thorough management. Closing the external ear canal after a prior meatoplasty can be difficult and requires careful handling of skin flaps. When cholesteatoma is extensive, discharge is persistent with resistant bacteria, or the ear is unstable, a staged approach is advisable. Preserving residual hearing is unlikely in these cases.

Free paper 0617

Cochlear implantation in patients with incomplete partition type 2 and enlarged vestibular aqueduct related to SLC26A4 status

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Introduction: Enlarged vestibular aqueduct (EVA) and incomplete partition type 2 (IP2) are common inner ear malformations associated with progressive or fluctuating sensorineural hearing loss that may lead to cochlear implantation (CI). Pathogenic variants in SLC26A4 represent the major genetic cause of this phenotype. While biallelic SLC26A4 variants (M2) confirm a monogenic diagnosis, monoallelic (M1) or negative (M0) findings, including cases with the CEVA haplotype, remain diagnostically inconclusive. However, data on CI utilization stratified by detailed molecular subgroups remain limited.

Material and methods: Forty-six patients with radiologically confirmed IP2 and/or EVA were retrospectively analyzed. Based on SLC26A4 genetic testing, patients were classified as M0 ($n = 15$), M0+CEVA ($n = 1$), M1 ($n = 3$), M1+CEVA ($n = 10$), and M2 ($n = 17$). Data on hearing CI usage were collected and categorized as unilateral, bilateral CI, or no CI.

Results: Cochlear implantation was performed in 15 of 17 patients (88%) in the M2 group (10 unilateral, 5 bilateral), with only 2 patients (12%) without CI. In the M1+CEVA group, 5 of 10 patients (50%) received CI (3 unilateral, 2 bilateral). Among M0 patients, 6 of 15 (40%) underwent CI (2 unilateral, 4 bilateral), while 9 (60%) did not receive CI. The single M0+CEVA patient did not undergo CI. In the M1 group, 1 of 3 patients (33%) received bilateral CI.

Conclusions: Patients with confirmed biallelic SLC26A4 variants (M2) most frequently required cochlear implantation, consistent with the clinical severity of this monogenic condition. In contrast, individuals with monoallelic variants or without SLC26A4 variants showed lower CI rates. Genetic confirmation of SLC26A4-related disease provides important information for clinical counseling and therapeutic planning in patients with IP2 and EVA.

Free paper 0225

Cochlear implantation outcomes in patients with far-advanced otosclerosis

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Introduction: Otosclerosis may involve the cochlea and lead to progressive sensorineural hearing loss. Cochlear implantation (CI) represents an effective option for hearing rehabilitation in these patients. However, CI in otosclerotic cases might show difficulties such as challenging scala tympani insertion or facial nerve stimulation due to transotic conduction from the electrode bundle. The aim of this retrospective study was to evaluate perioperative difficulties and hearing outcomes in patients with far-advanced otosclerosis (FAO) undergoing cochlear implantation.

Material and methods: A retrospective analysis was performed on 29 implanted ears in 24 patients who underwent cochlear implantation for hearing loss due to FAO at the Department of Otorhinolaryngology, Head and Neck Surgery, First Faculty of Medicine, Charles University and Motol University Hospital, Prague, between 2015 and 2024. Perioperative electrode insertion difficulties, electrode position, postoperative complications, and audiological outcomes were assessed.

Results: Improved hearing outcomes, reflected by better mean pure-tone average and speech intelligibility scores, were observed in more than 90% of patients. The severity of cochlear ossification on preoperative CT and MRI imaging was associated with increased electrode insertion difficulty; nevertheless, full electrode insertion was achieved in over 95% of cases. In five cases, scala vestibuli insertion was required. Neither the presence of cochlear ossification nor the extent of the surgical approach was associated with poorer hearing outcomes. Despite the need for extensive surgical techniques in some cases, permanent severe vestibular dysfunction occurred in only one patient.

Conclusions: Although cochlear implantation in patients with far-advanced otosclerosis is surgically more demanding and may require partial cochlear resection or scala vestibuli insertion, the complication rate remains low and hearing rehabilitation outcomes are favorable in the majority of cases.

Free paper 0448

Cochlear implantation versus auditory brainstem implantation in cochlear nerve dysplasia

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Introduction: Cochlear nerve dysplasia/deficiency (aplasia or hypoplasia) (CND) is a recognized etiology in congenital severe-to-profound sensorineural hearing loss and is associated with variable benefit from cochlear implantation (CI). In patients with preserved cochlear structure on imaging, both CI and auditory brainstem implantation (ABI) are utilized in clinical practice, but cohort-level characterization and standardized comparative analyses remain needed. This study aims to evaluate and compare the baseline clinical and radiological characteristics, and post-operative outcomes among children with CND received CI or ABI.

Material and methods: We retrospectively reviewed pediatric patients with radiologically diagnosed CND managed at a tertiary referral center. The CI cohort included 126 cases performed from April 2006 to March 2025. The ABI cohort included CND patients implanted from April 2020 to March 2025. For ABI, we summarized demographics, implantation laterality, prior CI pathways, follow-up distribution, and imaging phenotypes (cochlear turns and cochlear aperture size). Pre-operative clinical and radiological characteristics, postoperative auditory and speech outcomes were analyzed in both cohorts, including PTA and functional performance scales (CAP-II and SIR). Follow-up data were summarized according to routinely scheduled clinical visits and rehabilitation assessments.

Results: All participants attained improvement of hearing and speech after CI or ABI, while CND-ABI children showed a significantly faster improvement than CI in all assessments. After 2 years of implant, CND-ABI could attained PTA of 37.2 ± 1.9 dB HL and CND-CI was 52.6 ± 22.8 dB HL, and 83.3% CND-ABI children exceeded CAP 5 while only in 28.6% CND-CI children exceeded 5. Meanwhile, in speech intelligibility tests ABI children performed significantly better than CI, which also revealed in SIR scores.

Conclusions: In this large single-center CND cohort, ABI was frequently applied in anatomically CI-feasible inner ears, often after limited benefit from CI. Detailed comparative auditory and speech outcomes are underway and are expected to inform counseling and selection between CI and ABI in CND.

Free paper 0500

Cochlear implantation with a dexamethasone-releasing electrode carrier – A multicentre national study

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Introduction: Preclinical and clinical studies on the targeted application of glucocorticoids to the inner ear in conjunction with a cochlear implant (CI) show promising **Results:** inflammatory reactions, fibrosis and foreign body reactions can be significantly reduced, while residual hearing is better preserved. The first-in-human application in nine patients not only confirmed safety, but also showed stable and low impedance values and, in most cases, very good preservation of residual hearing.

Material and methods: As part of a multicentre, national, single-arm clinical study, a MED-EL cochlear implant with a dexamethasone-releasing electrode array (SYNCHRONY 2 FLEX28 DEX) was used. The aim of the study is to evaluate the safety and performance of this innovative medical device. The main criterion is the comparison of speech intelligibility before surgery and six months after surgery. In addition, various electrophysiological and patient-related parameters are being investigated.

Results: Within one year, 62 patients were enrolled in the study as planned and have recently followed up according to protocol. Initial results show a very good safety profile. No serious device-related adverse events occurred. The complete results of the primary and secondary endpoints will be reported after full analysis of the clinical trial data set.

Conclusions: Local drug release in the inner ear in combination with a CI shows great potential for sustainably improving CI care. The ongoing multicentre study with the dexamethasone-releasing electrode carrier has been extremely promising so far and may set a new standard in therapy in the future.

Free paper 0679

Cochlear implantation: The use of OTOPLAN reconstructed images in trajectory identification

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Objectives: This study aimed to define the best electrode trajectory line in cochlear implant (CI) surgery using the OTOPLAN (otology planning software) reconstructed 3D model and to investigate the surgical distance of the retro-facial approach as a direct access to the round window.

Material and methods: Computed tomography (CT) scans of the normal temporal bone were included for analysis in this study. OTOPLAN reconstruction was used to build 3D models with specific ear structures for study analysis.

Results: Twenty-five scans were included; the average age at the time of CT scan was 6.8 ± 12 years. Twelve scans (48%) were right-sided and thirteen (52%) were left-sided. The best trajectory line to the round window was identified in all scans. The retro-facial approach was the optimal approach for 52% of cases (13/25). In all scans, the safe distance from the facial nerve were in favor of the retro-facial approach ($P = 0.0011$).

Conclusions: The OTOPLAN reconstructed imaging provided a good analysis of the retro-facial approach and helped in planning the surgical trajectory line towards the round window. Additionally, calculation of the surgical distance can help the surgeon compare the retro-facial approach to the standard facial recess for preoperative planning. These findings may help in robotic surgery.

Free paper 0203

Cochlear metrics… Anatomy guided science!

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Introduction: Cochlear metrics – including cochlear duct length (CDL), basal turn dimensions (A/B-values), cochlear height (H-value), electrode-to-modiolus distance (EMD), and cochlear nerve cross-sectional area – can influence cochlear implantation outcomes. High-resolution CT/MRI and morphometric analysis now allow individualized electrode selection and optimized insertion strategies. Despite considerable inter-individual variability, incorporating these measurements into preoperative planning can improve surgical accuracy and potentially enhance auditory performance.

Material and methods: Data was collected from prospective clinical cohorts, cadaveric temporal bone assessments,

retrospective morphometric analyses, and large systematic reviews. Our studies included CDL–outcome correlations in prelingually deaf children, EMD differences between cochleostomy and round window insertion in cadaveric bones, and cochlear nerve cross-sectional area correlations with postoperative auditory scores. Additional literature on normative cochlear dimensions and population-based variability was reviewed.

Results: Significant anatomical variability was consistently noted, with CDL ranging approximately 28–36 mm. No significant association was found between CDL or cochlear nerve CSA and early auditory outcomes, indicating that cochlear size alone does not predict performance. Cadaveric analysis demonstrated higher EMD in cochleostomy insertions, with strong correlations to cochlear perimeter and inverse correlations with depth of insertion. Broader studies confirm differences in cochlear morphology across gender, ethnicity, and sensorineural pathology.

Conclusions: Findings support an anatomy-guided approach in cochlear implantation. Detailed preoperative evaluation enables appropriate electrode selection, reduces intra-cochlear trauma, and enhances modiolar proximity. The author's ongoing work – focused on electrode-modiolus distance in CI candidates, round window–IS Joint angulation, and EAC–round window angle – further advances individualized planning and strengthens the shift toward patient-specific cochlear implant customization.

Free paper 0412

Cochlear microphonic latency changes during cochlear implantation support basilar membrane fixation in mid-peak response patterns

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Introduction: Intraoperative electrocochleography (ECochG) enables real-time monitoring of cochlear function during cochlear implantation. Different ECochG amplitude patterns along the electrode array, classified as apical-peak (AP) versus mid-peak (MP) patterns, have been associated with differential hearing preservation outcomes, with MP patterns linked to poorer residual hearing. MP patterns are hypothesised to result from basilar membrane fixation disrupting normal traveling wave propagation. However, amplitude measurements alone cannot distinguish between this mechanism and alternative explanations such as basal hair cell survival. We investigated whether cochlear microphonic (CM) latency measurements could provide mechanistic insight into these distinct ECochG patterns.

Material and methods: Fifty adults with residual low-frequency hearing undergoing cochlear implantation with a lateral wall electrode array (Cochlear Ltd CI522) were included. Intraoperative ECochG was recorded using a 500 Hz stimulus at 100–110 dB HL. Patients were classified as AP (maximum CM amplitude at electrodes 20–22; $n = 31$) or MP (maximum amplitude at electrodes 2–18; $n = 19$). We analysed: (1) CM latency measured at the apical electrode, and (2) CM latency changes during CM drop events. Statistical comparisons used Mann-Whitney U tests and effect sizes (Cohen's d).

Results: Apical electrode latency was significantly longer in AP patients (1.92 ± 0.65 ms) compared with MP patients (1.39 ± 0.55 ms; $p = 0.004$, $d = 0.88$). During CM amplitude fluctuation events, AP patients exhibited latency increases ($+0.13 \pm 0.17$ ms), whilst MP patients typically showed significantly lower latency changes, often latency decreases (-0.06 ± 0.21 ms) ($p = 0.001$, $d = 1.03$). The mean latency change in AP patients was significantly different from zero ($p < 0.001$), whereas MP patients showed no significant deviation from zero. The AP-MP latency difference was most pronounced in patients without CM drops.

Conclusions: These findings are consistent with the hypothesis that MP patterns reflect disrupted traveling wave propagation, likely due to basilar membrane fixation. In AP patients, longer latencies and latency increases during CM events suggest normal apical wave propagation. In MP patients, shorter latencies and the absence of apical latency shifts indicate the CM response is generated at a fixed, more basal location. CM latency analysis may provide a valuable adjunct to amplitude monitoring for identifying cochlear trauma mechanisms during implantation.

Free paper 0035

Combination of ECAP thresholds and electrode position to explain individual differences in CI speech understanding

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Objective: Speech understanding in cochlear implant (CI) users is strongly influenced by the number and condition of spiral ganglion cells. Electrically evoked compound action potential (ECAP) thresholds provide an objective measure of neural excitability and are routinely collected intraoperatively and during postoperative follow-up. However, ECAP thresholds depend not only on neural integrity but also on electrode position, in particular the distance to the modiolus. Combining ECAP measurements with radiological data on electrode position allows estimation of this distance component, enables inferences about underlying neural structures, and may help explain individual differences in speech understanding.

Material and methods: In this retrospective study, measurements from one implanted ear of 44 postlingually deafened CI patients were analyzed. The cohort included perimodiolar and lateral electrode arrays from the Cochlear Nucleus implant series. Speech understanding was assessed with the Freiburger monosyllabic word test at 65 dB SPL in quiet and the adaptive Oldenburg Sentence Test in an S0N0 configuration. ECAP thresholds and modiolar distances were analyzed per patient using orthogonal regression to characterize

the linear relationship and determine the slope of the threshold–distance function. This patient-specific slope was then used as a predictor in a linear regression model to examine its relationship with speech understanding.

Results: The correlation between ECAP thresholds and distance was statistically significant in 28 of 44 patients, with Spearman's ρ values of up to 0.92. The slope of the threshold–distance function showed a clear association with functional CI outcomes: a steeper function was associated with better CI performance, explaining 12.46% of the variability in speech understanding in quiet at 65 dB SPL ($p = 0.016$) and 8.43% in noise ($p = 0.053$).

Conclusions: Neither ECAP thresholds nor electrode position alone showed a significant relationship with speech understanding, but their combination yielded a weak yet statistically significant association for speech understanding in quiet. Further refinement of the model, particularly through regional cochlear analysis, may better capture inhomogeneous distributions of residual spiral ganglion cells and improve the understanding of CI outcomes.

Free paper 0205

Communication barriers and accessibility of pharmaceutical counseling for patients with hearing loss in community pharmacies: A questionnaire-based study

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Introduction: Hearing loss may significantly affect patients' access to healthcare information and medication safety. Community pharmacists play a key role in providing medication counseling; however, communication barriers may reduce the effectiveness of pharmaceutical care for hearing-impaired individuals.

Material and methods: The aim of the study was to assess communication experiences of patients with hearing loss in community pharmacies, including clarity of pharmacist-provided information, availability of communication aids, and perceived accessibility of pharmacy services. A prospective, non-invasive, anonymous questionnaire-based study was conducted among 41 patients with hearing impairment, including users of cochlear implants, hearing aids, and other hearing implants. The survey consisted of 14 questions and was distributed between March and April 2025.

Results: The largest age group was 18–44 years (43.90%). A substantial majority of respondents (92.7%) reported that they usually do not meet pharmacists who communicate using sign language. Most participants (75.61%) declared that they have an opportunity to ask additional questions during a pharmacy visit. However, 31.6% of respondents stated that pharmacist-provided information was understood only sometimes. Adaptation of medication information to hearing impairment needs was inconsistent: 53.66% reported that adapted information is provided only sometimes, and 24.39% stated that they never receive printed or graphic medication information. Almost 61% reported that pharmacies do not provide information about support options for hearing-impaired individuals.

Conclusions: Although many respondents reported generally positive interactions and opportunities for clarification, significant gaps remain in consistent implementation of accessible communication practices. Wider use of written and visual aids, verification of patient understanding, and improved visibility of support options may enhance medication safety and patient-centered pharmaceutical care.

Free paper 0040

Communication between a pharmacist and a patient with hearing loss in a community pharmacy – Prospective, non-invasive questionnaire study

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Objectives: The primary objective was to assess, based on the results of a questionnaire-based survey, pharmacists' communication skills when interacting with patients experiencing hearing loss of varying severity. The secondary objective was to evaluate pharmacists' knowledge – derived from the collected responses – regarding the risk factors associated with hearing loss, including: comorbidities, pharmacotherapy involving ototoxic medications, patient age.

Material and methods: The study received approval from a bioethics committee. It was a prospective, anonymous, questionnaire-based study conducted among 130 pharmacists. The survey was distributed both online and in person and was targeted at pharmacists employed in community pharmacies. The questionnaire was created using Google Forms and distributed in two formats: printed and as an online form. It contained 19 questions, 18 of which were closed-ended, while the final question was open-ended. Among the 18 closed questions, 14 were single-choice and 4 were multiple-choice. The first group of questions pertained to pharmacists' communication skills. The second group focused on adverse drug reactions related to ototoxicity and pharmacists' knowledge of patient groups at increased risk for hearing loss. The third group addressed educational materials and technologies that facilitate communication with individuals who are hard of hearing. The open-ended Question 18 asked participants to propose solutions to support and improve communication between pharmacists and hard-of-hearing patients in community pharmacy settings.

Results: findings indicate that the majority (52.3%) believe their current training has not adequately prepared them to work with hearing-impaired patients. One-third of respondents emphasized that information on adverse effects impacting hearing should be more clearly highlighted in materials provided by pharmacists, indicating the need for tailored communication regarding drugs with potential ototoxicity. A need for adaptation of educational materials to better suit hearing-impaired patients was also noted. A total of 49.2% of respondents rated their own communication skills with hearing-impaired patients as average, while approximately 28.5% rated them as poor.

Conclusions: Based on the collected data, pharmacists assess their communication skills with hearing-impaired patients as insufficient. Deficiences in education, training and access to materials that facilitate communication with hearing-impaired patients are identified as the main barrier to effective communication.

Free paper 0145

Comparing cochlear implant patient reported quality of life changes between CI array types

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Introduction: Patient-reported quality of life (QOL) is a critical outcome measure in cochlear implantation (CI), complementing traditional speech perception metrics, but the contribution of devicecharacteristics, such as electrode array design, array positioning, and manufacturer, remain incompletely understood. Understanding if and how CI device characteristics influence QOL improvement may inform device selection, preoperative counseling, and interpretation of postoperative outcomes.

Material and methods: CI candidates completed the Cochlear Implant Quality of Life-35 (CIQOL-35), a validated psychometric assessment of QOL in adult CI users, before implantation, and at least six months post-implantation. For patients with multiple post-op CIQOL evaluations, the latest value was used. Electrode array type, manufacturer, device usage, and demographics information were obtained from patient records.

Results: Eighteen cochlear implant recipients were included (33.3% male, $n = 6$) with a mean age of 75.3 ± 16.1 years, of whom 55.6% received lateral wall (LW) electrodes ($n = 10$), 44.4% received perimodiolar (PM) electrodes ($n = 8$), with nonsignificant differences in preoperative CIQOL scores (LW: 38.8, PM: 32.0; $p = 0.11$) or time since completion postoperatively (LW: 308.1 days, PM: 356.6 days; $p = 0.6$). Mean CIQOL change showed a significantly lower improvement for LW compared with PM (mean difference –8.4 points, 95% CI: –16.5 to –0.4; adjusted $p = 0.04$) by at least six months post-implantation. Mean usage time was similar amongst both array types (LW: 12.4 hours/day; PM: 12.3 hours/day, $p = 0.93$). Further stratification by manufacturer and specific arrays per manufacturer revealed no significant differences. Demographic factors, including sex and age at implantation, were not significantly associated with CIQOL change (male: 12.6 ± 7.5 points vs female: 9.9 ± 8.8 points, $p = 0.51$; age correlation: $r = –0.14$, $p = 0.6$), and neither was time to CIQOL($r = –0.13$, $p = 0.6$) nor device usage ($r = 0.46$, $p = 0.25$). In this cohort, multiple regression showed that array type had the strongest association ($p = 0.06$) with CIQOL change, whereas age, sex, manufacturer, and CIQOL time were far less.

Conclusions: CI recipients experience meaningful quality of life improvements, with lateral wall or perimodiolar array type emerging as a factor influencing the magnitude of benefit. Electrode manufacturer, demographics, device usage, and follow-up time were not significant predictors.

Free paper 0615

Comparison of titanium clip versus standard fixation for electrode array stabilization in cochlear implantation: A prospective randomized study

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Introduction: Electrode migration is a rare complication following cochlear implantation. It may be associated with non-auditory stimulation and reduced speech perception. It has been reported mainly in thin, flexible arrays and may result from intracochlear tension caused by involuntary movements of the implant cable. The aim of this study was to compare two different electrode array fixation methods in order to evaluate their impact on electrode stability and auditory performance.

Material and methods: A prospective, randomized, single-blind study was performed. Every adult patient received the same kind of cochlear implant (MED-EL Synchrony Mi1210+ FLEX28). All patients underwent the same standard surgical procedure, consisting of a mastoidectomy and a facial recess approach. Participants were randomly assigned to one of two groups. The control group underwent a standard electrode fixation technique using muscle and fibrin glue, while the intervention group received a MED-EL titanium clip to secure the electrode guide in the facial recess. A postoperative CT scan was performed in all patients. All participants were followed for a minimum of two years, including regular device programming sessions and audiometric evaluations.

Results: Between December 2020 and January 2024, a total of 40 patients undergoing cochlear implantation consented to participate in the study, and were evenly assigned to each group. The mean age was 54 (18–85) years in the control group and 48 (26–84) years in the clip group. No significant differences were observed in the number of active electrodes at initial activation or at the last follow-up visit between both groups ($p \geq 0.05$). Audiological outcomes were comparable between groups, with mean pure-tone thresholds of 38 and 34 dB and speech discrimination scores of 57% and 60% at 65 dB for the control and clip group ($p \geq 0.05$). However, one patient in the non-clip group (2.5%) required revision surgery

due to a decline in auditory performance and radiological confirmation of electrode migration (exact p-value = 0.5).

Conclusions: Although electrode migration is an infrequent complication after cochlear implantation, the intraoperative placement of a titanium clip to secure the electrode array is a simple, reliable, and reproducible technique that may help minimize the risk of postoperative displacement.

Free paper 0676

Comprehensive assessment of cochlear health in DFNA9 patients in relation to cochlear implant outcome

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DFNA9 is an autosomal dominant disorder caused by mutations in the COCH gene, leading to the formation of toxic aggregates damaging several cochlear structures including spiral ganglion neurons (SGNs), and ultimately causing severe hearing loss. In a recent retrospective study we observed poorer neural health in DFNA9 patients undergoing cochlear implantation, as measured with intra-operative electrically evoked compound action potentials (eCAPs), compared to matched controls. Here we present a prospective post-operative study in which we applied an extensive test battery of neural health measures.

Twenty DFNA9 patients and an equal number of closely matched controls were invited to participate in a ~2 hour post-operative session. All patients had a MED-EL cochlear implant (CI) for at least 6 months. eCAPs were recorded with alternating polarity using MAESTRO's clinical AutoART software, and with a forward-masking paradigm using MAESTRO-based research software (MED-EL GmbH, Innsbruck, Austria). Multiple eCAP measures including amplitude, slope, threshold and latency were considered, as well as their inter-phase gap (IPG) effects. Electrocochleography (ECochG) and complex impedance measurements were performed with separate research tools provided by MED-EL. Spectrotemporal ripple discrimination was tested using SMRT software. Finally, pre-operative audiograms and speech tests in silence and in noise at time of testing were compared against these measures of cochlear health.

Preliminary results suggest poorer cochlear health scores for DFNA9 patients compared to controls. To this end, IPG effects were more discriminative than absolute eCAP measures, and additionally they predicted speech performance better. Speech perception both in silence and in noise was slightly worse in DFNA9 patients. Observed differences in ECochG measures and impedance will be presented, as well as their possible influence on neural health measures and hearing outcome.

Free paper 0642

Contraindications for cochlear implants in children with poor auditory performance with hearing aids: When and why?

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Introduction: Cochlear implantation (CI) outcomes in Brazil's public healthcare system remain inferior to those reported in developed countries, with only approximately 36% of implanted children using oral language as their primary mode of communication. The absence of standardized pre-operative protocols addressing behavioral, socioeconomic, and family adherence factors may partially explain these results. Over the past two years, a comprehensive pre-CI evaluation program was implemented to improve candidate selection beyond audiological criteria alone. This study aimed to identify patients with audiological indications deemed unsuitable for CI and to analyze the reasons for contraindication.

Material and methods: A retrospective cohort study was conducted reviewing medical records and audiological assessments of 297 pediatric patients (under 12 years) evaluated for CI between January 2023 and December 2025 at Hospital de Clínicas de Porto Alegre. All patients underwent multidisciplinary assessment, including speech therapy, social work, and psychological evaluation to determine surgical eligibility. Variables analyzed included age at first consultation, etiology of hearing loss, and time to surgery. Patients deemed unsuitable were classified into five categories: social, technical, neurological, follow-up-related, and low adherence to pre-implant therapies.

Results: Of 297 evaluated patients, 68 (22.9%) met audiological criteria for CI. Among these, 35 (51.5%) underwent implantation, 17 (25.0%) were contraindicated, and 16 (23.5%) remained under evaluation. Mean age at implantation was 20.94 months, with a mean time to surgery of 5.94 months. Patients deemed unsuitable presented a significantly higher mean age of 35 months compared to implanted patients (difference: 14.06 months; 95% CI: –25.23 to –2.88; $p = 0.015$). Contraindications were attributed to low adherence to pre-implant therapies in 7 patients (41.2%), social factors in 4 (23.5%), loss to follow-up in 4 (23.5%), and neurological conditions in 2 (11.8%). No technical contraindications were identified.

Conclusions: CI candidacy assessment must extend beyond audiological thresholds to incorporate socioeconomic context, family support networks, and adherence capacity. Multidisciplinary evaluation is essential to optimize outcomes and ensure equitable, cost-effective use of cochlear implantation within public healthcare systems.

Free paper 0383

Conventional impedance fluctuations in Slim Modiolar Electrode arrays

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Introduction: Prior studies demonstrated that impedance spikes (≥4 kΩ) in lateral wall cochlear implant electrodes (EA22) strongly predict complete hearing loss (90% of patients) and vestibular symptoms (70%). Whether these biomarker relationships translate to slim-modiolar electrode designs remains unknown. Here, we investigated impedance patterns and their relationship to hearing preservation, speech perception, and vestibular outcomes in EA32 slim-modiolar cochlear implant recipients with pre-operative low frequency average better than 85 dB HL.

Material and methods: Retrospective analysis of 100 adult EA32 recipients with conventional clinical impedance monitoring. Maximum impedance spikes were calculated from baseline (4 weeks post-activation). Outcomes included: complete hearing loss (≥110 dB HL at 12 months), speech perception in noise (BKB-SIN scores), and the presence of post-operative vestibular symptoms. Robust linear regression assessed speech outcomes controlling for age, baseline impedance, pre-operative hearing, and time to test.

Results: EA32 demonstrated different impedance dynamics compared to lateral wall electrodes. Mean maximum spike amplitude was 1.30 ± 1.56 kΩ (median 0.85 kΩ, range −−0.12 to 6.49 kΩ), 5.4-fold smaller than CI422/522 (7.0 kΩ). Only 8% of patients met the traditional ≥4 kΩ threshold versus 14–17% in prior studies. A ROC for hearing loss and spike amplitude suggested an optimal spike threshold of 1.27 kΩ. Unlike lateral wall electrodes, impedance spikes showed no predictive relationship with complete hearing loss at 12 months (28.6%, 2/7 complete loss versus 48.1%, 37/77 in non-spike patients). There was no relationship between spike patients and non-spike patients in hearing preservation at any frequency. Speech perception showed modest degradation in spike patients. Robust linear regression revealed high spikes (≥1.27 kΩ) associated with 1.91 dB SNR worse BKB-SIN scores (SE = 0.84, $p = 0.026$), after controlling for pre-operative performance. Vestibular symptoms trended higher in spike patients (63.3% vs 42.9%, OR = 2.30, $p = 0.081$), though this did not reach statistical significance.

Conclusions: Impedance biomarker relationships for lateral wall electrodes do not translate to EA32 slim-modiolar arrays. While spikes modestly predict speech perception degradation and trend toward vestibular symptoms, they do not predict the higher rate of total hearing losses seen with EA22. Biomarker validation is electrode-specific and cannot be assumed to generalize across different cochlear implant designs.

Free paper 0382

Crossover randomized controlled study: Preference for anatomy-based fitting (ABF) over standard mapping of CI processors

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Introduction: Cochlear implants (CIs) enhance hearing for funcional deaf patients, but sound quality remains moderate, particularly in noise and with music. As a significant contributor to this limitation, standard frequency mapping is under discussion, which may distort neural stimulation. Anatomy-based fitting (ABF) personalizes frequency mapping based on electrode position, potentially improving hearing outcomes. This study utilizes naïve CI-users and a randomized crossover design to mitigate the habituation effect in comparing the two methods.

Material and methods: Participants, diagnosed for unilateral or bilateral first-time cochlear implants and meeting specific criteria, were randomized into Standard Map (SMP) or ABF groups. After a three-month familiarization, participants switched mappings for another three months before testing both settings over the subsequent three-months. Speech perception was evaluated using the Freiburg Monosyllables (FMS) test and the Matrix Sentence Test (MST) in varying noise levels. Additionally, the Speech, Spatial and Qualities of Hearing Scale (SSQ) questionnaire assessed subjective hearing quality. The study included participants using various MED-EL devices and electrodes.

Results: Of 77 subjects initially recruited, 54 completed the study, with 23 dropping out for various reasons. The median FMS scores for SMP and ABF were 60.0% and 57.5%, respectively, while MST SRT was 0.40 dB SNR for SMP and 0.70 dB SNR for ABF. Preferred settings indicated that 26 subjects favored ABF, while 12 preferred SMP. The median SSQ score was higher in the ABF group (5.9) compared to the SMP group (4.9). Notably, even the SMP-preferred group showed better performance with ABF settings. Although no significant difference in speech perception scores was found, a substantial preference for ABF emerged, particularly among patients with single-sided deafness. The ABF group achieved consistently higher scores in both settings, suggesting a perception of improved sound quality.

Conclusions: Preliminary findings indicate no significant advantage for ABF in speech perception scores over SMP, but suggest enhanced sound quality and preference for ABF among subjects.

Free paper 0417

Defining clinically meaningful change in speech perception following cochlear implantation: A data-driven approach

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Cochlear implantation (CI) studies have extensively characterized speech perception outcomes and factors associated with postoperative performance over time. However, beyond describing group-level performance, clinically-based speech perception criteria are required to determine whether an individual recipient's performance has improved, remained stable, or declined. To enable more accurate interpretation of patient performance over time, this study aimed to characterize changes in speech perception following CI and to establish data – driven benchmarks for clinically significant change in speech perception. A retrospective analysis was conducted on 85 adult CI recipients (97 ears; mean age at implantation 51.5 ± 18.1 years) implanted between 2012 and 2023. Most were female (65%), with unknown hearing loss (HL) etiology (59%) and post-lingual onset (64%). Aided speech perception was evaluated using speech reception thresholds (SRTs) and monosyllabic word and phoneme scores in quiet, with hearing aid pre-implantation and CI – only post-implantation. Data were analyzed in two phases. First, comparing pre- and post-implantation performance showed that, one year after implantation, SRT improved by an average of 51 dB HL, and monosyllabic word and phoneme scores improved by 40% and 46%, respectively. Improvement in word scores correlated positively with duration of CI use, whereas no significant associations were found with age at implantation or HL etiology/onset. Poorer pre-implantation performance was associated with greater gains in both word and phoneme scores. Second, to define clinically significant change, longitudinal speech perception scores (beginning one-year post-implantation) were analyzed, and 95% confidence intervals (95% CIs) for maximum change (the difference between minimum and maximum post-implantation scores) were calculated while accounting for the number of assessments. The mean change was 17.1% (95% CI: 15.2–19.1%) for words and 12.2% (95% CI: 10.4–14.1%) for phonemes. Accordingly, changes exceeding 19.1% for words or 14.1% for phonemes were defined as clinically meaningful. Application of these criteria indicated that in 8.6% of assessment intervals, both word and phoneme scores exhibited clinically significant change, with 62.5% showing improvement and 37.5% decline between two consecutive measurements. These data-driven benchmarks enhance the interpretation of longitudinal CI outcomes, support identification of meaningful individual change, and offer a practical framework for clinical decision-making and personalized rehabilitation interventions.

Free paper 0324

Developing evidence-based guidelines for pediatric cochlear implant care in Latin America: A multidisciplinary consensus

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Cochlear implantation (CI) is an established standard intervention for children with severe-to-profound hearing loss, providing critical opportunities for auditory and language development. Nevertheless, clinical practices vary substantially according to regional, socioeconomic, and healthcare access factors. In Latin America (LATAM), heterogeneous healthcare systems and persistent barriers to advanced hearing technologies pose additional challenges to ensuring timely and equitable pediatric CI care. To develop evidence-based clinical guidelines and recommendations for the management of pediatric CI recipients in LATAM, aiming to promote optimal outcomes and equitable care from hearing screening through rehabilitation. The guideline development process involved collaboration among key stakeholders, including hearing care professionals. Clinical questions addressing pediatric hearing loss management were formulated and structured using the PICO framework. A comprehensive literature review was conducted based on predefined criteria, and evidence quality was assessed using the GRADE methodology. Draft recommendations were developed from the available evidence and submitted to structured voting and public consultation. The process began in May 2024 culminating in publication of the final consensus in February 2025. Initially, 112 key clinical questions were generated across the domains of hearing screening, candidacy, surgery, programming, and rehabilitation in pediatric CI care. Following public consultation with participation from more than 88% of working group members, the number of questions was reduced to 45. All retained questions were reformulated using the PICO framework to support structured literature review and GRADE-based appraisal. From these, 30 draft recommendations were developed and submitted to a second public consultation, with participation exceeding 80% of working group professionals. After incorporation of feedback, the final consensus resulted in 25 recommendations: 3 related to screening, 5 to candidacy, 7 to surgery, 5 to programming, and 5 to rehabilitation. The recommendations reflect regional best practices by integrating multidisciplinary expertise and contextual healthcare realities across LATAM. This consensus provides clear and structured guidance for the care of children with CI in LATAM. By prioritizing early access and appropriate intervention, the recommendations seek to improve auditory, cognitive, and language development outcomes, as well as quality of life, thereby supporting the delivery of equitable, high-quality pediatric cochlear implant care across the region.

Free paper 0455

Development of a community based cochlear implant program to increase patient access: Barriers, opportunities, and hope

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Optimizing and growing a cochlear implant program requires a strategic approach that balances clinical excellence, interdisciplinary collaboration, and proactive identification of barriers to care. As demand for cochlear implantation continues to increase, programs must adapt to ensure high-quality outcomes while supporting sustainable growth. This presentation examines key components of successful cochlear implant program development, with an emphasis on optimizing clinical workflows and expanding access to care. The session will also highlight patient-centered program design, including streamlined evaluation processes, coordinated care models, and targeted outreach initiatives aimed at improving access, engagement, and continuity of care. This presentation will provide clinicians and program leaders with practical strategies to optimize cochlear implant services, support program growth, and reduce barriers to care across diverse healthcare settings.

Free paper 0592

Diagnostic utility of whole exome sequencing in children with profound prelingual hearing loss and impact of genetic background on cochlear implantation outcome

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Hearing loss (HL) affects approximately 466 million people worldwide, and 1–6 per 1000 children are born with severe to profound HL. Cochlear implantation (CI) is the treatment of choice for these patients; however, variability in auditory outcomes persists. The aim of this study was to assess the impact of the genetic background of HL on CI outcomes in children with profound prelingual deafness. The study included 51 children implanted before the age of 2 years. Genomic DNA from patients and selected family members ($n = 105$) was analyzed using whole exome sequencing. Candidate variants were validated by Sanger sequencing, and copy number variants were confirmed using aCGH and qPCR. Auditory development was assessed using the LittlEARS Auditory Questionnaire (LEAQ) at CI activation and 5 and 9 months post-activation. The influence of preoperative hearing aids (HAs) responses and age at implantation was also evaluated. Probably causative genetic variants were identified in 75% (38/51) of patients. Among them, 28% were autosomal dominant, including several *de novo* variants, and approximately 30% (16/54) had not previously been associated with HL. Identified genes were mainly expressed in cochlear structures involved in auditory transduction.

All patients achieved comparable auditory outcomes, with a mean LEAQ score of 27.5 points at 9 months post-CI. A significant difference at CI activation was observed only between patients with broad versus minimal auditory responses in HAs. Auditory development was most dynamic during the first 5 months after implantation. No differences were found between patients with identified and unknown genetic etiologies. Earlier implantation and preoperative auditory responses were the main factors associated with better outcomes, suggesting the influence of additional modifying factors.

Free paper 0667

Does amplification normalize articulatory timing? Preliminary results on voice onset time in pediatric hearing aid users

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Introduction: Hearing aids (HAs) are the preferred method of intervention for children with mild to severe hearing loss, primarily used to support the development of speech and language skills to a level comparable to that of their peers. Acoustic assessments can be used to distinguish speech sounds from one another. Voice onset time (VOT) is the interval between a burst of plosive sound and vocal fold vibration, serving as a reliable acoustic parameter for distinguishing between voiced and voiceless plosives. However, studies directly examining articulatory timing and VOT in pediatric HA users are limited. This study aimed to investigate the speech production characteristics of children using HAs by analyzing their VOT values compared to those of normal-hearing peers.

Material and methods: Fourteen participants aged between 7 and 15 years were included in the study: seven with normal hearing and seven using bilateral HAs. After completing a demographic data form, participants were asked to produce meaningful words beginning with voiced and voiceless plosives. Speech samples were recorded three times and analyzed using the Praat software. The VOT was measured as the time between the transient burst and the onset of vocal fold vibration. Statistical analyses were performed using SPSS. Repeated-measures analysis of variance (ANOVA) and independent samples t-tests were utilized to compare the VOT data across repetitions and between groups, with the statistical significance level set at $p < 0.05$.

Results: Children using HAs exhibited significantly longer VOT values than their normal-hearing peers, particularly for voiced plosive consonants ($p < 0.05$). Differences in VOT for voiceless plosives were less pronounced but still observable. Furthermore, the duration of HA use and the degree of hearing loss were found to significantly impact VOT values,

suggesting altered articulatory timing correlated with auditory feedback levels in this population.

Conclusions: Hearing loss directly affects articulatory timing and speech production. While previous VOT studies have predominantly focused on cochlear implant users, our findings highlight significant deviations in VOT among HA users compared to normal-hearing children. Understanding these differences is crucial for tailoring targeted speech-language therapy and provides valuable baseline acoustic data for comparative studies in the broader auditory implant field.

Free paper 0640

Does preoperative hearing aid use is a predictor of early cochlear implant adherence?

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Introduction: A cochlear implant (CI) is indicated when conventional hearing aids (HA) provide no benefit. This fact discourages many families from using the devices properly before surgery. While some professionals argue that the use of HA may postpone the time for surgery, in our experience, we see it as a marker of commitment to treatment, also making the use of the external component of a cochlear implant after surgery easier. In January 2024, our institution established a multidisciplinary team to conduct comprehensive evaluations of deaf children to improve postoperative outcomes. One of the most important results in children in the first months is the continuous use of CI, so we designed a protocol that emphasised the use of hearing aids until the surgery and the use of datalogging as a treatment commitment parameter. This study aims to evaluate whether preoperative hearing aid usage predicts CI use during early postoperative follow-up visits and to compare outcomes between patients implanted before and after this institutional transition.

Material and methods: Retrospective observational study conducted at a specialised centre in Brazil. The sample comprised 56 children (25 girls, 31 boys) aged 8 months to 12 years (SD = 2.36). A total of 83 implanted ears were analysed (52 right, 31 left), including 29 unilateral and 27 bilateral cases. Daily hearing aid usage time before and after CI activation was collected.

Results: A significant positive correlation was observed between preoperative hearing aid usage and mean CI use during the first three postoperative revisions (Spearman $\rho = 0.6689$, $p < 0.001$). Additionally, a significant difference in mean CI usage was found between implantation groups ($t = -2.5612$, $p = 0.0162$), with a moderate-to-large effect size (Cohen $d = -0.94$), indicating that patients implanted in 2024 or later demonstrated greater CI usage time.

Conclusions: Preoperative hearing aid usage is a significant predictor of cochlear implant adherence during early postoperative follow-up. Patients implanted in 2024 or later demonstrate increased CI usage during initial revisions, suggesting potential improvements in evaluation protocols and patient selection following the implementation of our multidisciplinary team approach.

Free paper 0434

Does the postoperative result on the COSI: Patient-function perception of benefit varies depending on the type of electrode implanted?

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Introduction: Patient-reported outcomes is a key outcome after cochlear implantation and can be captured with the Client Oriented Scale of Improvement (COSI). Electrode design (perimodiolar vs lateral-wall/straight) may influence the listening experience beyond tonal thresholds.

Material and methods: A multicenter real-world study analyzed CI surgeries performed between December 2019 and March 2025. Patient self-perceived benefit was assessed using the COSI, which their priorities are scored from 1 to 5, with scores ≥4 indicating clinically meaningful improvement (better and much better). Based on this, outcomes were dichotomized into two groups: COSI ≥4 and COSI <4. Comparisons were performed between perimodiolar electrodes (PE) vs lateral-wall/straight (LWE), and stratified by COSI age version (children: ≤10 vs adults: ≥11years). Additionally, were analyzed the relationship between COSI and the 12-month pure-tone-average (PTA4; 0.5, 1, 2, and 4 kHz).

Results: The overall cohort included 1,627 cochlear implant recipients. Electrode design distribution was 40.9% ($n = 665$) perimodiolar (CI24RE, 412, 512, 532, 612, and 632) and 59.1% ($n = 962$) lateral-wall/straight electrodes (422, 522, and 622). COSI data were available for 36.6% ($n = 595$) of patients. It was more frequently recorded for lateral-wall/straight than for perimodiolar electrodes (67.4% vs 56.7%; $p < 0.001$), and more often in adults than in children (57.0% vs 43% patients). Despite lower completion rates, perimodiolar electrodes were associated with significantly higher rates of clinically meaningful benefit (COSI ≥4) compared with lateral-wall/straight electrodes (83.2% vs 66.9%; $p < 0.001$). This association remained significant when stratified by age, both in adults (83.7% vs 68.2%; $p = 0.001$) and in children (82.4% vs 65.4%; $p = 0.002$). No significant difference was observed in 12-month-postoperative PTA between perimodiolar and lateral-wall/straight electrodes (30.0 dB HL vs 28.75 dB HL, respectively). However, when PTA and COSI outcomes were analyzed jointly, a significant association emerged between poorer PTA and lower COSI score. Patients reporting COSI ≥4 had a mean PTA4 of 28.75 dB HL, whereas those reporting COSI <4 had a mean PTA4 of 33.75 dB HL ($p < 0.001$),

indicating that higher hearing thresholds were associated with worse perceived outcomes.

Conclusions: Perimodiolar electrodes were consistently associated with greater patient-perceived benefit (COSI ≥4) in both adults- children. Standardizing COSI collection within postoperative follow up is essential to strengthen routine outcome monitoring and interpret electrode-design effects more robustly in everyday practice.

Free paper 0644

Earlier cochlear implantation for children under 24 months of age is associated with a graded improvement in speech performance

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Introduction: There is increasing evidence that cochlear implantation (CI) before 12 months of age is both safe and associated with improved outcomes. However, most of the previous analyses implement a binary analyses of CI pre- and post- 12 months of age, preventing the determination of an optimal age for implantation.

Aim: The primary outcome was to evaluate the safety and efficacy of CI under 24 months, analysing age at implantation as a continuous predictor of outcomes. The secondary outcome is to compare children younger and older than 12 months.

Material and methods: A retrospective cohort study of children implanted before 24 months at a tertiary UK paediatric implant centre between 2000–2020. Exclusion criteria included: patients lost to follow-up, device non-users, sequential implantation, children with considerable complex needs. Outcomes included: Nottingham Auditory Milestones (NAMES), Category of Auditory Performance (CAP), IT-MAIS, communication mode, and surgical complications. Longitudinal modelling using generalized estimating equations assessed the independent effect of age at implantation (continuous variable), adjusting for follow-up duration and operative year.

Results: Ninety-three children were included with 42 implanted between 9–12 months and 51 implanted between 12–24 months. Surgical complication rates were comparably low between groups. In longitudinal modelling, younger age at implantation was independently associated with higher NAMES scores, with a +0.8-point advantage per month earlier implantation ($p = 0.003$). There was no evidence of differential rate of improvement, suggesting a sustained performance advantage rather than accelerated catch-up. Age was not independently associated with longitudinal CAP scores. IT-MAIS improvement showed significance in unadjusted analysis but attenuated after baseline adjustment. Secondary analyses comparing implantation pre- and post- 12 months of age showed that at one-year post-activation, speech-only communication was achieved in 71% of children implanted <12 months versus 55% in those implanted after 12 months. Furthermore, children implanted before 12 months had significantly improved CAP and NAMES scores.

Conclusions: Earlier cochlear implantation confers a continuous, sustained improvement in NAMES score without increased complication rate for children implanted between 9 and 24 months. These results suggest there may be a graded relationship between earlier implantation and speech performance.

Free paper 0082

Early activation in patients with presumed hearing preservation

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The study is a repeated-measure, single-subject experiment. To be included into the study, subjects must have been 18 years or older at the time of implantation and have up to normal hearing in the low frequencies (PTA at 125, 250, 500 Hz better than or equal to 60 dB HL), sloping to severe to profound sensorineural hearing loss in the high frequencies (PTA at 2000, 3000, 4000 Hz >75 dB HL) in the ear to be implanted. Preoperatively, candidates were assessed with their current amplification to evaluate their speech perception using CNC words and AzBio Sentences in noise in the ear to be implanted and everyday listening condition (hearing configuration worn every day). Postoperatively, subjects were scheduled for activation within 3 days following the surgical procedure. To better understand the conductive component associated with middle ear fluid, audiometric and wide-band acoustic immittance was assessed at 1-, 2-, 3-weeks post activation. At 1, 3 and 12 months, audiometric, speech perception, and questionnaire outcomes were assessed. The primary endpoint was the 3-month post-activation visit. The purpose of this study is to obtain preliminary efficacy data associated with cochlear implantation in individuals with low-frequency residual hearing who are next-day activated. The goal of the present research is to inform safety and effectiveness and clinical workflow in the case where a CI recipient has usable low-frequency hearing in the implant ear and desires an early activation.

Free paper 0546

Early auditory development following cochlear implantation in children with comorbidities

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Introduction: Auditory development following early cochlear implantation shows considerable variability across pediatric populations. While children without additional disorders often achieve age-appropriate auditory outcomes, those with comorbidities tend to demonstrate slower developmental trajectories or fail to reach expected milestones. Differences in outcome measures, assessment timing, and small heterogeneous samples further complicate comparisons across studies, highlighting the need for standardized approaches such as LEAQ reference curves. This study evaluates early auditory development in children with cochlear implants who have comorbidities using LittlEARS questionnaire.

Material and methods: The study group consisted of 117 children who received cochlear implants before the age of 2 years (mean age: 15 months; SD = 4), all diagnosed with profound bilateral sensorineural hearing loss and comorbidities. The reference group consisted of 117 children with profound bilateral sensorineural hearing loss and no comorbidities who received cochlear implants at a mean age of 13 months. Auditory development in all children was assessed with the LittlEARS Auditory Questionnaire (LEAQ) at CI activation and at about 1, 5, 9, and 14 months of CI use.

Results: The mean LEAQ total score increased over similar time frame from 5 pts to 24 pts in the study group with comorbidities, and form 8 pts to 33 pts in the reference group with no comorbidities. Nevertheless, significant differences between the groups in LEAQ scores were observed across each time interval.

Conclusions: Our results show that although children with comorbidities improve over time, their level of auditory development remains lower than that of children without comorbidities. This indicates the need for personalized training and targeted support for parents.

Free paper 0464

Early clinical experience with robot-assisted electrode insertion in cochlear implantation using the MED-EL OTOARM-OTODRIVE system

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Introduction: Manual cochlear implant (CI) electrode insertion is surgeon-dependent and associated with force fluctuations that may lead to intracochlear trauma. The MED-EL OTOARM-OTODRIVE system provides motorized control at ultra-slow, consistent speeds. This study describes the institutional experience, surgical workflow integration, and early hearing outcomes using this robotic-assisted system.

Material and methods: We conducted a retrospective descriptive study of 72 consecutive robot-assisted CI cases performed at a Canadian tertiary referral center between January and December 2025. All participants were adults without cochlear malformations undergoing implantation with MED-EL devices. We evaluated feasibility (setup and insertion times), electrode insertion depth via OTOPLAN analysis, and early hearing outcomes (1 and 3 month low frequency postoperative pure tone thresholds).

Results: Robotic setup and alignment added a mean of 374 seconds to the surgical procedure. Electrode insertion was standardized at 0.1 mm/s, with a mean duration of 440 seconds. Postoperative analysis showed a mean angular insertion depth of 573 degrees. No major complications, such as facial nerve palsy or device-related failures, were reported. In patients with residual low-frequency hearing ($n = 20$), 75% demonstrated minimal to excellent hearing preservation at 1 and 3 months follow-up.

Conclusions: Robot-assisted insertion using the MED-EL OTOARM-OTODRIVE system is safe, reproducible, and integrates efficiently into the standard surgical workflow. This expanded cohort, the first of its kind in North America, demonstrates that robotic assistance provides the precision and slow-velocity control necessary to support atraumatic insertion and hearing preservation goals.

Free paper 0497

Early communicative development in children with unilateral hearing loss

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Introduction: Unilateral hearing loss (UHL) accounts for approximately 20–50% of congenital hearing loss cases and is increasingly identified during infancy through universal newborn hearing screening. Although traditionally considered a "mild" condition, growing evidence suggests that children with UHL are at increased risk for speech–language, academic, and socio-emotional difficulties. However, data focusing on the first two years of life remain limited.

Objective: To longitudinally investigate early auditory and communicative development in infants with permanent UHL diagnosed through newborn screening, and to explore the influence of hearing loss severity and clinical variables on developmental outcomes.

Material and methods: A prospective longitudinal study was conducted at the Audiology Unit of the University of Naples "Federico II." Twenty-four infants with permanent UHL (mean age at diagnosis: 8.5 ± 5.0 months) were assessed at two time points (T0: 11.1 ± 3.1 months; T1: 19.7 ± 6.2 months). The cohort included moderate UHL (33.3%) and single-sided deafness (SSD; 66.7%). Auditory and communicative skills were evaluated using standardized age-appropriate tools (ILIP, CAP, IT-MAIS, MUSS, and Italian MacArthur-Bates CDI). Statistical analyses examined longitudinal changes and associations with hearing loss severity, etiology, psychomotor development, and family involvement.

Results: Significant improvement over time was observed in auditory performance measures (ILIP, $p = 0.004$; CAP, $p = 0.001$) and functional speech use (MUSS, $p = 0.0016$). However, at follow-up, 9/22 children (40.9%) demonstrated language performance below age expectations. Hearing loss severity emerged as a significant predictor: SSD was strongly associated with both altered auditory perception ($p = 0.0016$) and language delay ($p = 0.0092$). Psychomotor delay was significantly associated with altered auditory outcomes ($p = 0.007$). Etiology, age at diagnosis, and family involvement did not show significant associations.

Conclusions: Infants with UHL – particularly those with SSD – are at increased risk for early communicative vulnerability despite early diagnosis. These findings support the need for systematic early monitoring and targeted habilitative strategies within the first 24 months of life to mitigate long-term developmental consequences.

Free paper 0482

Early speech development in Romanian children with cochlear implants assessed using the LittlEARS® Early Speech Production Questionnaire (LEESPQ)

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Introduction: Assessing early linguistic development in babies is challenging because spontaneous speech is limited and direct testing often lacks sensitivity or feasibility. In this context, standardized parent-reported questionnaires provide a valuable alternative, capturing linguistic behaviors observed in the home environment. Among these, the LittlEARS® Early Speech Production Questionnaire (LEESPQ) was specifically designed to assess prelinguistic and early linguistic acquisition, covering the first 18 months of auditory experience.

Objectives: The aim of the study was to evaluate the validity, clinical applicability, and developmental sensitivity of the Romanian LEESPQ in children with cochlear implants (CIs), by analyzing its association with age at implantation, duration of auditory experience, and implantation laterality, and by comparing the developmental trajectory with that of normal-hearing (NH) children.

Material and methods: The study assesses the validity, reliability, and clinical sensitivity of the LEESPQ in pediatric cochlear implant users. Furthermore, it investigates the associations between total questionnaire scores and key clinical variables, including implantation laterality (unilateral versus bilateral), age at device activation, and duration of implant use. Forty-seven children with CIs (26 boys, 21 girls) were included, with implantation ages ranging from 9 months to 5 years. Of these, 21 received unilateral implants and 26 bilateral implants. Responses were analyzed both in relation to clinical variables and in comparison with available normative data from NH children, in order to delineate potential differences in linguistic developmental trajectories.

Results: Findings suggest that the LEESPQ is a reliable and clinically valuable instrument for monitoring post-implant linguistic progress. It provides relevant insights into early auditory access, the linguistic environment within the family, and the development of early verbal production. Scores were significantly influenced by age at implantation and duration of auditory experience, confirming the role of early stimulation and neural plasticity in shaping speech development after cochlear implantation.

Conclusions: The LEESPQ demonstrates strong clinical utility as a sensitive tool for monitoring early preverbal and verbal development in children with CIs.

Free paper 0334

ECochG monitoring of manual and OTODRIVE CI insertions

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Introduction: During cochlear implant (CI) surgery, it is our aim to minimize insertion trauma and preserve intracochlear structures and hearing as much as possible. New developments like CI insertion robots can be valuable to further optimize our surgical technique. To better understand the potential benefit on intracochlear structure preservation during implantation by robotic insertion, we conducted a case-control study comparing electrocochleography (ECochG) and electrode impedances during manual and OTODRIVE assisted surgery.

Material and methods: ECochG responses were recorded in more than 35 CI recipients undergoing either manual or OTODRIVE robot-assisted CI surgery led by two experienced surgeons in the same center. The acoustic stimulation to elicit this response was presented via Etymotic ER-3C insert earphones. The earphones were connected to an external acoustic stimulator, which was programmed and triggered by Maestro 9.0.4 based research software (MED-EL GmbH, Innsbruck, Austria). The recordings were performed during electrode insertion. Alternating-polarity ECochG measurements were made continuously as a response to a 12-ms-long chirp at 40 dB above the subject's pre-operative hearing threshold at 500 Hz.

Results: An event-related categorization was performed to distinguish specific patterns within the continuous ECochG and impedance signal. The multifrequency chirp stimulus allows us to follow the tonotopic arrangement throughout the electrode insertion, as seen by rise and subsequent falls in the single frequency components of the stimulus once the electrode contact passed the generator site. Drops in multiple ECochG frequency responses combined with significant impedance changes indicates the electrode array touching and/or impeding the basilar membrane. With this event-related ECochG and impedance categorization a comparison can be made in intracochlear changes between manual and robot assisted CI insertion.

Conclusions: The event-related approach using simultaneous multifrequency ECochG and impedance recording gives the surgeon a better insight in the induced intracochlear changes during insertion. Continuous monitoring can be of true value for optimizing both robot assisted and manual insertion trajectories and therewith minimizing intracochlear damage.

Free paper 0199

Educational trajectories of youth with cochlear implants: Academic performance and challenges

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Introduction: Cochlear implants (CIs) significantly improve access to oral language in children and adolescents with severe-to-profound hearing loss, facilitating inclusion in mainstream education. However, educational outcomes are heterogeneous, influenced by factors such as age at implantation, family support, teaching strategies, and school environment. Understanding these trajectories is essential to inform inclusive educational practices.

Material and methods: This descriptive-exploratory study combined quantitative and qualitative approaches. The sample consisted of 100 youths aged 18–40 years (mean age of 26 years) with CIs from a population of 329, which attended regular (51%) or bilingual (49%) educational settings. Data collection included academic records, student questionnaires, and semi-structured interviews. Quantitative data were analyzed using descriptive statistics, while qualitative responses underwent thematic content analysis.

Results: The sample comprised 47% males and 53% females. Current employment status was 26% students, 16% unemployed, and 58% employed. Educational attainment included 6% basic, 11% secondary, 45% professional, 38% higher education, and 4% master's degrees. Among higher education graduates, 32% studied TIC (information and communication technologies), 18% Management, and 16% Social Sciences/Education. For professional courses, 47% pursued TIC, 16% Social Sciences/Education, and 13% Health and Well-being. Unemployment was higher among those with secondary education (75%), whereas 88% of university graduates were employed in their field of study. Academic challenges primarily involved literacy, written expression, and oral comprehension in noisy environments. Students described auditory fatigue and participation barriers in group activities.

Conclusions: Youth with CIs exhibit generally positive academic outcomes, particularly when implantation occurs early and adequate family and therapeutic support is provided. Nevertheless, challenges persist, particularly in literacy and social integration. Inclusive pedagogical strategies, teacher training, and individualized support are crucial to optimizing educational and occupational trajectories. These findings underscore the need for integrated interventions combining health, education, and family support to enhance both academic success and well-being.

Free paper 0029

Effect of baseline stimulation on vestibular responses in human vestibular implant recipients

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Introduction: Unilateral vestibular implants require baseline stimulation to encode bidirectional head motion. However, baseline activation reduces the dynamic range available for excitation and may affect overall performance. This study evaluated how baseline stimulation influences vestibular responses evoked by electrical modulation in humans.

Material and methods: Ten patients with bilateral vestibulopathy participated in the VertiGO! trial. Each received a vestibulo-cochlear implant with three semicircular canal electrodes. Electrical stimulation was delivered as biphasic pulse trains, either without baseline or with a continuous baseline set at 50% of the individual dynamic range. Eye movements were recorded using video-oculography and quantified as peak eye velocity (PEV) and misalignment angle. Test-retest reliability was excellent (ICC = 0.96 for PEV, 0.82 for angle).

Results: Baseline stimulation did not consistently alter the upper comfort limit. It enabled bidirectional percepts and eye movements but reduced response magnitudes. Excitatory PEVs decreased by 34% compared with stimulation without baseline, while inhibitory PEVs reached only 7% of this maximum. Excitatory responses were eight times stronger than inhibitory responses. Misalignment angles were comparable across conditions, indicating preserved response direction.

Conclusions: Baseline stimulation allows bidirectional encoding but reduces total response capacity. Inhibitory responses remain weak, and overall output is dominated by excitation. For optimal fitting of unilateral vestibular implants, lower baseline levels should be considered to preserve functional response magnitude. Bilateral implantation may ultimately offer superior bidirectional sensitivity without compromising excitatory strength.

Free paper 0248

Effect of cochlear implant electrode array to scala tympani volume ratio on early hearing preservation

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Introduction: Hearing preservation is possible following cochlear implantation; however, the magnitude of preserved hearing remains difficult to predict. The amount of space an electrode array occupies within the scala tympani (ST) may be one variable that influences hearing preservation. This study analyzed the influence of the ratio of the volume of the electrode array to ST volume, in addition to patient variables, on the low frequency hearing preservation for cochlear implant (CI) recipients of straight arrays.

Material and methods: A retrospective review of cochlear anatomy and electrode characteristics was performed for CI recipients with a pre-operative unaided detection threshold ≤45 dB HL at 250 Hz. A linear mixed effects model analyzed the effects of ST volume, ratio of electrode array volume to ST volume, angular insertion depth (AID), age at surgery, and biologic sex on the shift in low frequency pure tone average (LFPTA; 125, 250, 500 Hz) between activation and 6 months post-activation.

Results: For the 45 patients, LFPTA shifts were significantly influenced by ST volume ($p = 0.004$), array volume to ST volume ratio ($p = 0.04$), and sex ($p = 0.02$), with better hearing preservation observed for cases with larger ST volume, smaller array volume to ST volume ratio, and female biological sex. There were no significant main effects of interval ($p = 0.08$), age ($p = 0.07$), or AID ($p = 0.13$).

Conclusions: Patient and device variables including larger ST volume, array volume relative to ST volume, and female biologic sex are variables that should be considered for hearing preservation in cochlear implantation.

Free paper 0524

Effect of electrode array and surgical approach on structure and hearing preservation in cochlear implantation: A randomized controlled trial

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Introduction: To assess the effect of electrode array model, lateral wall and Mid-Scala, and surgical approach, via the round window or cochleostomy on structure and hearing preservation after cochlear implantation surgery.

Material and methods: Forty-eight adults with sensorineural hearing loss receiving a cochlear implant were included between 2020 and 2025 in a tertiary referral center in The Netherlands. Participants were eligible with any degree of residual hearing. According to randomization, participants underwent cochlear implantation of a lateral wall or perimodiolar array via round window or cochleostomy approach. Outcomes were structure preservation based on preoperative high resolution computed tomography and postoperative cone beam computed tomography images and hearing preservation based on pure tone thresholds from before implantation and at six weeks.

Results: 36/48 (75%) of arrays were in the scala tympani. The lateral wall + round window group showed no scalar translocation (0%), both the lateral wall + cochleostomy and perimodiolar + cochleostomy groups showed scalar translocation in 2/12 (17%) and the perimodiolar + round window group showed scalar translocation in 6/12 (50%), with a significant difference between the four interventional groups ($P = 0.02$). Median hearing preservation across participants was 24%, and was similar in all groups (lateral wall + round window: 26%, lateral wall + cochleostomy: 42%, perimodiolar + round window: 22%, perimodiolar + cochleostomy: 6%; $P = 0.23$). Median hearing preservation was similar in all degrees of trauma (no trauma: 18%, potential trauma: 28%, scalar translocation: 16%; $P = 0.49$). Minimal hearing preservation was seen in all degrees of trauma.

Conclusions: The least traumatic insertion is achieved with lateral wall arrays implanted via a direct round window approach. Non-mechanical factors may contribute to the loss of residual hearing.

Free paper 0167

Effect on the recognition of spectral information and phonemes using anatomy-based cochlear implant fitting based on postoperative imaging

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Introduction: Postoperative digital volume tomography imaging enables precise determination of the position of the cochlear implant (CI) electrodes in relation to the tonotopic frequency distribution on the basilar membrane. This information can be used during CI fitting to minimize the frequency-to-place mismatch in the cochlea by assigning the frequency range of each filter bank to the respective electrode contact position. This study examines if the individualized anatomy-based CI-fitting can accelerate the CI rehabilitation process in newly implanted unilateral, bimodal, and single-sided deaf CI users. Speech comprehension based of phoneme-recognition and resolution of spectral information using distinction between consonant and dissonant sounds are investigated. The results are compared with those of individuals with standard CI-fitting and normal-hearing.

Material and methods: At the appointment for processor activation, newly implanted patients receive either anatomy-based or standard CI-fitting in a randomized manner. Over a period of 6 months, patients are examined to assess the development of their speech comprehension. Two weeks after the initial fitting, as well as after 3 and 6 months, all users undergo a test to recognize phonemes and assess their preferences for musical intervals. These tests are also performed on people with normal hearing and compared with the results of the CI users. Bimodal users and people with single-sided deafness also complete a speech test in noise to investigate the potential benefits of anatomy-based fitting in terms of binaural integration and tasks to compare the perception of the acoustic hearing with that of the CI. These tasks comprise pitch recognition as well as a subjective timbre and pitch comparison.

Results: Initial results from the ongoing study indicate an advantage of anatomy-based compared to standard CI-fitting, particularly with regard to the ability to use spectral information for phoneme recognition and the distinction between harmonic and disharmonic sounds.

Conclusions: Anatomy-based fitting is a useful approach for improving comprehension of high-frequency speech components and sound perception in CI patients.

Free paper 0346

Effectiveness of cochlear implants in elderly patients

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The effectiveness of cochlear implants (CIs) in elderly patients, particularly those aged 75 and older, has garnered attention due to the aging population. This study analyzes CI outcomes in patients aged 65 and older who have had their implants for at least two years at Kobe University Hospital. A total of 25 participants were evaluated: 15 in the latter-stage elderly group (aged 75 and over) and 10 in the early-stage elderly group (under 75). The average age of the latter-stage elderly group was 80.2 years, while the average age of the early-stage elderly group was 69 years.

Speech perception was assessed using monosyllables, words, and sentences from the 67-S Speech List and the CI-2004. These results were then compared over time. Results were also noted for cases evaluated three years post-implantation. Initially, the early-stage elderly group performed better in quiet and noisy environments up to the two-year mark. However, by the three-year mark, the latter-stage elderly group had significantly improved speech perception, closing the performance gap between the two groups. Similar trends were observed in word and sentence comprehension.

Among the early-stage elderly group, cases of poor performance were associated with prior depression or difficulties in testing environments, despite adequate conversational abilities in daily life. Most participants aged 65–74 had stable listening abilities one year after implantation. Those aged 75 and older initially had poorer outcomes but showed substantial improvement after two to three years, reaching performance levels comparable to those of younger peers.

These findings underscore the substantial advantages of cochlear implants for elderly patients in early- and latter-stages. Notably, individuals aged 75 and older can experience substantial improvements in auditory function after receiving an implant. The results suggest that cochlear implantation is an effective treatment for improving speech perception in latter-stage elderly, with a significant window of opportunity for improvement noted between two and three years after the procedure. The study underscores the importance of timely intervention and ongoing evaluation to optimize the benefits of cochlear implants for the aging population.

Free paper 0239

Effects of auditory training on speech recognition in children with single-sided deafness and cochlea implants using a direct streaming device: A pilot study

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Introduction: Treating individuals with single-sided deafness (SSD) with a cochlear implant (CI) offers significant benefits for speech perception in complex spatial listening environments.

Material and methods: After implantation, training without involvement of the normal-hearing ear is essential. Therefore, the AudioLink streaming device (MED-EL GmbH, Austria) can be used to connect the externally worn audio processor to media devices; thus, the auditory stimuli are directly streamed to the implanted ear. The aim was to test whether children with SSD, aged 5–12 years, accept this training method and whether auditory training, streamed directly via AudioLink using the Tiptoi device (Ravensburger GmbH., Ravensburg, Germany), improves speech recognition.

Results: A total of 12 children with SSD and implanted with a CI received Tiptoi training via AudioLink and were asked to practice daily for 10 min over a period of one month. All participants completed the training. The measurements employed to assess improvement included speech audiometry, speech, spatial, and quality of hearing scale for parents (SSQ P), and specially designed tasks crafted for this study. Daily training of 9.93 min was reported. The word recognition score (WRS) at 65 dB and 80 dB in aided condition significantly improved and the WRS streamed via AudioLink was significantly better after training. The speech, spatial, and qualities of hearing scale for parents (SSQ P questionnaire) showed significant improvement in the dimension of quality of hearing and overall gain. The outcomes of the Tiptoi tasks resulted in a significant benefit in both categories of the "recognition of sounds" and "understanding of sentences".

Conclusions: The results are very encouraging and do not only show the positive uptake of daily training at home but also how this resulted in a significant improvement in subjective and objective measures for this rather short training period of one month only.

Free paper 0378

Electrode contacts in the functional acoustic hearing region for adult and pediatric cochlear implant recipients

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Introduction: Hearing preservation is possible after cochlear implant (CI) surgery, allowing for the use of electric-acoustic stimulation (EAS). Some CI recipients with preserved low-frequency hearing may have electrode contacts in the functional acoustic hearing region. The objectives of this study were to evaluate the incidence of CI electrode contacts within the functional acoustic hearing region and clinical implications with respect to long-term hearing preservation and speech recognition outcomes in adult and pediatric EAS users.

Material and methods: A retrospective review was conducted at a tertiary referral center including adult and pediatric CI recipients implanted with a 24-, 26-, 28-, or 31.5-mm straight electrode array who had preserved low-frequency acoustic hearing (≤80 dB HL at 250 Hz) at device activation. Angular insertion depth (AID) of individual electrode contacts was derived from intra-operative or post-operative imaging. Proximity of contacts to the functional acoustic hearing region was calculated using post-operative unaided thresholds. Outcomes included changes in low-frequency pure tone average (LFPTA) and speech recognition in quiet and noise. Multivariable regression and linear mixed-effects models assessed the influence of proximity, AID, age, biological sex, pre-operative hearing, and follow-up interval.

Results: The majority (74%) of CI recipients had at least one electrode contact within the functional acoustic hearing region – with a higher incidence for pediatric recipients (90%). Neither AID nor proximity significantly predicted delayed loss of residual hearing in adults or children over follow-up periods extending to ≥3 years post-activation. LFPTA declined slightly over the first several years, though most CI users maintained acoustic hearing. Proximity was not associated with speech recognition in quiet; however, in adult EAS users, electrode placement closer to the boundary of the functional acoustic region was associated with improved speech recognition in noise, with poorer performance with larger gaps or overlap in stimulation.

Conclusions: Electrode overlap with the functional acoustic hearing region is common but does not predispose CI recipients to delayed loss of residual hearing. Large gaps in stimulation or significant overlap may negatively affect speech in noise performance, highlighting the potential value of individualized mapping strategies.

Free paper 0112

Empowering patients: Advancing towards bilateral CI treatment

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Since the introduction of cochlear implantation (CI) in the 1980s, it has become an established intervention for individuals with severe to profound sensorineural hearing loss. Over time, CI indications have broadened. What began as a unilateral solution for bilateral deafness has expanded to include candidates with residual hearing. Evidence has also shown that early implantation is essential for optimal language and speech development in children, leading to a progressive lowering of the implantation age, from toddlers to infants younger than nine months. In the past decade, indications for children up to 18 years have further expanded from unilateral to bilateral CI to support their developmental needs.

Despite the recognized importance of bilateral hearing for adults as well, the Netherlands does not reimburse a second CI for individuals over 18 under the Health Insurance Act. The National Health Care Institute argues that scientific evidence for the added benefit of a second CI remains inconclusive. However, the value of bilateral implantation depends on factors more nuanced than those currently considered. At the same time, healthcare systems face increasing pressure due to an aging population, rising costs of advanced technologies, and shortages in healthcare personnel. Expanding care in one domain inevitably affects resources in another, making careful and welljustified allocation of public funds essential. Any resulting inequalities must be ethically defensible, yet the current policy on second CI reimbursement risks arbitrariness and injustice.

Existing cost-effectiveness criteria insufficiently capture the benefits a second CI may offer adult users. A more appropriate assessment would consider how a second CI contributes to an individual's ability to flourish within their specific context. This calls for a broader set of evaluative criteria than those typically applied in Dutch healthcare allocation decisions. Given the potential benefits and the inherent uncertainty of outcomes, a case-by-case approach to reimbursement decisions for a second CI is ethically justifiable.

This presentation, approaches the topic from multiple perspectives. Its aim is not only to deepen understanding of bilateral cochlear implantation but also to encourage a broader view that moves beyond strictly quantitative, cost-effectiveness-driven considerations, offering tools grounded in ethical models and patient experience.

Free paper 0722

ENT disease burden and access to cochlear implantation in Kazakhstan: Public health implications for hearing rehabilitation

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Introduction: Hearing impairment represents a significant component of the global burden of ear, nose and throat (ENT) diseases and is associated with major consequences for language development, education, and social integration. Congenital severe or profound sensorineural hearing loss occurs in approximately 1.5–6 per 1000 newborns worldwide and constitutes the main indication for cochlear implantation. In Kazakhstan, cochlear implantation (CI) has been implemented since 2007 as part of the national program for high-technology medical care.

Objective: To analyze the burden of hearing impairment within the structure of ENT diseases in Kazakhstan and to assess systemic factors influencing access to cochlear implantation.

Material and methods: This study synthesizes national administrative data, published research, and health technology assessment reports on cochlear implantation services in Kazakhstan. Epidemiological data on hearing loss and CI procedures were analyzed alongside health system indicators, including screening coverage, availability of specialized centers, and workforce capacity. Particular attention was given to trends in the age of implantation and the regional accessibility of services.

Results: Cochlear implantation services in Kazakhstan have expanded since their introduction in 2007, with approximately 4962 procedures performed, including around 3725 in children. The number of operations currently exceeds 465 annually. Improvements in newborn hearing screening and clinical protocols have increased the proportion of children receiving implantation before age 2. However, access to CI remains geographically uneven due to the concentration of services in a limited number of specialized centers. Additional challenges include shortages of audiologists and rehabilitation specialists, as well as limited integration of children with implants into mainstream education systems.

Conclusions: Hearing impairment remains an important component of the ENT disease burden in Kazakhstan and represents a significant public health challenge. While cochlear implantation programs have improved access to advanced treatment technologies, further strengthening of early detection systems, regional service availability, and rehabilitation infrastructure is required.

Free paper 0580

Etiologies of hearing loss in a large cohort of CI recipients

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Introduction: The etiologies underlying severe to profound hearing loss are heterogeneous. A comprehensive understanding of these etiologies is essential for optimizing diagnostic pathways, patient counseling and outcome expectations. Lately, the increasing diagnostic yield of genetic testing highly contribute to etiological diagnosis.

Material and methods: A retrospective analysis of the pediatric and adult CI database of Ghent University Hospital, Belgium, was performed, including 883 individual patients. Hearing loss etiologies were related to the timing of implantation and the patient's age at implantation. CT and MRI imaging were consistently performed in CI candidates. CMV analysis on newborn blood spots and genetic testing have been widely performed in pediatric patients with congenital or early-onset hearing loss over the past two decades. In adult patients with unexplained hearing loss, genetic testing has been performed increasingly in recent years. Genetic testing has evolved from single-gene analysis in earlier years to whole-exome sequencing nowadays.

Results: Among the 883 included patients, a definite etiology could be established in 526 patients (60.0%). In this group, genetic causes were predominant, comprising nonsyndromic etiologies (22.8%, mainly *GJB2*) and syndromic etiologies (14.1%). Infectious causes were also prevalent, including prenatal infections (14.1%, in more recent years almost exclusively congenital cytomegalovirus infection) and postnatal infections (10.6%, mainly meningitis). Bilateral Menière's disease and otosclerosis were identified in 7.4% and 6.7% of patients, respectively. A younger age at implantation was significantly associated with successful etiological identification ($p < 0.001$). In recent years, an increasing rate of etiological diagnosis has been observed, mainly attributable to advances in genetic diagnostics.

Conclusions: Using a structured diagnostic protocol, a hearing loss etiology can be identified in the majority of patients with severe to profound hearing loss. Genetic etiologies are most prevalent, followed by prenatal and postnatal infectious causes. Etiological distributions differ according to the patient's age; however, genetic testing can also contribute to etiological diagnosis in adult-onset hearing loss.

Free paper 0393

Evaluating cochlear implant electrode fit across 1042 cochleae: A CT-based frequency-specific simulation study for anatomical based fitting

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Introduction: Substantial inter-individual variation in cochlear anatomy poses a key challenge in cochlear implant (CI) electrode selection and underscores the need for personalised, anatomy-based planning. Despite the fact that cochlear anatomy has been described in numerous studies, large-scale, systematic investigations linking cochlear variations to the selection, alignment, and positioning of lateral wall electrode arrays remain limited.

Material and methods: The present retrospective single-centre study evaluated 1042 temporal bones from 521 patients undergoing clinical high-resolution temporal bone CT between January and December 2024 at a tertiary referral centre. Full-dose CT (median DLP 52.9 [49.2–56.8] mGy) was reconstructed to depict the cochlea and imported into an otological planning software for automated 3D cochlear assessment. A series of preoperative CI simulations were conducted, encompassing six distinct electrode types. The outcomes encompassed the analysis of CDL disparities by sex and side, the proportion of overlong CI insertions, and the simulated positioning of the most apical electrode contact. Frequency allocation along the cochlear duct was determined by computational methods.

Results: The mean cochlear duct length (CDL) was found to be statistically equivalent across both sexes and ear sides. In 34 mm electrode cases, the cochlea was exceeded in 18% of cases, while in 31.5 mm electrode cases, this was only the case in 0.8%. Conversely, 28 mm and shorter arrays remained within the limits of the cochlea in all cases. It was determined that a range of 26–34 mm was necessary to achieve optimal placement of the most apical electrode contact within the desired 150–200 kHz range for anatomical based fitting.

Conclusions: The present study identified significant inter-individual variations in cochlear duct length, independent of factors such as sex or ear side. Whilst the 28 mm electrode is universally applicable, its use is limited by its effect on cochlear coverage. In contrast, the 31.5 mm long electrode ensures high coverage potential and frequency targeting with minimal risk of over-insertion.

Free paper 0668

Evaluating the real-world impact of Roger adaptive digital modulation technology on speech understanding in cochlear implant users

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Introduction: Despite advances in cochlear implant (CI) technology, understanding speech in noisy environments continues to be a persistent difficulty for users. This challenge is particularly relevant in densely populated and acoustically complex settings, including tier-3 cities in India where traffic, crowd activity, and enclosed public spaces generate high and fluctuating background noise levels. Even with optimized CI programming, speech perception (SP) often declines significantly as signal-to-noise ratio (SNR) worsens. Adaptive digital modulation (DM) systems, such as Roger technology, are designed to enhance the speech signal relative to background noise and may offer meaningful improvements in both controlled and everyday listening situations.

Objective: This multicentric Indian study examined the effectiveness of Roger adaptive DM technology on speech perception in unilateral CI users across clinical and real-world environments.

Material and methods: Thirty unilateral CI users (aged 13–58 years) were evaluated using 13 different combinations of CI program settings and Roger microphone configurations. Assessments were conducted in a two-room audiology setup and in real-world environments including a hospital waiting area, cafeteria, and programming room. In the audiology setting, speech-in-noise (65 dB HL) was delivered at 90° azimuth on the CI side, while recorded sentences were presented from 0° azimuth at a 1.5 m distance. Mean ambient noise levels in real-world settings were 59 dB SPL (waiting area), 69 dB SPL (cafeteria), and 43 dB SPL (programming room).

Results: All Roger configurations significantly enhanced speech recognition scores (SRS). The most effective setup – Roger Select-IN in lanyard beamformer mode positioned 6 inches from the speaker – achieved 50% SRS at –20.3 dB SNR (±2.06), compared to –12.9 dB in SIN mode (UltraZoom + SNR Boost) ($p = 0.0001$). In real-world conditions, SRS improved by 38% (SD = 0.98) in the waiting area, 48% (SD = 1.04) in the cafeteria, and 16% (SD = 0.66) in the programming room.

Conclusions: Roger technology significantly enhances speech perception, particularly in noisy environments, supporting its application in varied real-life listening scenarios and complex auditory conditions.

Free paper 0229

Evaluation of a de-escalated post-operative cochlear implant programming protocol

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Objective: Cochlear implantation often requires frequent post-operative programming visits which can disrupt daily life, impose financial burdens, and delay access for new cochlear implant (CI) candidates. This study evaluated the feasibility of a de-escalated schedule of four programming appointments within the first year after surgery.

Material and methods: A retrospective review was completed for 236 patients aged 0–100 years who received CI from July 2022 to December 2023. Explants, reimplants and second CI within the study window were excluded. Collected data included demographics, schedule adherence, additional visit reason, and Consonant-Nucleus-Consonant (CNC) word scores for adults.

Results: A total of 201 CI recipients (mean age 46.9 years; 72.6% adults) met inclusion criteria. Most were male (53%), White (88%), Non-Hispanic (54.7%), and privately insured (56.2%). Overall, 53% adhered to the 4-visit protocol, 35% required 1–2 additional visits, and 12% required 3–6. Among those requiring additional appointments ($n = 95$), 28.4% followed the prior protocol of up to 10+ visits. Adherence to the new streamlined protocol improved by 43% over the study period. On multivariate analysis, each additional year of age at surgery reduced the odds of adherence by 3.4% ($p < 0.05$). No statistical or clinical differences were observed in 12-month CNC scores between patients with ≤4 versus >4 visits.

Conclusions: A de-escalated post-CI programming schedule of four visits in the first year is feasible and does not compromise adult speech perception outcomes. Older patients may require closer follow-up. Successful implementation may require time for workflows and provider adoption.

Free paper 0419

Evaluation of auditory verbal performance of pediatric CI users with inner ear malformations

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Introduction: Cochlear implant can be applied to individuals with both normal and abnormal inner ear anatomy, but it may be contraindicated for individuals with some abnormal inner ear anatomy (e.g. labyrinthine aplasia). Individuals with inner ear malformations such as IP-II, IP-I, cochlear hypoplasia, or common cavity may benefit optimally from cochlear implant similarly to individuals with normal inner ear anatomy. Although auditory input is similar, it remains unclear how auditory verbal performance develops in individuals with inner ear malformations. Therefore, the purpose of this study was to determine the auditory verbal performance of cochlear implant users with inner ear malformations.

Material and methods: A total of 32 cochlear implant users, 15 with inner ear malformations and 17 with normal cochlear anatomy, aged 3–12 years, were included in the study. The Turkish version of the "Parents' Evaluation of Aural/Oral Performance of Children" questionnaire was used to examine the auditory verbal performance of the participants. Additionally, the factors affecting auditory verbal performance in inner ear malformations were also investigated.

Results: No significant difference was found in the subtest scores of *Quiet*, *Noise* and *Total* between cochlear implant users with normal anatomy and those with inner ear malformations ($p > 0.05$). A significant difference was found in the subtest scores of *Quiet* between unilateral cochlear implant users with normal anatomy and those with inner ear malformations ($p = 0.04$). No significant difference was found in any subtest scores between unilateral and bilateral cochlear implant users with inner ear malformations ($p > 0.05$).

Conclusions: Many studies have shown that the use of cochlear implants at an early age in children with hearing loss has a significant effect on many developmental areas such as listening skills, speech intelligibility, learning skills, speech and language development. Despite the inner ear malformation, the fact that the subtest results of these individuals are similar to normal anatomy shows us that auditory verbal performance is independent of anatomy. The effect of anatomy on auditory verbal performance is especially evident in quiet conditions and in the case of unilateral cochlear implant use.

Free paper 0637

Evaluation of local evoked potentials and eSRT responses in auditory brainstem implant users: Preliminary findings

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Introduction: An auditory brainstem implant (ABI) is a neuroprosthetic device used when the auditory nerve is nonfunctional, transmitting auditory information directly to the cochlear nucleus electrically. eSRT, and eCAPs are common postoperative objective measurements used in cochlear implants. As ABI electrodes are placed in the cochlear nucleus, the responses obtained vary. Both the prevalence and

applicability of LEP and ESRT measurements in ABI users remain insufficiently investigated, and data on the obtainability of measures such as eSRT in this population are limited. This study aimed to determine rates of obtaining LEP and eSRT in ABI users.

Material and methods: The study included six ears from five ABI users (median age: 10 years, range: 9–29 years). LEP and eSRT measurements were conducted. The LEP amplitude was determined based on the difference between the negative and positive peak points. eSRT measurements conducted at 226 probe tones, with contralaterally for unilateral users and ipsilaterally for bilateral users. eSRT and eCAP measurements were performed only on actively used electrodes to avoid unpleasant sensations or side effects during the stimulations. Stimulation parameters were individually adjusted based on each user's clinical fitting settings to avoid discomfort. Stimulation levels were initiated at a comfortably audible level and gradually increased up to a level considered unlikely to cause discomfort.

Results: This study included 5 ABI patients (2 adult and 3 children), comprising a total of 6 implanted ears. One user had bilateral implantation, three users had left-sided implantation, and one user had right-sided implantation. A total of 32 active electrodes across 6 ears were evaluated. LEP responses were successfully recorded within the individual dynamic range in 18 of the 32 evaluated active electrodes (56.25%), while no response was obtained in 14 electrodes (43.75%). eSRT measurements were performed in three patients; however, no measurable eSRT responses were obtained.

Conclusions: These preliminary results showed that LEP recordings were feasible in most active ABI electrodes, supporting their potential use for objective electrophysiological assessment and fitting in ABI users. While these findings are indicative, the final conclusions will be refined. Additionally, this study expected to contribute the ABI fitting practices in clinical settings.

Free paper 0102

Evaluation of Remote Check in children with cochlear implants in Saudi Arabia

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Objective: This study evaluates the feasibility of reducing in-person appointments by utilizing Remote Check (RC) in pediatric cochlear implant (CI) recipients and investigates the most suitable age range for implementing RC.

Material and methods: Fifty-eight pediatric CI recipients, aged 1–17 years, were evaluated using a web-based RC application by audiologists. Most (84.5%) used verbal communication. Inclusion criteria required stable map status, caregiver tech proficiency, and a compatible phone.

Results: Remote assessments were beneficial, with 89.7% of participants successfully completing RC. Aided threshold tests (ATT) were completed in 73.2% of participants, while speech-in-noise tests (Digit Triplet Test, DTT) were completed in 47.3%. Children as young as 4 successfully completed ATT, while a minimum age of 7 was required for DTT. A significant relationship between age and test success was demonstrated. Verbally communicative children had higher completion success rates. Parental education was significantly correlated with DTT success, with higher success rates in children whose parents had undergraduate degrees. With RC use, 69% of children did not need clinic visits, emphasizing the need for personalized and remote support for optimal cochlear implant performance. In-person appointments were primarily required due to concerns about the duration of device usage.

Conclusions: The study confirms the effectiveness and feasibility of using RC in pediatric CI users, even as young as one year old with stable aided hearing. The findings advocate for the integration of RC into routine follow-up protocols, offering a more accessible option for enhanced patient care.

Free paper 0499

Evaluation of remote programming in routine cochlear implant follow-up

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Introduction: Remote programming is not yet part of the usual standard of care practice related to cochlear implant (CI) systems. However, remote programming has the potential to be an efficient and cost-effective method for cochlear implant users by minimizing travel burden and facilitating access to care. The aim of this study was to evaluate the Target CI version 1.5 and the Advanced Bionics Remote Support app in CI patients.

Material and methods: This prospective monocentric study will include 51 adult patients unilaterally implanted with or without contralateral hearing aid or bilaterally implanted (17 subjects/group), with a minimum of 6 months of CI experience. Instructions were provided to the participants during the first visit on how to use the app. Speech recognition in noise using French Matrix test and in quiet using monosyllabic words is assessed, following a one-month chronic use of remotely fitted sound processor and compared to the same test at baseline. Data on adverse events related to the app, ease of use, subjects and CI clinician satisfaction and psychophysical and objective measures are collected the day of the remote fitting session and one month later during the visit on site.

Results: Data of the first 16 patients are available. The mean age was 53 ± 12 years. Speech intelligibility in quiet and noise was similar one month after the remote session compared to baseline assessment. Connection problems occurred in two patients, leading to repeated attempts to obtain voice communication. New version of iOS26 caused voice communication

interruption, forcing patients to use another device for audio communication. CI clinicians noticed that there is no sound level scale in the app, which would be useful for precise fittings. Voice communication cannot be streamed during fitting, which slightly impacts voice quality. Nevertheless, all patients and CI clinicians gave positive feedbacks and were very satisfied with the remote fitting.

Conclusions: Thes preliminary results suggest that remote programming using the Advanced Bionics Remote Support app is a reliable and effective solution for CI patients technically competent to manage the equipment. Future care of CI patients could combine remote CI fitting and in-clinic visit.

Free paper 0602

Evaluation of remote programming of cochlear implants under challenging conditions

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Introduction: Since the COVID-19 pandemic, telemedicine has been increasingly integrated into cochlear implant (CI) care. Two complementary remote strategies have been implemented: synchronous remote fitting, which replicates real-time programming sessions with clinician and patient connected simultaneously, and asynchronous remote monitoring, which enables continuous device surveillance through digital platforms such as the HearCare app (MED-EL), independent of scheduled appointments.

Objective: The objective of this study was to evaluate the safety, technical performance, and clinical value of both approaches, and to explore their contribution to continuity of care, early detection of technical issues, and patient autonomy.

Material and methods: Synchronous remote fitting was conducted using standard MAESTRO software operated by experienced clinicians via secure web connection, with local assistance available for the CI user. Satisfaction and technical performance were assessed through online questionnaires completed by both patients and clinicians. Asynchronous monitoring involved CI users employing the HearCare app to assess implant integrity, processor status, and daily usage. Clinicians reviewed automated alerts and remote diagnostic reports. When necessary, fitting maps were adjusted using MAESTRO software, and updated programs were delivered to patients through the app.

Results: In the synchronous cohort, 55 CI users and 45 programmers completed questionnaires. Users reported high satisfaction (mean 8.1/10), and clinicians rated compliance at 9.3/10. Ninety-five percent of clinicians were satisfied and all would recommend the procedure. Technical performance was strong, with mean scores of 8.8 for audio quality, 8.0 for video quality, 8.7 for internet stability, and 9.0 for server access. Minor delays occurred in 16% of sessions and interruptions in 19%, but session duration was comparable to face-to-face visits and no additional appointments were required. In the asynchronous group, 29 patients using SONNET 2/3 or RONDO 3 processors participated. The HearCare app detected clinically relevant device-related events including microphone failure, irregular processor use, and abnormal impedance trends. Users valued its usability and sense of security, while clinicians emphasized earlier issue detection and workflow optimization.

Conclusions: Overall, synchronous remote fitting and asynchronous monitoring represent complementary pillars of modern CI telehealth. Real-time programming combined with continuous digital surveillance enhances safety, access, and patient autonomy while maintaining clinical effectiveness.

Free paper 0036

Evaluation of the MED-EL-MultiLinguProfile case history tool for multilingual children with CI

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Introduction: A case history that documents a child's language and hearing biography, is essential in cochlear implant (CI) and auditory rehabilitation for multilingual children with CI(CwCI), as it underpins diagnostic procedures, goal setting, and parent counselling. The aim of this project was to develop the MED-EL *MultiLinguProfile,* an instrument, that enables a comprehensive case history for CwCI and supports its effective use in parent counselling.

Material and methods: Based on a systematic literature review, a prototype of the case history form was developed. Semi-structured expert interviews ($n = 10$) with speech-and-language-therapists (SLTs) and teachers (TCHs) provided contextualised feedback. On this basis, the case history form was revised, and a manual as well as an evaluation sheet were designed. In a formative, user-centred evaluation, additional professionals applied the *MultiLinguProfile* in clinical practice and rated predefined evaluation categories on a five-point-Likert-scale. A cut-off value of 3.5 indicated the need for optimisation. Group comparisons were conducted between SLTs in CI centres, SLTs in private practice, and TCHs in schools for the deaf/hard of hearing regarding the usability and usefulness of the *MultiLinguProfile*.

Discussion: Analysis of the interviews indicated that the case history form was perceived as useful and easy to handle, while requiring a clearer structure and more accessible wording. In the subsequent practical evaluation, $n = 25$ professionals participated (age: $M = 36$, SD = 9; CI-related work experience: $M = 7.1$ years, SD = 5.5). MED-EL-*MultiLinguProfile* received high ratings for content quality ($M = 4.12$, SD = 0.91) and usefulness ($M = 4.17$, SD = 1.03). The duration of administration received the lowest rating ($M = 3.04$, SD = 1.00).

Conclusions: The MED-EL-*MultiLinguProfile* enables a systematic case history for multilingual CwCI and supports the

structured derivation of therapy goals and priorities for parent counselling. Its clear layout and supportive supplementary materials facilitate implementation in clinical practice. For professionals, the MED-EL-*MultiLinguProfile* provides a practical and efficient framework for collecting comprehensive, contextually grounded case histories in multilingual CwCI. The evaluation sheet uses visual symbols to aid communication during parent counselling, and the manual offers easily accessible, evidence-based guidance on multilingualism and hearing disorders.

Free paper 0567

Evaluation of verbal and musical short-term memory in children with cochlear implants: Relationship with music perception and neurophysiological responses

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Introduction: Auditory short-term memory (STM) is critical for processing complex sounds and is hypothesized to be domain-specific (verbal vs musical). While verbal STM is well-studied in pediatric cochlear implant (CI) users, musical STM and the neurophysiological mechanisms underlying auditory STM – specifically the capacity to store and automatically discriminate differences in auditory sensory input – remain largely unexplored. This study investigated verbal and musical STM in children with unilateral/bilateral CIs versus typical-hearing (TH) peers, and their relationship with music perception and neurophysiological responses (MMN).

Material and methods: Participants included children with unilateral CIs ($n = 15$; age = 11.60 ± 2.29), bilateral CIs ($n = 35$; age = 11.08 ± 2.47), and a TH control group ($n = 22$; age = 11.63 ± 2.45). MMN was assessed under three musical interval conditions (C4-E4, C4-G#4, C4-C5). Behavioral measures comprised auditory sensory memory (TP-Detect), musical (MP-Comparison) and verbal (VP-Comparison) STM, and music perception (TR-CAMP: timbre, PDD).

Results: Mixed ANOVA for MMN area revealed significant main effects for condition ($p < 0.001$) and group ($p < 0.001$), confirming a systematic increase in MMN area as the musical interval size widened across all groups. No significant Group x Condition interaction was observed ($p > 0.05$). Post-hoc analysis showed that TH children had significantly larger C4-C5 MMN areas than unilateral users ($p = 0.018$), while no significant differences were observed between bilateral CI users and TH peers.TH group outperformed CI users in TP-Detect, MP-Comparison, and timbre ($p < 0.001$). Conversely, no significant differences in VP-Comparison scores were found across groups ($p > 0.05$), and all groups performed significantly better in VP than MP tasks (TH: $p = 0.028$; CI: $p < 0.004$). Regression analysis showed that group differences in musical STM remained significant even after accounting for MMN area ($p = 0.012$). Age correlated with timbre in the unilateral group ($r = 0.695$, $p = 0.004$) and with PDD in both CI groups ($p < 0.05$). No age-controlled correlation emerged between timbre and musical STM ($p > 0.05$).

Conclusions: These findings support a domain-specific difference in auditory memory, as CI users showed significant musical STM deficits despite comparable verbal STM performance. Bilateral usage appears to provide a neurophysiological advantage, bringing neural responses to a level similar to TH peers.The persistence of behavioral musical STM differences after accounting for MMN area may suggest that these deficits likely involve higher-order cognitive processes beyond automatic sensory discrimination.

Free paper 0376

Evidence-based clinical guidelines for adults cochlear implantation in Latin America: A regional consensus initiative

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Introduction: Hearing loss is a major contributor to global disability, with a disproportionate burden in low- and middle-income regions such as Latin America (LATAM) and is associated with reduced quality of life, social isolation, depression and elevated risk of cognitive decline. Cochlear implantation (CI) has demonstrated substantial clinical, social, and economic benefits for adults who derive limited benefit from hearing aids. The absence of regionally adapted clinical guidelines contributes to delayed referral and inconsistent clinical practice.

Objective: To develop a region-specific, evidence-based set of clinical recommendations for adult cochlear implantation in Latin America, addressing screening, candidacy, surgery, programming, and rehabilitation, with the aim of reducing practice variability and improving equitable access and outcomes.

Material and methods: A multidisciplinary CI Task Force comprising otorhinolaryngologists, audiologists, and auditory rehabilitation professionals from 14 LATAM countries conducted a structured guideline development process. Clinical questions were generated and reformulated using the PICO framework. Systematic literature searches were performed, and evidence was graded using the GRADE. Recommendations were developed through Evidence-to--Decision frameworks. Draft recommendations underwent structured voting and two rounds of public consultation. The process was conducted between May 2024 and February 2025 using a transparent online guideline-authoring platform.

Results: An initial set of 87 questions covering the continuum from adult hearing loss screening to post-implant rehabilitation was generated. After prioritization and public consultation with participation exceeding 88% of task force members, 41 questions were retained and reformulated in PICO format. Based on systematic evidence appraisal and

expert consensus, 31 draft recommendations were developed and submitted to a second public consultation, with participation exceeding 80%. The final consensus resulted in 22 recommendations: 2 related to screening, 4 to candidacy, 7 to surgery, 5 to programming, and 4 to rehabilitation. Recommendations integrate best available evidence with regional healthcare realities.

Conclusions: This LATAM consensus provides a structured, evidence-based framework for adult cochlear implant care tailored to regional epidemiology, healthcare systems, and access constraints. By standardizing clinical pathways and promoting timely identification and intervention, these recommendations aim to reduce inequities and improve CI utilization and outcomes across LATAM.

Free paper 0157

Expanded pediatric indications of MED-EL Bonebridge

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Introduction: MED-EL Bonebridge is an active transcutaneous device FDA-approved in the United States for patients over 12 years old. The aim of this study is to evaluate a single institution's outcomes for children aged 4–10 years implanted with Bonebridge.

Material and methods: After institutional review board approval, patients were prospectively recruited into a novel indication clinical trial for device implantation beginning January 2024. Three patients undergoing off-label surgery were included. An additional patient who had surgery at another site is also included. Descriptive statistics are presented.

Results: 12 children (ages 4–10 years, 42% female) underwent Bonebridge implantation (11 unilateral, 1 bilateral) for conductive hearing loss (pre-operative bone conduction pure tone average (PTA) mean 62.2, range 52.5–73.8). 11 of the patients had atresia and 1 had Branchio-Oto-Renal (BOR) syndrome. All implants at our institution partially compressed the dura. There were no intraoperative complications, and minimal pain control was required post-operatively. Follow up has ranged from 6–12 months, with 2 patients experiencing minor complications: skin erythema, device retention difficulty. One medically complex patient had intracranial hypertension unrelated to the device post-operatively. There have not been any severe complications or need for device removal. All patients have reported benefit from device use, with a Glasgow Children's Benefit Inventory (GCBI) overall score mean 34.6. Consonant-nucleus-consonant (CNC) scores improved, from a mean 14% (range 0–56%) pre-operatively to mean 69% (range 44–78%) at 3 and 6 months post-operatively. Mean 6 month post-operative SRT of 24.2 dB (range 15–40 dB) improved from 57.2 dB (55–60 dB) pre-operatively. Several children required replacement of the Samba 2 processor due to damage.

Conclusions: Implantation with MED-EL Bonebridge has been performed safely in children as young as 4 years old with good audiometric outcomes. There have been minor wound and device retention complications, but all children continue to use and benefit from implanted devices. Long-term multi-institutional data collection is ongoing.

Free paper 0146

Experiences of Sentio system implantation in young children with microtia/atresia

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Introduction: Surgically placed Bone Anchored Hearing Systems (BAHS) have been used clinically for nearly 50 years in patients with conductive or mixed hearing loss, as well as those with single-sided deafness. For children, early access to sound is crucial for speech development, social interaction, and cognitive function. Children with atresia and/or microtia, who lack a fully developed outer ear and ear canal, are of particular interest due to their conductive hearing loss and potential future desire for reconstructive surgery. Preservation of well-vascularized soft tissue around the ear is essential to enable subsequent ear reconstruction and requires extra caution when planning incision and implant placement.

Objectives: This presentation aims to highlight general considerations and share case reports from recent Sentio implantations in young children within this patient cohort.

Material and methods: A prospective, multicenter clinical investigation evaluating the safety and performance of the Sentio system (Oticon Medical AB, Askim, Sweden) in paediatric patients aged 3–11 years is currently taking place in the United Kingdom, the Netherlands, and Spain (clinicaltrials.gov identifier: NCT06976086). Patients will be followed for 12 months post-implantation with a focus on clinical, audiological and patient-reported outcomes.

Results: To date, 16 of 50 children have been implanted with the Sentio device across participating sites, including 10 diagnosed with atresia/microtia. Preliminary results from implantation surgeries shows that a posterior incision can be useful for this specific patient group. Additionally, a slightly posterior implant placement was successfully utilized for these patients as compared with patients without future reconstruction needs. All surgeries were completed within 45–50 minutes and postoperative recovery was uncomplicated. Compared to unaided conditions, use of the Sentio 1 Mini sound processor demonstrated a significant gain of 30–45 dB across PTA4 frequencies and marked improvement in speech perception in quiet. All patients and parents report high satisfaction with the system.

Conclusions: With its small size and flexible fixation, preliminary results show that Sentio can be safely implanted in children with microtia/atresia with good audiological outcomes and preserved possibilities for future ear reconstruction.

Free paper 0253

Experimental ECAP-based measures to fit focused multipolar stimulation for Nucleus® Nexa™ smart implants

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Introduction: Existing Nucleus devices use monopolar stimulation (MP) that recruits neurons up to some distance on either side of the stimulating electrode. The new Cochlear™ Nucleus® Nexa™ implant uses simultaneous multipolar stimulation to focus the current field, allowing the spread of current to adjacent sites to be controlled, reduced or eliminated. However, there are additional parameters to tune in comparison to MP modes of stimulation. Our experience with behavioural fitting of focused multipolar stimulation (FMS) indicates that threshold (T) and comfortable levels (C) are more variable across electrodes, such that standard interpolation techniques used for MP mapping cannot be successfully applied.

Material and methods: As part of Cochlear's Nexa Electrode-Neural Interface studies, this study investigated three different methods of fitting experimental sound processor programs using FMS with the Nexa smart implant research system. A behavioural single-channel T profile was obtained using an automated Von Bekesy method, while neural response telemetry thresholds (NRT) were used to create two objective profiles employing different focusing levels. T and C profiles were then adjusted using six channel groups to account for loudness summation. Fourteen new CI recipients used the behavioural fitting for three months, then trialled the three new programs in a balanced cross-over design. Outcomes included Spanish HINT (SNR50), word recognition in quiet, SSQ12 questionnaires, and clinician fitting experience.

Results: Objective profile-based programs were simpler to fit than behavioural profile programs. Speech recognition in noise was not significantly different between programs (with <1 dB mean differences). Word scores in quiet and SSQ12 scores were also not significantly different between programs.

Conclusions: These preliminary results demonstrate that simpler objective-measure based fittings may produce equivalent performance to behavioural profile fittings for FMS in cochlear implants. The study provided valuable insights into how to reduce the complexity of fitting FMS, and which parameter settings may lead to optimised performance in Nexa CI recipients.

Free paper 0050

Exploration of the effectiveness of online remote programming for domestic cochlear implant systems

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Objective: To evaluate the effectiveness of remote programming for domestic cochlear implant (CI) systems and provide clinical trial evidence to promote remote hearing rehabilitation services.

Material and methods: Twelve subjects implanted with the domestic Nurotron cochlear implant who had been using the device for more than six months (average age 45.58 ± 10.85 years) were enrolled. Each participant underwent one online remote programming session and one in-person traditional programming session in random order. The clinical efficacy of remote programming was assessed using aided hearing thresholds, speech recognition rates, and subjective questionnaires. A non-inferiority test was applied to analyze the difference in outcomes between remote and traditional programming.

Results: The aided hearing thresholds across all frequencies and the speech recognition rates in quiet environments met the predefined non-inferiority margins ($\Delta = 4/5$ dB or 5%). Subjective questionnaire scores indicated good user acceptance, demonstrating that remote programming was non-inferior to traditional programming in both objective and subjective evaluations.

Conclusions: Online remote programming of domestic cochlear implants demonstrated comparable effectiveness to conventional in-person programming for hearing improvement and speech recognition, exhibiting good feasibility and clinical utility. The remote programming function has the potential to enhance the rehabilitation experience for CI users, particularly benefiting those in medically underserved areas or with limited mobility.

Free paper 0305

Fifteen years of early activation at KAESC

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Introduction: Early activation of cochlear implants (CI) has progressed from an experimental concept to an established clinical pathway at the King Abdullah Ear Specialist Center (KAESC). Over the past fifteen years, KAESC has transitioned from conventional activation timelines of 4–6 weeks post–surgery to routine activation within the first few days following implantation.

Material and methods: This abstract summarizes KAESC's real-world experience from more than a decade of high-

volume CI practice. Program development focused on minimally invasive surgical techniques, standardized postoperative monitoring, and clearly defined eligibility criteria for early activation. A structured, interdisciplinary workflow was implemented to ensure wound integrity assessment, telemetry verification, patient readiness, and immediate counseling. The protocol employs a twostep activation approach: initial activation at 5 days post-surgery, followed by a subsequent activation within 24 hours to facilitate early mapping and close monitoring during initial auditory adaptation.

Results: Across fifteen years of implementation, early activation has demonstrated a high level of safety, reliability, and acceptance among patients, parents, and clinicians. Clinical observations include early impedance stabilization, consistent audiological progress, and high patient satisfaction. Early access to sound reduced anxiety associated with prolonged waiting periods and promoted earlier engagement in auditory rehabilitation. Importantly, no increase in postoperative complications, flap-related issues, or device-related concerns was observed when appropriate selection criteria and monitoring protocols were applied. The streamlined workflow reduced delays, improved fitting efficiency, and supported adherence to followup schedules. Over time, the protocol integrated effectively with remote care models, newer processor technologies, and anatomy-based fitting strategies.

Conclusions: Fifteen years of experience at KAESC confirm that early activation of cochlear implants is a stable, effective, psychologically well-tolerated, and patient-centered component of modern CI care. With structured protocols, clear eligibility criteria, and consistent monitoring, early activation can enhance clinical efficiency, support patient wellbeing, and strengthen rehabilitation outcomes. This long-term experience provides a practical roadmap for centers seeking to adopt or optimize early activation pathways, including in humanitarian CI programs.

Free paper 0519

First clincal experience with a novel robotic-assisted system for cochlear implant electrode insertion

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Objectives: While cochlear implant (CI) surgery has achieved remarkable success, the complete preservation of residual hearing remains a key challenge. Robotic-assisted electrode insertion holds promise for enhancing standardization, precision, and control – factors that may contribute to minimizing mechanical trauma. Recent research suggests that automation can significantly reduce intracochlear forces by reducing manual manipulation of the electrode. Furthermore, techniques such as gentle round window (RW) sealing and optimized lead management can help prevent the transmission of excessive forces into the cochlea. We present first clinical experiences with a novel robotic system designed for CI electrode insertion, along with a refined surgical workflow aimed at minimizing intracochlear forces throughout the entire implantation process.

Material and methods: Robot assisted (OTODRIVE, MED-EL, Innsbruck) electrode insertion was used in 10 subjects receiving a flexible electrode of different length: FLEX26 ($n = 1$), FLEX28 ($n = 6$), speed was 0.1 mm/s. Manipulation of the electrode with additional tools during insertion (e.g., due to buckling, ect.) was tracked. Surgical times, electrode impedances, and pure tone audiogram (pre-OP, fist fitting) were evaluated.

Results: Robot-assisted cochlear implant electrode insertion required additional preparation time. To mitigate insertion-related pressure, a large round window (RW) opening was created. In all cases, robotic insertion was successfully completed, enabling a standardized, slow, and smooth electrode placement with minimal need for manual correction. Following insertion, the electrode lead was manually secured within a groove in the facial recess to prevent force transmission into the cochlea during lead management. The RW was sealed using a drop of autologous venous blood to minimize manipulation.

Conclusions: Robotic assistance enables smoother, more controlled electrode insertions, supporting greater standardization and potentially reducing electrode buckling. Maintaining surgical control throughout the procedure is essential for structural preservation. These initial findings mark a promising step toward systematically assessing the benefits of this technique.

Free paper 0351

Five-year cognitive follow-up after cochlear implantation in older adults with severe or profound hearing loss: A prospective longitudinal cohort study

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Introduction: Hearing loss is a major modifiable risk factor for cognitive decline and dementia in older adults. Cochlear implantation improves auditory function, but long-term cognitive outcomes have not been fully characterized.

Objective: To evaluate the longitudinal impact of cochlear implantation on cognitive function over five years in older adults with severe-to-profound postlingual hearing loss.

Material and methods: *Design* – prospective longitudinal cohort study. *Setting* – single center; *Participants* – a consecutive sample of 104 older adults (mean [SD] age, 69 [8.7] years; 53% male) with postlingual bilateral severe-to-profound hearing loss, who received a unilateral cochlear implant (CI) between April 2015 and July 2025. Participants were assessed preoperatively and annually for five years. Intervention – cochlear implantation. *Main outcomes and measures* – the primary outcome measure was cognition, assessed using the Repeatable Battery for the Assessment of Neuropsychological Status for Hearing-Impaired Individuals (RBANS-H).

Results: Among the full cohort, RBANS-H total scores improved significantly from baseline to one year post-implantation (mean difference = –5.68, SE = 1.32, 95% CI = –8.83

to −2.49, $p < 0.001$) and remained stable through five years. Memory subdomains showed similar early gains, while attention and language remained stable, and visuospatial performance declined over follow-up. Participants at risk for mild cognitive impairment preoperatively ($n = 37$, 35.6%) exhibited disproportionate early improvements, particularly in attention, and only two participants progressed to dementia over five years. Significant gains in health-related quality of life (HRQoL) and speech perception in quiet and in noise were observed at one year and persisted through five years postoperatively. Vestibular function remained unchanged throughout follow-up.

Conclusions: Cochlear implantation in older adults with severe-to-profound hearing loss yields early cognitive gains followed by five-year stabilization with sustained improvements in HRQoL and speech perception, supporting timely intervention to maintain cognitive and psychosocial function.

Trial registration: clinicaltrials.gov (NCT02794350).

Free paper 0336

Follow-up of early cochlear implant device activation 48 months after surgery

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Introduction: A previous prospective study comprising an observation interval of 12 months could demonstrate that early fitting of the cochlear implant (CI) audio processor is a feasible and safe procedure with comparable follow-up effort. In comparison to a control group (CG), there were no wound healing disorders or additional pain during the early fitting. Although more early minor complications were observed in the early fit group (EF), there were no long-term wound healing problems caused by the early processor activation after one-year observation. The early fitting procedure was well appreciated by nearly all EF patients and enabled a remarkable reduction in the waiting time between CI surgery and initial activation. Inpatient rehabilitation was initiated within 14 days of discharge. Finally, early CI rehabilitation intervention was included in the German catalogue of follow-up rehabilitation. As there is no long-term data on the impact of early fitting and rehabilitation over a period of more than one year available, the present study focuses on follow-up results over a period of up to four years of CI usage.

Objective: Evaluation of the long-term effects of early cochlear implant device activation (early fitting) within 14 days post-surgery, and to compare these outcomes with those of patients receiving their first activation after the standard healing phase of 4–6 weeks. This study will assess speech perception, patient-reported outcome measures (PROM), the frequency of appointments for audio processor adjustments, and any adverse events over a 36-month observation period, beginning 12 months post-surgery.

Material and methods: In this retrospective study, 127 patients were assessed, with participants categorized into an early fitting group (EF, $n = 67$) and a control group (CG, $n = 60$). Outcomes were evaluated using questionnaires (NCIQ, SSQ) to measure various aspects of speech perception and quality of life. Additionally, medical side effects were documented. Data collection occurred during yearly follow-up appointments, allowing for a comprehensive comparison of outcomes between the early fitting group and the control group.

Results: As the data is still being reviewed, the results will be presented at the conference.

Free paper 0158

Forward-masking electrical stimulation for eeABR acquisition: A novel clinical approach for determining side selection and cochlear implant candidacy

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Objective: Extracochlear electrical stimulation of the promontory or round window can elicit electrically evoked auditory brainstem responses (eeABR), providing objective information on cochlear nerve integrity and supporting cochlear implant (CI) candidacy assessment. However, clinical adoption has been limited by large stimulus artifacts that obscure neural activity. This study evaluates a novel stimulation and signal-processing approach based on forward masking and artifact subtraction, designed to obtain reliable, reproducible eeABR recordings.

Material and methods: A prospective study was performed using an animal model (20 rat ears) (NIH-NIDCD Grant 1R43DC021116). Transtympanic monopolar electrical stimulation was delivered to the cochlear promontory through a custom system and software (IHS). Stimuli consisted of a 100-μs biphasic pulse with currents between 200 and 900 μA. eeABR responses obtained with and without forward-masking artifact cancellation were compared.

Results: Recordings demonstrated stable, reproducible eeABR waveforms. As in acoustically evoked ABR, the II–III complex was the most robust and consistently identifiable component. The forward-masking subtraction technique significantly reduced stimulus artifact, allowing clear isolation of neural activity from electrical contamination.

Potential Clinical Applications: This methodology may provide valuable objective information in challenging CI-candidacy scenarios, including inner ear malformations, cochlear nerve hypoplasia, cochlear trauma or fractures with suspected neural compromise, ossified or degenerative cochleae (otosclerosis, meningitis, labyrinthitis), long-standing profound hearing loss, objective side selection based on the ear with better eeABR responses, auditory neuropathies affecting proximal fibers or the spiral ganglion, and patients with vestibular schwannomas treated surgically or with

radiosurgery, where determining CI versus ABI candidacy requires evidence of residual neural conduction.

Conclusions: Combining extracochlear electrical stimulation with forward-masking artifact subtraction enhances the clarity and reliability of eeABR recordings. This technique shows strong potential as an objective tool for assessing cochlear nerve function, guiding CI sideselection, and improving diagnostic accuracy of disorders of the cochlea and eighth cranial nerve.

Free paper 0069

Frequency-specific time adjustment during stimulation with hearing aids and cochlear implants in bimodal treatment: Effect on directional hearing

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Introduction: Previous studies have shown that the sound localization ability of users of a cochlear implant (CI) in combination with a conventional hearing aid (HA) on the opposite side (bimodal users) improves when the constant interaural time delay caused by the different devices and stimulation sites is minimized. Since version 9, this has been possible in the MED-EL CI fitting software Maestro with a programmable delay that uses the same delay value for all CI frequency bands. However, excitation propagation in the cochlea is actually frequency-dependent and increases towards low frequencies. Can the binaural hearing performance of bimodal CI users be further improved by frequency-specific delay?

Material and methods: In our current study, we use frequency-specific delay values for each CI electrode depending on their position in the cochlea.

Results: In over 50% of the included bimodal users ($N = 15$), frequency-specific delays led to a further improvement in directional hearing (RMS error and signed bias).

Conclusions: Adjusting the timing of CI stimulation with frequency-dependent delays to match the contralateral hearing aid further improves the temporal synchronization of the modalities. This approach is likely to lead to further improvement in directional hearing in the majority of bimodal patients compared to an across-frequency delay.

Free paper 0299

From protocol to practice: Early multisite results of bionicVEST-2

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Bilateral vestibulopathy (BVP) is a chronic and debilitating disorder characterized by bilateral loss of vestibular function, leading to persistent imbalance, gait instability, oscillopsia, and severely reduced quality of life. Current management relies primarily on vestibular rehabilitation, which offers limited benefit in patients with severe or complete bilateral vestibular loss. Vestibular implants have emerged as a promising therapeutic approach to restore vestibular function through direct electrical stimulation of the vestibular nerve. However, previous implant designs have been associated with a substantial risk of hearing loss, restricting their use to patients with severe pre-existing deafness.

The BionicVEST2 project aims to overcome this limitation by developing and clinically evaluating a novel hearingpreserving vestibular implant. This study describes the protocol of a prospective, multicenter, adaptive feasibility clinical trial designed to assess the safety and efficacy of the BionicVEST2 investigational device in adults with BVP. The implant delivers chronic electrical stimulation to the otolithic organs using a dedicated intravestibular electrode, while avoiding cochlear insertion to preserve residual hearing.

Up to 18 adult patients with confirmed BVP will be enrolled across three European centers. The study follows a staged adaptive design, beginning with an early feasibility phase in patients with moderate to severe hearing loss to assess safety and hearing preservation, followed by a broader inclusion of patients with better hearing if predefined Go/NoGo criteria are met. All participants serve as their own controls, with outcomes compared to baseline. Primary efficacy endpoints include changes in gait and balance performance, assessed by the Dynamic Gait Index, Functional Gait Assessment, and computerized posturography at 6 months post-activation. Secondary endpoints focus on hearing preservation, device- and procedure-related adverse events, and quality of life. A blinded cross-over phase with stimulation ON and OFF is included to control for placebo effects.

The BionicVEST2 trial aims to demonstrate that vestibular neurostimulation can safely improve balance in patients with BVP while preserving functional hearing, potentially expanding vestibular implant therapy to a broader patient population with significant unmet clinical needs.

Free paper 0669

Functional and surgical outcomes of cochlear implantation: Clinical evidence from the Department of Laryngology, Medical University of Silesia

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Introduction: Modern precision otology aims to optimize the clinical benefits of cochlear implantation (CI) through refined surgical techniques and personalized postoperative care. In an aging population, a key challenge is assessing how general health status and chronological age influence auditory outcomes and the stability of hearing preservation (HP).

Material and methods: The study analyzed a cohort of 108 adult patients (median age: 61 years) who underwent unilateral cochlear implantation. Health burden was assessed using a standardized Comorbidity Index. HP analysis was performed on a subgroup ($n = 25$) with measurable preoperative hearing; the HP rate was calculated using the HEARRING formula for frequencies 250–2000 Hz. Additionally, aided hearing thresholds (PTA4, calculated for 500, 1000, 2000, and 4000 Hz) were evaluated in a subgroup ($n = 19$) to assess technical audibility levels with the speech processor. Statistical analysis included Pearson/Spearman correlations and Student's *t*-tests/Kruskal-Wallis tests.

Results: A statistically significant, moderately strong negative correlation was found between patient age and aided PTA4 thresholds with the speech processor ($r = -0.525$; $p = 0.021$), indicating that older individuals achieved superior technical audibility outcomes. HP analysis demonstrated high stability regardless of the health profile; no significant differences in HP were observed between healthy patients and those with multimorbidity (Student's *t*-test, $p > 0.05$), nor were there differences based on the type of implant ($p > 0.05$). A noticeable clinical trend was noted between higher corticosteroid doses and HP outcomes ($r = -0.35$; $p = 0.084$), with a statistical power of 0.204, suggesting the pilot nature of this specific analysis. BMI did not influence HP results ($r = 0.07$).

Conclusions: Advanced age is not a barrier to achieving optimal audibility benefits; the geriatric population demonstrates high efficacy in adapting to electrical stimulation. The "soft surgery" technique provides reproducible hearing preservation results regardless of cardiometabolic comorbidities, confirming the robustness of the procedure. While clinical trends regarding steroid otoprotection are promising, they require further verification in larger research cohorts.

Free paper 0388

Future CI care: Remote monitoring in cochlear implant users – Feasibility and reliability in adolescents

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Objectives: Remote monitoring technologies for cochlear implant (CI) users offer the potential for more efficient care. This study aimed to evaluate the feasibility and reliability of home-based monitoring of auditive performance in adolescent CI users. Four objectives were set: (1) To compare self-administered audiometry via Remote Check (RC) with audiometry conducted in the clinic; (2) To determine how reliably an audiologist can ascertain the need for follow-up based on the information provided through RC; (3) To evaluate the feasibility of implementing RC; (4) To explore how adolescent CI users experience the use of RC.

Material and methods: Prospective cohort study. CI-users aged 10–19 years completed the RC tests along with two validated questionnaires. An audiologist subsequently reviewed this data. During routine annual clinical visits, aided tone thresholds and speech perception in noise were measured, and their CI fitting was evaluated. A second audiologist reviewed the data. Following the clinical appointment, participants completed evaluation questionnaires.

Results: 25 patients were included. Mean aided thresholds obtained via RC were 6.4 decibel lower compared to clinical measurements. This difference was statistically significant across all tested frequences. No statistically significant difference was observed for the digits in noise test. The reviewing audiologists reached concordant conclusions in two-thirds of the cases, while three CI related issues were not detected through RC. A potential time save for audiologists of 51% was found. Evaluation questionnaires indicated high levels of satisfaction. Overall, 79% of participants and 88% of parents favored replacing routine follow-ups with RC.

Conclusions: Aided thresholds obtained via RC were significantly lower than clinical measures, while speech in noise results were comparable. Interpreting differences between RC and clinical audiometry on an individual level is hindered by substantial variability. Not all CI-related issues were detected remotely, even with the added validated questionnaires. Specific considerations should guide adolescent candidate selection for RC-based follow-up. RC shows promise as an adjunct CI aftercare for adolescents with stable performance, offering substantial time savings and resource reallocation. Both adolescents and parents expressed high satisfaction, with most favoring RC-based follow-up over traditional annual visits.

Free paper 0399

Future of CI care: Remote versus in-clinic cochlear implant programming during rehabilitation – Clinical outcomes and patient perspectives

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Introduction: Broader cochlear implant (CI) candidacy criteria and an aging population are increasing demand for CI rehabilitation, placing pressure on in-clinic capacity. Remote programming may improve accessibility and efficiency, but evidence for its effectiveness during early rehabilitation and the optimal timing of remote sessions remains limited. This study evaluated the non-inferiority of remote CI programming compared with standard in-clinic fitting and assessed patient experiences.

Material and methods: In this prospective study, 43 postlingually deafened adult CI users were allocated to standard in-clinic fitting only ($n = 21$), remote programming during the second fitting session ($n = 12$), or remote programming during the third fitting session ($n = 10$). All participants followed an identical rehabilitation schedule apart from the modality of one fitting session. Outcomes were assessed at the fourth session. The primary outcome was speech perception in quiet, measured as phoneme scores at 65 dB SPL. Secondary outcomes included free-field tone audiometry and programming parameters (M- and T-levels). Non-inferiority of remote versus in-clinic fitting was tested using a predefined margin. Patient experiences were evaluated using a dedicated questionnaire.

Results: Mean phoneme scores were 73% (SD = 11) in the remote group and 76% (SD = 11) in the in-clinic group. The mean difference of –3% (95% CI: –9.4 to 3.9) met the non-inferiority criterion. Free-field audiometric thresholds were comparable between groups (remote: 24 ± 5 dB HL; in-clinic: 25 ± 5 dB HL), and no clinically relevant differences were observed in programming parameters. Participants without prior remote experience initially reported more negative expectations, whereas those who underwent remote programming reported high satisfaction, ease of use, and willingness to continue remote sessions.

Conclusions: Replacing one in-clinic rehabilitation session with remote programming is non-inferior to standard care for speech perception outcomes. High patient satisfaction supports remote programming as a feasible and accessible addition to CI rehabilitation.

Free paper 0474

Future-proofing adult cochlear implant care through streamlined pathways

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Introduction: The growing number of cochlear implant (CI) recipients, many of whom require frequent clinic visits during the first year post-implantation, places increasing pressure on clinical resources and demands significant time and financial investment from patients. Remote care solutions and streamlined care pathways offer a promising alternative, with the potential to reduce this burden while enabling more flexible, personalized, and convenient care. We present these insights within the context of the STREAM study, a care innovation and clinical implementation project designed to enhance efficiency across the CI care pathway for both users and clinicians.

Material and methods: Over a 12-month period, the adult CI team at our clinic developed a revised CI care pathway. As part of a clinical innovation project, a preliminary cohort of adult CI users underwent early activation (within 5 days post-implantation) combined with a reduced in-clinic appointment schedule. Participants followed this streamlined care pathway, with progress routinely monitored using remote care tools and CI-specific quality of life measures (CIQOL tools) at regular intervals during the first six months post-activation.

Results: Implementation of the revised care pathway highlighted key considerations, including time investment, multidisciplinary team engagement, logistical preparation, and patient and clinician readiness for remote care. The ongoing study includes a first cohort of 40 participants, of whom 15 have completed follow-up through six months post-activation. Clinical and patient-reported outcome data will be presented at the conference.

Conclusions: Insights from both CI users and clinicians indicate that remote and hybrid care approaches are feasible and acceptable within adult CI care. Drawing on stakeholder perspectives and early findings from the STREAM implementation, we propose a forward-looking, evidence-based transformation of the CI care pathway. Streamlining care through remote and hybrid solutions has the potential to optimize resource allocation, reduce patient and environmental burden, and empower CI users and clinicians, without compromising quality of care.

Free paper 0590

Genetic determinants of partial deafness in cochlear implant candidates: Insights from targeted and whole-exome sequencing

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Introduction: Partial deafness (PD) is characterized by high-frequency hearing loss and may be treated with electric or electric-acoustic stimulation. Although genetic factors play an important role in hearing loss, the molecular basis of PD remains insufficiently understood.

Material and methods: The study included 71 patients with PD, divided into two groups: patients with normal hearing in the low and/or mid-frequency range (PDT-ENS/EC, $n = 37$) and patients with mild to severe hearing loss in these frequencies (PDT-EAS, $n = 34$). All patients tested negative for pathogenic variants in the DFNB1 locus and the m.1555A>G variant in the *MT-RNR1* mitochondrial gene, and had no environmental HL risk factors. Genomic DNA was isolated from peripheral blood or buccal swabs obtained from available family members. Targeted next-generation sequencing (NGS) using a multi-gene panel (237 genes) was performed in 40 probands, and whole exome sequencing (WES) was conducted in 5 of them and in an additional 31 patients, followed by bioinformatic analysis. Family segregation analyses were performed using standard Sanger sequencing.

Results: The genetic cause of PD was identified in 24% of the studied patients (17/71). In the PDT-ENS/EC group, probably causative variants were identified in 14% (5/37) of patients, while in the PDT-EAS group they were detected in 35% (12/34). The majority of identified variants were located in known genes associated with both autosomal recessive and dominant forms of PD; however, nearly half of them were novel and had not previously been reported in the context of the disease. Among the contributors to PDT-ENS/EC, variants in *OSBPL2* and *SYNE4*-two relatively recently described hereditary hearing loss genes-were identified.

Conclusions: Our study showed that postlingual HL more severe in the low-frequency range is associated with a higher detection rate of causative variants in PD patients. Identifying the genetic basis of PD is important for prognosis, therapeutic effectiveness, and recurrence risk.

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Free paper 0431

Genetic perspective on hearing augmentation in patients with rare inner ear malformations

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Introduction: Inner ear malformations (IEMs) occur in up to one-third of children with congenital hearing loss (HL) and significantly affect the choice and outcome of hearing augmentation, including cochlear implants (CI), bone-conduction devices (BCD), and hearing aids (HAs). Despite substantial advances in the genetics of HL, the genetic basis of IEMs remains insufficiently understood.

Material and methods: The study included 56 patients with bilateral HL and radiologically confirmed IEMs (excluding incomplete partition type 2 and enlarged vestibular aqueduct) from the Outpatient Genetic Clinic of the Institute of Physiology and Pathology of Hearing. Genomic DNA extracted from peripheral blood was analyzed using next-generation sequencing with a targeted panel of 237 or 263 HL-related genes. Variants were evaluated according to ACMG/AMP guidelines. Data on hearing devices used by patients were also collected.

Results: A genetic cause of HL and IEMs was identified in 37 of 56 patients (66%). Pathogenic variants in *EYA1* or *SIX1*, causative of branchio-oto-renal spectrum disorders, were found in 15 patients, most commonly presenting with cochlear hypoplasia and benefiting from various hearing augmentation devices. Variants in *CHD7*, causative of CHARGE syndrome, were detected in 12 patients who typically showed semicircular canal hypoplasia or aplasia and predominantly benefited from CI. In 4 of 5 males with incomplete partition type 3, pathogenic variants in *POU3F4* were identified; most of these patients used HAs. In the remaining six patients, genetic causes included rare syndromes, with CI providing benefit.

Conclusions: Genetic etiologies of HL with IEMs are highly heterogeneous, with marked phenotypic variability even among patients carrying variants in the same gene. Differences in hearing augmentation strategies reflect variability in HL severity and anatomical constraints related to IEMs. The high diagnostic yield and identification of rare syndromes underscore the importance of comprehensive genetic testing in patients presenting with IEMs and HL.

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Free paper 0177

Guiding principles of the therapeutic approach to rehabilitation of children with CI – ACIR consensus paper

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Objectives: The developmental outcomes for children following cochlear implantation (CI) surgery can vary considerably. This variability is partly attributable to inconsistencies in postoperative rehabilitation and the absence of relevant standards. The Association for Cochlear Implant Rehabilitation in Germany (ACIR) has addressed this issue by developing guiding principles to establish evidence-based quality standards for rehabilitation following CI surgery in children.

Material and methods: The development of these guiding principles involved a nominal group process, which entailed a review of current guidelines and evidence-based intervention recommendations. This group consisted of nine of the 20 CI centers within ACIR. The authors adapted the principles in accordance with the international consensus statement for family-centered intervention. All ACIR members engage in structured consensus conferences, with the process anticipated to conclude in summer 2026.

Results: A set of twelve guiding principles (P1–12) has been delineated for this therapeutic approach to children with CIs (ages 0–18). P1 underscores the necessity for postoperative rehabilitation for all pediatric patients. P2 to P9 outline the therapeutic approach, which is family-centered and utilizes evidence-based interventions (P2). The primary objectives include empowering families in their interactions with their child and providing coaching in facilitative language strategies (P3). The therapeutic procedure employs an aural-oral approach (P4), recognizing speech and language development as a multidimensional process (P5). Continuous diagnostic monitoring of developmental progress is imperative (P6), and families are instructed in the use of supplementary assistive hearing technologies (P7). Support is also provided to promote identity development and self-reliance, assisting children in navigating life with hearing loss (P8). For children with multiple disabilities, augmentative and alternative communication methods are integrated early in therapy (P9). P10 to P12 address quality assurance, emphasizing a specialized interdisciplinary rehabilitation team (P10), ongoing qualification of team members (P11), and evaluation of the rehabilitation program (P12).

Conclusions: These guiding principles represent the inaugural development of quality standards for evidence-based practices in Germany, aiming to assist service providers in enhancing therapeutic approaches for children receiving CIs. The ACIR consensus paper aligns with existing medical and audiologic guidelines.

Free paper 0512

Head-tracked listening reveals persistent spatial asymmetries in children with UCHL using bone conduction implants

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Children with unilateral conductive hearing loss (UCHL) experience significant binaural hearing disadvantages, including reduced speech intelligibility, impaired spatial hearing, and increased reliance on compensatory strategies in complex acoustic environments. Bone conduction implants (BCIs) provide substantial benefits for speech perception in UCHL, yet their effects on dynamic listening behaviors, particularly headorienting strategies that support better-ear listening, remain poorly understood. This study evaluated how BCI use influences both speech-in-noise performance and head-movement behavior in pediatric UCHL during a spatially complex listening task.

Eight children with UCHL and eight age- and sex-matched normal-hearing (NH) peers completed a head-tracked, virtual-reality speech-in-noise task. Target sentences were presented from 0° or ±60° azimuth amid continuous multitalker babble. Adaptive procedures measured speech reception thresholds (SRTs) across varying signal-to-noise ratios (SNRs). NH children completed binaural and monaural (plug-and-muff) conditions, while UCHL participants were tested unaided and with their BCI activated. Continuous head-movement tracking quantified rotation amplitude, velocity, and duration.

BCI activation significantly improved SRTs for targets presented on the impaired-ear side ($p < 0.05$). Unaided UCHL children showed pronounced SNR asymmetries, requiring far more favorable SNRs for lateral compared to frontal targets. With BCI use, aided performance approached binaural NH performance at moderate SNRs, though performance declined more steeply at poorer SNRs, suggesting persistent limitations in spatial cue utilization. Head-movement analyses revealed that NH children used efficient, low-amplitude turns and minimized movement when spatial cues were ambiguous. In contrast, unaided UCHL children demonstrated larger, more frequent rotations consistent with better-ear listening. BCI activation reduced these compensatory movements but did not normalize them to NH levels, indicating ongoing dependence on monaural strategies and incomplete restoration of binaural advantage.

These findings demonstrate that BCIs improve audibility and modify orienting behavior in pediatric UCHL, but residual

asymmetries continue to limit robust spatial hearing. While BCI use narrows performance gaps with NH peers, children with UCHL still rely on compensatory head movements, particularly under degraded SNR conditions, highlighting the need for rehabilitation strategies targeting binaural integration.

Free paper 0231

Hearing and living with cochlear implants: Psychoacoustic, speech, music, and psychosocial implications

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Traditionally, cochlear implant (CI) outcomes have been evaluated primarily through audiological measures such as hearing thresholds and speech perception scores. However, successful rehabilitation extends beyond auditory performance to include psychosocial well-being, mental health, and social participation. Emerging evidence highlights the complex interaction between auditory outcomes, cognitive abilities, and psychosocial factors in CI users across diverse demographic profiles.

This presentation discusses the relationship between audiological performance and psychosocial status in pediatric and adult CI users, focusing on subjective hearing quality and psychosocial well-being. Auditory perception was assessed using speech perception tests in quiet and noise, including the Hearing in Noise and the Matrix Tests. Perceived sound quality was evaluated with the Hearing Implant Sound Quality Index (HISQUI), alongside measures of pitch and speech perception using fine structure (FS) coding strategies. Psychosocial outcomes were measured using validated instruments, including the Learned Helplessness Scale, Beck Depression Inventory, and Beck Anxiety Inventory.

Results show significant improvements after implantation across auditory and psychosocial domains, though outcomes varied between individuals. Temporal fine structure sensitivity was linked to improvements in complex listening performance such as speech-in-noise and music perception, whilst FS coding strategies were shown to enhance pitch and speech-in-noise perception. Early auditory access through cochlear implantation facilitated effective psychosocial integration into the auditory world, despite persistent difficulties in complex everyday listening situations.

Interestingly, higher education levels were linked to slightly lower self-reported hearing quality, suggesting that personal and professional expectations can shape subjective perceptions beyond actual auditory performance. Similarly, better cognitive skills were associated with lower learned helplessness, indicating that some CI users develop more effective strategies for coping with everyday communication challenges. Several prelingually implanted participants achieved long-term academic and professional success in demanding fields, including medicine, engineering, and media studies, highlighting the benefits of early implantation. Subjective hearing evaluations suggest that self-assessment may be influenced by contextual and psychosocial factors beyond auditory performance alone.

These findings support a multidisciplinary and holistic approach to cochlear implantation, emphasizing the role of audiologists in integrating audiological assessments with patients' subjective experiences to optimize rehabilitation outcomes and long-term quality of life.

Free paper 0051

Hearing Loss Quality of Life Questionnaire (HL-QOL): First study findings on holistic outcomes

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Introduction: The monocentric study *Measuring Effects of Cochlea Implantation Holistically* began in November 2023. It aims to prospectively investigate the holistic effects of cochlear implant (CI) use by assessing quality of life, self-esteem, feelings of loneliness, and difficulties in the workplace. Changes and developments are to be documented at three timepoints: pre-surgery and at 3 and 12 months of device use. The newly developed and validated Hearing Loss Quality of Life Questionnaire (HL-QOL) is being applied for the first time in a large cohort of CI users. Herein we present the results up to the 3-month timepoint.

Material and methods: Initial datasets obtained from surveys of patients receiving their first CI, aged 18–80 years, were evaluated. Quality of life (HL-QOL), loneliness (UCLA Loneliness Scale), self-esteem (RST), and work-related difficulties (WLQ) were assessed. Only complete datasets available by September 2025 were considered, using non-parametric tests in SPSS 29.0.1.0.

Results: 85 people met the inclusion/exclusion criteria and were included in the study. Quality of life improved significantly ($p < 0.001$) from pre-surgery ($M = 79$) to 3-month ($M = 92$). Self-esteem and loneliness remained nearly unchanged on average and did not change significantly. Among the 31 employed participants (36.5%), work-related difficulties were relatively rare both pre- and post-operatively. Age and sex showed no statistically significant effects.

Conclusions: Quality of life in individuals with hearing loss can be substantially improved within the first three months of CI use, regardless of age or sex. It remains to be seen if self-esteem, loneliness, and work-related difficulties will show significant changes after 12 months of CI use.

Free paper 0218

Hearing preservation in cochlear implant surgery

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Introduction: Today the indications of cochlear implant surgery has been expanded to patients who have residual to normal hearing in the low frequency region and ski-sloped mid and high frequency hearing loss but cannot benefit from conventional hearing aid. Current frontiers in implantation involve strategies to preserve residual acoustic hearing and the development of algorithms to combine electric and acoustic hearing.

Material and methods: Low frequency hearing preservation was compared between Round Window (RW) insertion, Extended Round Window (ERW) insertion and cochleostomy, with different types of electrodes and surgical techniques during approach to cochlea, opening the cochlea and after opening the cochlea.

Results: Hearing preservation is higher with RW approach as compared to ERW approach. Hearing preservation with properly done cochleostomy is same as RW approach. Hearing preservation is maximum with newer short, thin and soft electrodes. Slow and smooth electrode insertion shows better results.

Conclusions: RW is most suitable approach for hearing preservation emphasising the importance of natural entry into cochlea without drilling. Correct place of cochleostomy is critical for avoiding damage to inner ear structures. Slow and smooth insertion of electrodes is vital for hearing preservation. Short, thin and soft electrodes causes less intracochlear trauma.

Free paper 0210

Hearing rehabilitation for external and middle ear malformations: When and what?

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Congenital malformations of the external and middle ear represent a heterogeneous group of conditions that frequently result in conductive or mixed hearing loss, with a relevant impact on speech development, educational achievement, and quality of life. Progress in diagnostic imaging, surgical planning, and hearing implant technology has significantly changed the rehabilitative approach to these patients. This presentation reviews current strategies for hearing rehabilitation in external and middle ear malformations, focusing on two key clinical questions: when to intervene and what rehabilitation option to choose. Patient-related factors such as age, degree and type of hearing loss, anatomical constraints, bilateral involvement, and associated syndromes are discussed as the basis for individualized decision-making. Particular emphasis is placed on implantable bone conduction devices and active middle ear implants, which today offer predictable and stable auditory outcomes and often allow earlier functional rehabilitation than traditional reconstructive procedures. In pediatric patients, special attention is given to timing of intervention, highlighting the importance of prioritizing auditory function over aesthetic reconstruction during critical periods of auditory and language development. The indications, benefits, and limitations of the different implantable solutions are critically analyzed. The role of classic atresioplasty is addressed, acknowledging its limited and highly selective indication due to variable long-term hearing results and potential complications. This presentation reflects more than four decades of clinical experience in hearing rehabilitation for patients with external and middle ear malformations, with a focus on long-term functional outcomes.

Free paper 0089

Hearing rehabilitation in inner ear malformations

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Hearing rehabilitation in patients with inner ear malformations (IEMs) requires a highly individualized strategy guided by the underlying anatomical subtype and neural integrity. This talk presents six representative clinical cases spanning a broad spectrum of IEMs: two cases of Incomplete Partition Type I (IP-I), one IP-II (Mondini malformation), one IP-III, one case of Large Vestibular Aqueduct Syndrome (LVAS), one case of Michel aplasia, and one case of cochlear nerve hypoplasia. Rehabilitative outcomes vary markedly among these malformations. Cochlear implantation (CI) is generally feasible in IP-II and IP-III malformations; however, IP-III cases are frequently limited by compromised neural function, resulting in variable auditory benefit. In IP-I malformations, auditory outcomes depend largely on residual neural availability. In contrast, Michel aplasia, characterized by complete labyrinthine absence, precludes implantable hearing solutions. Patients with LVAS and cochlear nerve hypoplasia are often better managed with appropriately fitted hearing aids, achieving functional speech perception. Across this heterogeneous population, successful rehabilitation depends on the integration of radiologic findings, electrophysiological measures, and behavioral auditory performance. The talk highlights the critical role of individualized mapping strategies, speech processor optimization, and ongoing auditory rehabilitation in maximizing functional outcomes for patients with complex IEM anatomy.

Free paper 0141

Hearing restoration strategy in NF2-related schwannomatosis: outcomes of cochlear implantation and auditory brainstem implantation

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Introduction: NF2-related schwannomatosis (NF2-SWN) is mainly characterized by bilateral vestibular schwannomas and progressive bilateral hearing loss. Due to tumor progression and/or treatment-related damage (surgery or radiosurgery), bilateral sensorineural hearing loss is one of the most severe dysfunctions, and restoring hearing is still challenging in NF2-SWN. The main objective is to investigate the hearing restoration strategies in these patients.

Material and methods: We reviewed our NF2 multidisciplinary cohort (until Dec 2025, $n = 242$) and identified all NF2-SWN patients who underwent CI or ABI. CI was offered for non-serviceable hearing with an anatomically intact cochlear nerve, with or without tumor removal; cochlear nerve integrity was verified intraoperatively using eABR/BAEP. Outcomes ABI was offered when the cochlear nerve was anatomically damaged after tumor resection, using the 16-channel Nurotron® WH-01A auditory brainstem prosthesis. Outcomes included aided sound-field pure tone thresholds, open-set word recognition, CAP-II score, environmental sound recognition, and lip-reading word recognition with or without device use.

Results: For hearing restoration, 30 CIs were performed in 27 patients (Jan 2017 – Sep 2025), including CI with tumor removal ($n = 8$, 27%) and CI without tumor removal ($n = 22$, 73%). At the latest follow-up (≥1 year), CI without tumor removal tended to yield better hearing and speech outcomes than CI with tumor removal, without a statistically significant difference. ABI was performed in 25 patients (Jan 2019 – Jul 2025), including 4 patients who received both CI and ABI. In the prospective Nurotron ABI series ($n = 24$; mean age 31 years; M: F 9: 15), mean follow-up was 8.8 ± 4.0 months (range 3–12). Seventeen patients (71%) reached ≥1-year follow-up, and 14/17 (82%) were regular users at 1 year. At latest follow-up, lip-reading alone was 23.3 ± 12.7% and ABI+lip-reading 31.5 ± 17.3%.

Conclusions: A nerve-status–driven pathway is feasible in NF2-SWN: prioritize CI when the cochlear nerve is intact (with or without tumor removal) and use ABI when the bilateral auditory nerves cannot be preserved. Our data support integrated, multidisciplinary hearing rehabilitation and provide early clinical outcomes of a domestically developed 16-channel ABI system.

Free paper 0350

Holistic assessment of cochlear implant outcomes using the international classification of functioning disability and health model: Data analysis of a longitudinal prospective multicenter study

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Purpose: To study outcome after cochlear implantation using the Cochlear Implant (CI) outcome assessment protocol based on the International Classification of Functioning, Disability and Health (ICF) model (CI-ICF).

Material and methods: The raw data of a prospective, longitudinal, multicenter study assessing ICF was analyzed. In total, 72 CI candidates were assessed before and six months after cochlear implantation using CI-ICF protocol. The following assessment tools were used: (1) the Work Rehabilitation Questionnaire (WORQ) revised for CI users, (2) the Abbreviated Profile of Hearing Aid Benefit (APHAB), (3) the Audio Processor Satisfaction Questionnaire (APSQ), (4) the Speech, Spatial, and Qualities of Hearing Questionnaire with 12 items (SSQ12), (5) the Hearing Implant Sound Quality Index 19 (HISQUI19), (6) the Nijmegen Cochlear Implant Questionnaire (NCIQ) (7) pure tone audiometry, (8) speech audiometry in quiet and in noise, and (9) sound localization.

Results: There was a significant improvement of speech discrimination in quiet ($p = 0.015$; $p < 0.001$) and in noise ($p = 0.041$; $p < 0.001$), sound detection (PTA4; $p < 0.001$), tinnitus (WORQ question 7; $p = 0.026$), listening (HISQUI19 total score; $p < 0.001$), communicating with – receiving – spoken messages (APHAB total score; $p < 0.001$), conversation (WORQ question 11; $p < 0.001$), family relationships (WORQ question 14; $p < 0.001$), community life (WORQ question 13; $p = 0.019$), the NCIQ total score ($p < 0.001$) and all NCIQ subdomain scores ($p < 0.001$). Sound localization measured with the SSQ12 Spatial subdomain score significantly improved ($p < 0.001$), while the psychometric sound localization test results did not. There was no significant subjective deterioration of vestibular functioning and lack of substantial

change in sound aversiveness. CI users reported a high level of implant satisfaction after implantation.

Conclusions: This study highlights the positive impact of cochlear implantation on auditory performance, communication, and subjective well-being. The CI-ICF protocol provides a holistic and comprehensive view of the evolution of CI outcomes by not only covering body functions and structures outcomes, but also including results concerning activities and participation as well as environmental factors.

Free paper 0142

Holistic outcomes in paediatric cochlear implant care: An integrated, child-safety and trauma-informed health systems perspective

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Introduction: Paediatric cochlear implant (CI) outcomes are often reported using clinical and audiological measures. While essential, these indicators do not show whether CI care systems are safe, integrated, and responsive to child's lived experience across everyday environments. Integrated, people-centred care and children's rights frameworks highlight safeguarding, wellbeing, participation, and autonomy as core outcomes. This case study reframes paediatric CI outcomes through a child-safety, trauma-informed, integrated health-systems lens.

Material and methods: A qualitative case study used a narrative approach, integrating lived-experience analysis with detailed observations of a paediatric CI user across clinical, educational, and community settings. The analysis examined how system-level decisions – particularly within clinical governance, informed consent, and programming – translated into everyday listening environments. This was complemented by analysis of published paediatric implantation protocols and international policy and health-systems evidence relevant to access, safeguarding, and referral pathways. Data were examined thematically using an integrated care framework incorporating trauma-informed principles (safety, choice, collaboration, empowerment, trust).

Results: Outcomes valued by the child and family extended beyond auditory performance. Key domains included physical comfort and sensory safety, emotional regulation, communication access across settings, agency in device use, participation in learning and peer activities, and sustained engagement with the implant. When supports were responsive to real-world listening demands and respected the child's autonomy, improvements were observed in wellbeing and academic achievement, including increased classroom participation, improved attention and listening stamina, and stronger learning outcomes. Periods of distress, withdrawal, or device refusal aligned with unmet safety, autonomy, or communication needs rather than behavioural non-compliance. Gaps in informed consent and limited health–education communication increased risk for a child with limited capacity to self-advocate.

Conclusions: Holistic paediatric CI outcomes depend on integrated, child-safe systems, not clinic-based metrics alone. Embedding safeguarding and trauma-informed practice supports sustained device use, strengthens ethical care, protects children's rights, and improves participation and educational outcomes. Outcome frameworks should complement audiological measures with indicators of safety, dignity, participation, and quality of life.

Free paper 0104

Host response, microbiome, pain, and aftercare in bone-anchored hearing systems: Integrating clinical, microbiological, and retrieval-based evidence

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Introduction: Bone-anchored hearing systems (BAHS) have advanced considerably through improved implant design and minimally invasive surgical techniques. However, postoperative care still relies largely on empirical antibiotic therapy without microbiological diagnostics, despite increasing evidence that chronic microbial colonisation and biofilm-mediated inflammation contribute to adverse skin reactions and pain. To address this gap, we conducted a series of prospective studies to characterise host tissue responses and microbiome dynamics surrounding BAHS.

Material and methods: Peri-abutment soft tissue and fluid, and electively retrieved implants were analysed using a multimodal framework incorporating histology, immunohistochemistry, microbiology, micro-CT, qPCR, and clinical record review. Gene expression of cytokines and factors related to inflammation, tissue healing, remodelling, and bacterial recognition was assessed in 12 patients. Fifty-seven staphylococcal isolates were characterised by whole-genome sequencing, virulence profiling, biofilm assays, and antibiotic susceptibility testing, with correlations to clinical symptoms including Holgers scores, pain, and hygiene-related factors. In parallel, 21 explanted implants were examined to evaluate the tissue–implant interface in clinically failing systems.

Results: Inflammatory cytokines and Toll-like receptors showed elevated expression compared with baseline, indicating sustained inflammatory activity. Pain and inflammation correlated strongly with virulence traits of clinical isolates. *Staphylococcus aureus* was frequently detected in painful cases, even without overt infection, and was closely associated with inflammatory reactions. Microbiological profiling revealed widespread biofilm formation, hygiene-associated slime production, and notable resistance to fusidic acid and tetracycline – antibiotics commonly used in BAHS aftercare – with resistance increasing further under biofilm conditions. In the retrieval cohort, chronic pain and infection were the primary reasons for implant removal. No consistent association was found between implant design, osseointegration, and clinical outcome, underscoring the dominant influence of microbial and inflammatory factors.

Conclusions: The peri-abutment environment of BAHS exhibits prolonged inflammatory activity alongside diverse bacterial colonisation. Combined *in vivo* and *ex vivo* analyses demonstrate that biofilm-driven staphylococcal colonisation, particularly by *S. aureus,* is central to pain and adverse skin reactions, while current empirical aftercare is insufficient. These findings highlight the need for microbiome-informed diagnostics, improved hygiene strategies, and biofilm-targeted therapies to enhance BAHS management and guide future implant development.

Free paper 0479

How should we perform Osia® implantation: The experiences of two European clinics

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Introduction: The aim of this study is to present the experience of two European clinical centers (Poznan, Poland and Freiburg, Germany) regarding the implantation of the Osia® system.

Material and methods: The study included patients who underwent Osia® OSI200 and OSI300 implantations using the typical technique used in Poznań (49 procedures), the typical technique used in Freiburg (40 procedures), and the new combined technique (10 planned procedures). Patients were and will be analyzed for surgical procedure, postoperative healing, and long-term skin integrity and aesthetic outcomes.

Results: Most patients who underwent the typical surgical procedure did not experience any serious complications. Excellent skin integrity was achieved in both centers, and scar visibility was minimal in most patients. The Freiburg center (typical technique) achieved significantly better results than the center in Poznan in terms of retroauricular bump visibility or palpability ($p < 0.0001$) and postoperative pain ($p < 0.05$). However, patients in Poznan (typical technique) experienced less numbness ($p < 0.05$). Preliminary results of the new combined Poznan-Freiburg technique will also be presented.

Conclusions: Implantation of the Osia® system is a safe procedure, with postoperative complications occurring in a small percentage of cases. The typical surgical technique used in Freiburg reduces the visibility and palpability of the retroauricular bump and postoperative pain but is associated with a slightly higher risk of numbness and, in some cases, a more visible scar compared to the typical technique used in Poznan. We hope that the new joint Poznan–Freiburg technique will combine the advantages of both typical methods.

Free paper 0047

How successful is CI for SSD MED-EL CI users in the long term?

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Introduction: Cochlear implantation for single-sided deafness (SSD) has become an increasingly adopted intervention, offering improvements in speech perception in noise, spatial hearing, quality of life, and tinnitus reduction. While the benefits of implantation are well documented, more recently poor device usage has been reported. Also little is known about how real-world device use relates to clinical outcomes over time.

Objective: To examine longitudinal objective and subjective outcomes following cochlear implantation for SSD and to evaluate patterns of daily device use and its association with clinical benefit.

Material and methods: Data from 139 adults implanted with a MED-EL device were included (age range 21–86 years). Outcomes were tracked across multiple postoperative intervals (3, 6, 12, 24 months, and long-term). Speech-in-noise was assessed in three spatial configurations (S0/N0, S0/Nci, Sci/Nhe), and subjective outcomes were measured using the SSQ and TRQ questionnaires. Daily device use was evaluated across intervals and examined in relation to clinical outcomes.

Results: Speech-in-noise performance improved across all spatial configurations, with the most rapid and sustained gains observed for Sci/Nhe, reflecting robust and enduring head-shadow benefit. Significant improvements were also evident in SSQ Total, Speech, Spatial, and Listening Effort subscales, with benefits emerging early and remaining stable long-term. Tinnitus distress (TRQ) showed a marked and sustained reduction from 3 months onward. Device use remained high and stable, averaging 6.5–8 hours/day across follow-up intervals, with no significant decline over time. Two meaningful relationships were identified: (1) Higher daily device use was associated with lower tinnitus distress, independent of time since implantation; (2) For Sci/Nhe, higher device use became predictive of better spatial hearing performance from 6 months onward, suggesting that established, consistent use supports long-term auditory adaptation.

Conclusions: Cochlear implantation for SSD provides early, sustained improvements in speech-in-noise performance, subjective hearing quality, and tinnitus relief. Device use remains consistently high among recipients and plays a meaningful role in long-term adaptation, particularly in spatial hearing and tinnitus reduction. These findings underscore the clinical importance of supporting and monitoring consistent device use as part of routine rehabilitation for SSD.

Free paper 0115

Hypertonic saline (4.54%) versus mannitol (20%) for brain relaxation in pediatric auditory brainstem implantation: A single-center retrospective observational cohort study

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Introduction: Mannitol is frequently utilized to achieve intracranial brain relaxation during the retrosigmoid approach for auditory brainstem implantation (ABI). Hypertonic saline (HS) is an alternative for reducing intracranial pressure; however, its application during ABI surgery remains underinvestigated. We aimed to compare the efficacy and safety of HS and mannitol for maintaining brain relaxation.

Material and methods: This single-center retrospective cohort study included pediatric patients undergoing ABI surgery from September 2020 to January 2022 who received only 4.54% HS or 20% mannitol for brain relaxation. The analysis involved initial doses, subsequent doses, and dosing intervals of the two hyperosmolar solutions, as well as the time elapsed from meningeal opening to the first ABI electrode placement attempt. Additionally, the analysis encompassed electrolyte testing, hemodynamic variables, urine output, blood transfusion, second surgeries, adverse events, intensive care unit length of stay, and 30-day mortality.

Results: We analyzed 68 consecutive pediatric patients; 26 and 42 in the HS and mannitol groups, respectively. The HS group exhibited a reduced rate of supplementary use (7.7% vs 31%) and lower total urine volume. Perioperative outcomes, mortality, and length of intensive care unit stay did not exhibit significant between-group differences, despite transient increases in blood sodium and chloride observed within 2 h after HS infusion.

Conclusions: In pediatric ABI surgery, as an osmotherapy for cerebral relaxation, 4.54% HS demonstrated a lower likelihood of necessitating additional supplementation than 20% mannitol. Furthermore, the diuretic effect of HS was weak, and the increase in electrolyte levels during surgery was temporary and slight.

Free paper 0333

Impact of electrode position and anatomy-based fitting on subjective music perception in cochlear implant users

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Introduction: This prospectively pilot study evaluated whether anatomy-based frequency allocation (anatomy-based mapping) affects subjective music perception in experienced cochlear implant users. The primary endpoint was the Part I difference score of the Münster Music Questionnaire (anatomy-based minus standard mapping). Secondary endpoints comprised selected Part II items (listening context, listening mode, motivation, preferences). Exploratory analyses examined instrument recognition and preference, associations with electrode insertion angle, and potential sequence/order effects.

Material and methods: In a within-subject crossover design, all participants completed both mapping conditions with varied starting sequence (Group A: standard –> anatomy-based, $n = 9$; Group B: anatomy-based –> standard, $n = 3$). After each switch, the identical questionnaire was repeated after a 2–5 week adaptation interval. Inclusion criteria were CI use ≥1 year, Freiburg monosyllables ≥50% at 65 dB, and Oldenburg Sentence Test SNR ≤+2 dB. Electrode insertion angle was quantified using OTOPLAN. Ordinal variables were analyzed with paired Wilcoxon signed-rank tests, nominal multicategorical variables with the Stuart–Maxwell test, and paired dichotomous variables with McNemar tests; false discovery rate (FDR) correction was applied for multiple comparisons.

Results: In the total sample ($n = 12$), the Part I difference score indicated an overall benefit of anatomy-based mapping (mean 44.25; SD = 38.65; median 47.5; range –47 to 95) with pronounced inter-individual variability. No significant difference between starting sequences was observed for the primary endpoint (Welch's t $p = 0.615$; Cohen's $d = –0.25$). The Part I delta-score was not significantly associated with insertion angle (Spearman rho = –0.329; $p = 0.297$). Self-reported music listening duration increased under anatomy-based mapping ($p = 0.019$), whereas most other Part II items remained stable. Exploratory instrument-level analyses showed descriptive increases in recognition (most pronounced for guitar: 50.0% –> 91.7%; McNemar $p \approx 0.074$), but no instrument comparisons remained significant after FDR correction. Instrument preference patterns showed descriptive shifts without FDR-significant effects.

Conclusions: Anatomy-based mapping was associated with a positive mean subjective benefit and significantly longer music listening duration in experienced CI users, suggesting potential clinical relevance. However, response heterogeneity and indications of sequence/adaptation effects, together with non-significant FDR-adjusted instrument-level results, warrant larger, balanced crossover trials with standardized (possibly longer) adaptation periods, predefined endpoint hierarchies, and complementary objective music outcomes.

Free paper 0453

Impedance changes after years of cochlear implant usage

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Introduction: Impedances are standard measurement, which evaluates the transition between electrode contact and cochlear tissue. They can describe changes in cochlear tissue as a reaction for foreign body or some inflammatory process. Bigger

changes can influence hearing benefit. Standardly we can see changes in impedances in stabilization period during first weeks of stimulation, after that period they should stabilize.

Aims: The aim of our study is to compare stability of impedances on different electrodes during years of cochlear implant usage in children.

Material and methods: Our study included 51 ears in 33 patients implanted with Medel cochlear implant during 2015–2023. Mean day usage of the processor is 10.89 ± 2.47 hours, min 6.8 hours/day. 4 patients have one electrode turned off - 3 electrode 12, 1 electrode 8. Other patients had all electrodes turned on. In all cases we analysed impedances during first fitting, second fitting (1–2 weeks), 1 month, 3 months, 1 year and 3 years after the first fitting. Impedance analysis was done on each electrode and we checked their changes during mentioned interval. We used correlation of impedance profile between each measurement period.

Results: The correlation of impedance profile was worse between second fitting and one month ($R = 0.44$) The best correlation was between 1 and 3 years ($R = 0.98$). From the analysis can be seen that impedances still goes down after 3 years from the first fitting. Biggest difference and highest impedances can be seen in apex where impedances started 10.04 ± 1.53 kΩ, after 3 years 7.23 ± 1.34 kΩs. In mid of cochlea impedances started at 6.24±0.49 kΩ, after 3 years 4.67 ± 0.48 kΩ and in base 6.52 ± 0.72 to 5.59 ± 1.22 kΩ.

Conclusions: Corelation analysis show stabilization of impedance profile after first year of CI usage, but after 3 years of CI usage impedances still go down. In our cohort of patients 25.4% has more than two times higher impedances in apex than in mid or base part of cochlea.

Free paper 0045

Improving CI mapping accuracy using cortical auditory evoked responses (CAEPs)

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Introduction: The current standard programming of hearing implants relies heavily on subjective feedback from patients to determine the Threshold (T) and Most Comfortable Levels (C/MCL). However, subjective responses may not be reliable, especially in patients with cognitive impairments, non-English speakers, or children. Objective tools like CAEPs have the potential to eliminate subjectivity and expedite the creation of optimal maps for better hearing outcomes. Acoustic CAEP measurement as a tool to optimise CI outcome in both SSD and BD.

Objectives: This study aimed to explore whether acoustic cortical auditory evoked potential (aCAEP) measures could validate cochlear implant (CI) maps and enhance auditory outcomes in adults with single-sided deafness (SSD) or bilateral hearing loss.

Material and methods: Researchers measured aCAEPs in CI recipients using speech tokens (/m/, /g/, /t/, /s/). If aCAEP responses were absent for any speech tokens, the CI map was adjusted and CAEP measures were repeated. Speech testing occurred before and after CAEP-guided map adjustments.

Results: The study included 67 SSD-CI and 108 unilateral CI users. Initially, all CIs were mapped based on subjective loudness perception. Out of these, 65 users exhibited aCAEP responses for all four speech tokens and were considered optimized from the start. However, 110 participants lacked an aCAEP response for at least one token, leading to CI map adjustments. These adjustments enabled aCAEP responses for all four speech tokens in 54 individuals. Speech perception significantly improved in both quiet and noisy environments after aCAEP-based adjustments.

Conclusions: The study successfully employed aCAEP recordings to validate CI mapping and enhance speech outcomes in CI users. This objective tool shows promise in mitigating the limitations associated with subjective feedback and improving the efficiency and effectiveness of CI mapping.

Free paper 0122

In vivo imaging of cochlear implant electrode orientation relative to scalar tilt

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Objective: Visualization of cochlear implant (CI) electrode contact position offers insights into electrode-cochlea biomechanics. Prior in vivo imaging studies have assessed electrode distances to a fixed modiolar axis, but electrodes' orientation within the cochlear canal and their relationship to the scala tympani's dynamic anatomical tilt have not been investigated. This study employed in vivo flat-panel computed tomography (FPCT) imaging to examine the flexibility and dynamic behavior of lateral wall arrays.

Material and methods: This retrospective cohort study included eight MED-EL FLEX28 CI users. FPCT images were acquired, and reconstructions were aligned to a standardized cochlear coordinate system. Vectors perpendicular to electrode contacts were used to estimate contact orientation using mid-modiolar image slices and 3D renderings. Anatomical landmarks were used to calculate scalar tilt.

Results: A significant correlation was observed between scalar tilt and contact orientation ($r = –0.44$, $p < 0.0001$). The scala tympani exhibited its greatest tilt relative to the X-Y plane in the hook region, then transitioned to a parallel orientation at approximately 180° angular depth before increasing tilt again between 180° and 360°. Electrode arrays demonstrated rotational alignment with the scala between 180° and 360° angular insertion depth.

Conclusions: Flexible lateral wall electrode arrays accommodate the natural anatomical tilt of the scala tympani, with

contact orientation aligning to cochlear structures for much of the insertion trajectory. This in vivo analysis provides new insights into the biomechanical interactions of electrode arrays within the cochlea and may have implications for structure preservation, spectral resolution, and CI stimulation patterns.

Free paper 0007

Incidence of trans-impedance matrix pattern variants in patients with normal anatomy receiving cochlear implantation

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Introduction: Transimpedance (TIM) heatmap patterns have previously been described and categorized for patients at risk for cochlear abnormalities. The implications of these patterns are not well understood. Comparing the incidence of TIM pattern categories in patients with no known risk factors for cochlear anomalies is insightful, serving as the impetus for this research.

Material and methods: Patients >6 months of age with normal gross cochlear anatomy and no concern for fibrosis that had intra-operative TIM testing completed were included. The incidence of normal and variant TIM patterns was evaluated and compared to electrode position found on intra-operative X-ray.

Results: There were 310 ears that underwent implantation and subsequent intra-operative TIM assessment. Of these, 86.4% ($n = 268$) of the implants demonstrated a normal TIM heatmap, while the remaining demonstrated historically described pattern variants. The incidence of normal TIM heatmaps was higher than historically studied patients that were at risk for cochlear abnormalities. Pattern variants also appeared to be influenced by electrode type.

Conclusions: There is a decreased incidence of TIM heatmap pattern variants in CI recipients with normal gross cochlear anatomy compared to patients that were at risk for cochlear abnormalities. Further study to elucidate what drives pattern variants in patients with risk of cochlear abnormality is warranted to better understand the intracochlear microenvironment and current spread implications.

Free paper 0532

Increasing access to CI: A global collaborative advocacy network, CIICA

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Introduction: CI in children and adults is proven effective and cost-effective, but it is estimated that only 1 in 20 of those who could benefit receive implant and access remains variable even in high income countries.

Material and methods: A global consultation of CI users, families, professionals and industry exploring views on: (1) The barriers to access to CI; (2) Overcoming the barriers; (3) Examples of successful advocacy. Interviews with 32 individuals from 22 countries, and survey of 63 individuals from 28 countries. Emergent themes were analysed and recommendations for increasing access to CI made.

Results: *The major barriers to access to CI* – lack of awareness of the impact of hearing loss and CI, of referral pathways, of funding. *The strengths of advocacy work* – increased grass roots action in time of societal change, powerful messages, decision makers listen to the user voice, inclusion of diversity of views, flexible and responsive. *The challenges of advocacy work* – managing diversity of views, mixed messages, shortage of time and resources for volunteers, lack of advocacy training. Support for developing collaborative advocacy work – advocacy/user/family groups working together for increased CI access and long-term management with 52 examples of advocacy success shared by user/family groups across the globe.

Conclusions: (1) "Without awareness, there is no demand; without demand no services", Der, 2025: the network increases global awareness and demand supported by evidence and passion. (2) "Effective advocacy transforms awareness into action, and action into change", Sara Rubinelli, CIICA, 2026. (3) "Access to CI shouldn't depend on your age or how well you navigate the system. Get CI advocacy on the agenda – politicians aren't waiting for you", Rob Beenders, CIICA, 2025.

CIICA (CI International Community of Action) – established as a network, with over 700 individuals and 130 organisations in 76 countries and shared global goal of increasing access to CI and lifelong services. Actions: Interactive website providing advocacy training, advocacy resources, accessible evidence to support advocacy, online events sharing advocacy successes, global research initiatives. Examples of change achieved in policy, funding decisions and practice by network members shared to inspire action.

Free paper 0113

Influence of age at implantation and implant duration on auditory and speech-language outcomes in children with auditory brainstem implants

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Introduction: Auditory brainstem implants (ABI) are used in children with severe to profound hearing loss who are not candidates for cochlear implantation. Although previous studies have demonstrated the benefits of ABI for auditory perception, the effects of implantation age and implant duration on long-term speech and language development remain unclear.

Objective: To investigate the influence of age at implantation and implant duration on post-operative auditory and speech-language outcomes in pediatric ABI users.

Material and methods: This retrospective study included 136 children aged 1.42–8.61 years who underwent ABI surgery between 2019 and 2025 and were followed for at least 2 years. Among them, 44 children who developed speech were analyzed. Associations between age at implantation, implant duration, pre-operative CAP scores, and auditory and speech-language outcomes 2–6 years after implantation were examined.

Results: The 44 children with speech development had a mean age of 7.64 ± 1.62 years (20 males, 24 females). Post-operative follow-up durations were 2 years ($n = 8$), 3 years ($n = 18$), 4 years ($n = 14$), 5 years ($n = 2$), and 6 years ($n = 2$). Based on implantation age, children were divided into those implanted before 3 years ($n = 14$) and after 3 years ($n = 30$). Children implanted before 3 years showed significantly better aided PTA ($p = 0.035$), CAP ($p = 0.032$), IT-MAIS/MAIS ($p = 0.044$), and MUSS scores ($p = 0.046$) than those implanted later. Speech intelligibility was also significantly higher in the younger implantation group. In addition, speech intelligibility increased with implant duration, with mean values of 31.54% at 2 years, 42.54% at 3 years, 54.26% at 4 years, and reaching approximately 97% at 6 years post-implantation.

Conclusions: ABI significantly improves auditory and speech-language outcomes in children, particularly when implantation occurs before 3 years of age. Speech intelligibility continues to improve with longer implant use, approaching near-normal levels after extended follow-up. These findings underscore the importance of early implantation and long-term rehabilitation in pediatric ABI recipients.

Free paper 0672

Intraindividual comparison of MRI artifact size of 2nd and 3rd generation CI magnets

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Introduction: The diagnostic accuracy of magnetic resonance imaging (MRI) examinations is compromised by image artifacts in cochlear implantees. Statical magnetic fields generated by 3.0-T scanners have the potential to demagnetize implants. The development of rotatable implant magnets was aimed at supporting the advancement of 3.0-T MRI scanners and eliminating the risk of demagnetization of cochlear implant magnets.

Objective: The aim of this study was to compare the image artifacts caused by first- and second-generation rotatable cochlear implant magnets in 3.0 T MRI examinations.

Material and methods: Three participants with first- and second-generation rotatable cochlear implant magnets underwent 3.0 T MRI T2W TSE sequences. The cochlear implant was attached to the head at the implanted side. The dimensions of the image artifact were assessed in the transverse plane.

Results: Intra-individual cross-sectional evaluations revealed that with a combined inaccuracy of 5 mm at a resolution of 2 mm, the images affected by the cochlear implant presented the same maximum image artifact size of 125 mm for all subjects for the rotatable cochlear implant magnets of the 1st and 2nd generation.

Conclusions: No difference in the size of image artifacts was detected that was within the limit of error established by the resolution, the localized scan shift, and the replicability of the head tilt angle relative to the chest in a human subject. It is assumed that better magnetic positioning can be reached without increasing the magnetic artifact size.

Free paper 0392

Intraoperative cochlear microphonic response patterns and postoperative hearing preservation: Insights from a retrospective cohort

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Introduction: Preserving residual hearing (RH) has become a major objective in cochlear implantation. Despite advances in electrode design and surgical techniques, postoperative RH loss remains common. Intracochlear electrocochleography (ECochG) provides real-time electrophysiological feedback during insertion and is considered a promising biomarker of cochlear integrity. Different cochlear microphonic (CM) response patterns have been described, but their clinical relevance remains insufficiently understood. In particular, it is unclear whether CM patterns are associated with postoperative changes in low-frequency hearing thresholds.

Objectives: The primary objective of this study was to determine whether intraoperative CM response patterns are associated with postoperative loss of RH. Secondary objectives were to assess whether electrode configuration and etiology of hearing loss provide additional explanatory value in predicting HP outcomes.

Material and methods: A retrospective analysis was conducted on patients with preoperative RH who received a cochlear implant at Ghent University Hospital between August 2019 and December 2025 using Slim Straight, SlimJ, Slim Modiolar, or Mid-Scala arrays. Continuous CM recordings were obtained from the most apical electrode contact using 250 Hz and 500Hz acoustic stimuli. Outcomes measures included CM response pattern, maximal CM amplitude [μV], and hearing preservation defined as the absolute low-frequency pure-tone average (LFPTA; 250–500 Hz) threshold shift between pre- and postoperative values.

Results: Forty-two patients (mean age 50 years) were included. The mean absolute LFPTA shift was 27.68 dB HL (SD = 20.670). Most patients demonstrated complete HP (42.9%), while one showed complete loss of RH (2.4%). A type A CM response pattern was most common (42.9%). CM response pattern, electrode configuration, and etiology were not significant predictors of LFPTA threshold shift. Although no statistically significant associations were observed, estimated marginal means showed a trend toward smaller LFPTA shift for Type A, C and CC patterns compared to Type B and D.

Conclusions: Intraoperative CM response pattern, etiology of hearing loss, and electrode configuration were not robust predictors of postoperative RH. However, observed trends suggest more favorable preservation outcomes for CM patterns A, C, and CC. Larger studies are needed to confirm these preliminary findings and clarify the clinical relevance of CM response patterns.

Free paper 0542

Investigating the effect of cochlear implant usage metrics on cortical auditory-evoked potential responses in adult recipients post-implantation

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Introduction: The present study seeks to expand upon prior research by examining the effects of usage metrics, CI usage frequency (average daily CI use) and duration (total years of CI use) on post-operative outcomes in unilateral CI recipients.

Objectives: The primary objective was to investigate the relationship between CI usage frequency and duration on electrically evoked cortical auditory-evoked potential (eCAEP) response latency [ms] and amplitude [μV]. A secondary aim was to explore associations between eCAEP responses, CI outcomes, inter-patient variability, and device-related factors.

Material and methods: Adult CI users ($n = 41$) who previously exhibited absent acoustically evoked CAEP responses participated. eCAEP P1-N1-P2 peak latency and amplitude were recorded for apical, medial, and basal electrode contacts when present. CI duration was defined as the number of years between the date of CI activation and date that eCAEP testing was performed. CI usage frequency was defined as the average number of hours per day of audio processor use, which was recorded using the CI programming software.

Results: Detectable eCAEP responses were observed in 27 participants (65.85%) across one or more electrode contacts. Of these, 18 (43.9%) showed responses at all three contacts, seven (17.07%) at two contacts, and two (4.88%) at one contact. The remaining participants ($n = 14$, 34.15%) had absent or undetectable responses. Usage frequency data were available for 32 (78%) participants (median 10.35 hours/day, range 0.2–16 hours/day). Participants with detectable basal electrode responses ($n = 14$) demonstrated significantly higher daily CI use (11.8 hours/day) compared to those with non-detectable responses (6.25 hours/day; $p = 0.026$). Higher usage frequency was associated with reduced N1, P2, and P1-N1 inter-peak latencies ($p \leq 0.015$). CI duration did not significantly differ between response groups; however, longer duration was associated with increased P2 and N1-P2 amplitudes ($p \leq 0.009$). Notably, most participants who previously exhibited absent acoustic CAEPs developed eCAEP responses following consistent CI use.

Conclusions: Overall, these findings suggest that greater daily CI use is associated with reduced eCAEP response latency, while longer CI experience is associated with larger response amplitudes. Together, these results highlight the importance of consistent device use in adult CI users.

Free paper 0170

Investigating the impact of cochlear morphology on outcomes in cochlear implant recipients

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Introduction: Due to time constraints, most previous work has explored relationships between a narrow set of imaging metrics and behavioural outcomes. As a result, it is unclear how other anatomical characteristics derived from clinical computed tomography (CT) scans relate to a diverse set of psychophysical and speech performance metrics. The objective of this work was to relate psychophysical and speech measures from cochlear implant users to metrics derived from CT scans.

Material and methods: Fourteen adult cochlear implant users ($N = 20$ ears) implanted with MED-EL arrays (fifteen 28 mm and five 31.5 mm) with pre- and/or post-operative CT scans participated in the study. All speech and psychophysical scores were acquired in a sound booth, using participants' clinical maps, including consonant-nucleus-consonant (CNC) words, AzBio sentences, quick spectral modulation detection (QSMD), and pitch ranking. A deep learning algorithm was used to automatically segment the intracochlear scalae on pre-operative scans. Post-operative scans were rigidly registered to the pre-operative scans, and imaging metrics including angular insertion depth (AID), distance-to-modiolus, angular separation between contacts, and scalar volume were extracted. Pearson correlations were used to assess the relationships between imaging metrics with psychophysical and speech metrics.

Results: Preliminary analyses suggest that both speech and psychophysical measures are associated with multiple pre- and post-operative image-derived morphological characteristics. Some notable relationships include a statistically significant relationship between CNC scores in quiet and the total AID ($R = 0.65$, $p = 0.0019$); a statistically significant relationship between CNC scores in quiet and mean angular separation ($R = 0.6$, $p = 0.0048$); and a statistically significant relationship between both full ($R = 0.57$, $p = 0.035$) and restricted ($R = 0.53$, $p = 0.049$) bandwidth QSMD and scala tympani volume.

Conclusions: Preliminary results demonstrate that speech and psychophysical performance in cochlear implant users are influenced by multiple anatomical characteristics derived from clinical pre- and post-operative scans. Relationships were observed between AID, angular separation, and volume with speech recognition and/or psychophysical performance. These findings highlight the potential influence of multiple anatomical factors on cochlear implant outcomes. Expanding this work to larger cohorts will be essential for confirming these trends and guiding individualized clinical programming.

Free paper 0041

Investigations on directional hearing with one-sided fitting of an active middle ear implant or bone conduction hearing implant

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Objective: Implantable hearing systems can be a treatment option for patients with conductive or combined unilateral hearing loss. Because indications overlap, a systematic comparison of audiologic performance is clinically relevant. In particular, unilateral stimulation of the ipsilateral cochlea using an active middle ear implant (Vibrant Soundbridge, VSB) may provide advantages for binaural processing compared to bone-conduction implants (Bonebridge, BB), which stimulate both cochleae simultaneously. This study investigates directional hearing abilities and speech intelligibility in unilaterally implanted VSB and BB users.

Material and methods: Thirteen unilateral VSB users and eight unilateral BB users (MED-EL, Austria) were included. All implantations were performed at least six months prior to testing. The contralateral ear exhibited at most mild hearing loss (pure-tone average ≤30 dB across four frequencies). Sound localization, speech intelligibility (Freiburg monosyllabic word test and Oldenburg sentence test), audiometric thresholds, and patient-reported outcome measures (International Outcome Inventory for Hearing Aids; Speech, Spatial and Qualities of Hearing Scale-12) were assessed.

Results: The groups did not differ significantly regarding age (VSB: 44.6 ± 14.4 years; BB: 44.5 ± 17.3 years), bone-conduction thresholds (VSB: 26.4 ± 6.9 dB; BB: 23.3 ± 6.7 dB), or speech intelligibility in the Freiburg monosyllabic word test (VSB: 80.0% ± 16.7%; BB: 69.4% ± 13.2%) and Oldenburg sentence test (VSB: −8.9 ± 2.6 dB; BB: −7.2 ± 4.4 dB). Implantation was 4.2 ± 2.7 years (VSB) and 7.5 ± 3.5 years (BB) ($p < 0.05$). Sound localization tended to be within the reference range more often in VSB users (56% ± 16%) than in BB users (49% ± 12.9%), though without statistical significance. VSB users showed a tendency toward smaller lateral localization error, especially for frontal sound presentation. For lateral stimuli above 60°, both groups increasingly perceived sound contralateral to the source. Subjective hearing disability was significantly lower in the VSB group.

Conclusions: When comparing the sound localization ability between BB and VSB users, the study displayed a trend toward better results with the VSB. Larger patient cohorts are required to confirm these findings and to determine the clinical relevance of the observed differences.

Free paper 0371

Is the *Symbiotic* approach the ideal regulation modality for bimodal hearing adults?

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Introduction: Hearing results for bimodal hearing subjects are controversial, depending on the different modalities of regulation used for the cochlear implant (CI) and the contralateral hearing aid (HA), namely *Classic/conventional*, *Synchronized* and *Symbiotic* regulation approaches. In international surveys of bimodal hearing and CI provision services for adults more than 60% of respondents indicated that they did not adjust HA programming after the CI was activated, due to lack of experience in HA fitting or long time-consuming procedure. Only 32 to 64% of CI users regularly wear contralateral HAs, despite the well-known benefits of bimodal hearing (e.g., speech perception in noise, sound localization, better music perception). This is not surprising because in *Classic/conventional* and *Synchronized* regulations, CI sound processors are fitted by the audiologist in the Center, while the contralateral HAs are regulated independently by a different HA specialist with conventional or manufacturers' HA prescriptive formulas.

Objective: This study aims to verify that the innovative *Symbiotic* regulation of the CI with an integrated HA and a dedicated fitting formula (Adaptive Phonak Digital Bimodal-APDB), performed by the same audiologist, allows to achieve adequate rehabilitative hearing levels, using both devices.

Material and methods: Thirty adults (12 females; 18 males; age range: 18–69 years) with bimodal hearing have been enrolled in a 18-month study and divided into three groups of ten subjects for each of the regulation modes (*Classic/conventional*, *Synchronized* and *Symbiotic*). Statistical analysis of demographic characteristics and hearing outcomes observed in the three groups was conducted using the *R* statistical software.

Results: For all subjects, the *Symbiotic* regulation approach allowed significantly better hearing performances ($p < 0.05$) compared to those obtained to either the *Classic/conventional* or the *Synchronized* regulations. Nine out of 10 subjects dismissed their HAs in both *Classic/conventional* and *Synchronized* groups, using their CI alone. In the *Symbiotic* group, all (10/10) subjects retained their HA along with the CI.

Conclusions: The *Symbiotic* bimodal fitting formula provides significant hearing benefits compared to *Classic/conventional* and *Synchronized* regulations and it proves to be the ideal adjustment and coupling modality between a CI and contralateral integrated HA in bimodal listeners.

Free paper 0134

Knowledge, attitudes, and practices of pediatricians regarding profound sensorineural hearing loss

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Objectives: To assess the knowledge, attitudes, and practices of pediatricians regarding profound sensorineural hearing loss (PSNHL), its management, and cochlear implantation in Karachi, Pakistan.

Material and methods: *Study design*: Prospective cross-sectional study. *Place and duration of study*: Section of Otorhinolaryngology, Department of Surgery, Aga Khan University Hospital, Karachi, conducted over six months following ERC approval (ERC 2025-11068-32918) on 17-Jan-2025. A validated 25-item questionnaire was administered to 117 pediatricians using convenience sampling. The tool assessed knowledge (14 items), attitudes (7 items), and practices (4 items) regarding PSNHL and cochlear implants. Content validity (S-CVI = 0.95) and internal consistency (knowledge $\alpha = 0.82$, attitude $\alpha = 0.76$, practice $\alpha = 0.79$) were established. Data were collected via online forms by trained personnel.

Results: Among pediatricians surveyed, 16.2% reported being very familiar with PSNHL, while 59.0% were somewhat familiar. Confidence in diagnosing PSNHL was moderate, with 47.0% somewhat confident and 28.2% not confident. Awareness of national SNHL guidelines was low (62.4% unaware). Referral practices varied: 32.5% referred eligible children for cochlear implant evaluation most of the time, whereas 16.2% never referred. Notably, 63.2% could not name two or more local cochlear implant centers. Attitudes were generally positive; 79.5% were interested in further training, and 68.4% considered post-implant rehabilitation extremely important. Subgroup analyses revealed that consultants demonstrated significantly better clinical practices related to cochlear implant referrals compared to residents (67% vs 42%; $p < 0.001$), despite no significant differences in knowledge ($p = 0.075$) and attitudes ($p = 0.105$). No significant differences were observed in knowledge ($p = 0.238$), attitudes ($p = 0.576$), or practices ($p = 0.327$) between pediatricians practicing in private versus public hospitals. Both groups identified financial constraints and limited access to services as primary barriers.

Conclusions: Knowledge gaps and limited awareness hinder timely PSNHL intervention, particularly Cochlear Implants, despite generally positive attitudes. Targeted CME and national guidelines are urgently needed.

Free paper 0180

Lack of auditory sensation through a cochlear implant, but present electrical compound action potentials in patients with translabyrinthine vestibular schwannoma resection

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Introduction: Auditory nerve monitoring via electrically evoked compound action potentials (eCAP) can be used to assess cochlear neural integrity during vestibular schwannoma (VS) resection. Herein we report on 5 cochlear implant (CI) patients who underwent VS translabyrinthine resection with present eCAP responses both intraoperatively and postoperatively. Patients either did not perceive any sound through their CI or rapidly adapted to electrical stimulation, suggesting that the presence of eCAP does not guarantee preservation of auditory nerve function in patients with VS resection.

Material and methods: Five patients underwent simultaneous VS translabyrinthine resection and cochlear implantation who had present eCAP responses intraoperatively and postoperatively. Intracochlear electrodes were used to elicit and record eCAP responses intraoperatively during VS tumor resection and again postoperatively at subsequent audiology programming visits.

Results: The five patients underwent simultaneous translabyrinthine VS resection and cochlear implantation without any reported surgical complications. All patients had eCAP responses present during their VS resection and for at least 50 days post-surgery. Three of the five patients did not perceive any sound with the cochlear implant. Present eCAPs in these three patients may be attributed to a response from the distal end of the auditory nerve, downstream from the VS. The other two patients heard non-speech sounds (i.e. beeps), but these sounds quickly became inaudible, indicating that their auditory nerves lacked the ability to integrate the electrical stimulus over time. In all five patients, surgical insult disrupted critical neural function, which was not detected by eCAP alone.

Conclusions: The presence of an eCAP response through the postoperative period does not guarantee auditory sensation through a CI. While eCAP measurements provide insight into the function of the distal end of the nerve, it does not ascertain integrity or function of the larger auditory neural pathway. Therefore, eCAPs should not be used in isolation to monitor auditory nerve function during VS resection but may instead be used in conjunction with objective measures like electrically evoked stapedial reflex that assess higher auditory pathways and rely on the auditory system's ability to temporally integrate signals.

Free paper 0363

Late-onset edema in cochlear implant recipients: An evaluative study

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Objective: To characterize and manage edema as a late complication in patients with cochlear implants (CI).

Material and methods: A retrospective study was conducted using medical records from 2,368 implanted ears at the Cochlear Implant Section (SIC) of the Craniofacial Anomalies Rehabilitation Hospital (HRAC/USP – Bauru). Fifty ears presenting any type of late edema (≥ 3 months postoperatively) over the implant body were eligible for inclusion. The following characteristics were assessed: Demographic and implant-related variables: sex; age at implantation; laterality; device brand and model; interval between surgery and onset of edema; age at edema episode; and associated comorbidities. Clinical characteristics of the episode: side of edema; probable etiology; presence of associated pain; functional impact on device use; implant integrity; and recurrence. Management and clinical outcomes: adopted approach (conservative treatment, hospitalization, or surgery); type of procedure performed; and clinical evolution after intervention.

Results: Late-onset edema occurred in 2.15% of implanted ears, with a mean interval of 6.1 years between surgery and the first episode. Most edema cases occurred in pediatric patients (0–12 years), representing 57%, and the most common cause was idiopathic. Pain associated with edema was reported in 58.1% of cases but was not a predictor of worse prognosis. Regarding management, 77.4% of episodes were treated conservatively, and 50% of these were recurrent. Edema behaved as a major complication in 22.6% of episodes, requiring hospitalization in 11.8% and surgical intervention in 10.8%. No bacterial growth was identified in any collected samples.

Conclusions: Late-onset edema represents a relevant clinical complication that can impact device use. Although often classified as a minor complication, recurrence was observed in a significant proportion of cases, and some evolved into conditions requiring hospitalization or surgical intervention, including explantation. Therefore, late-onset edema should be carefully monitored over the long term due to its potential for recurrence and functional impact.

Free paper 0515

Listening to patients: Towards person centred CI care

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Introduction: Patient and person-centered health care (PCC) has been shown globally to have positive impact on outcomes from health care, including Patient-Reported Outcome Measures (PROMS) but this has been less discussed in the area of adult CI services. The aim was to explore: (1) The experiences of adults of person centered CI services; (2) Their views on what should be included in person centered CI services and the barriers to delivery; (3) Their views of collaborative ways to facilitate PCC.

Material and methods: Five global on line conversations were held by CI International Community of Action (CIICA), led by an audiologist, CI users and interested professionals over 14 months. 77 members of CIICA, from 19 countries attended. The Conversations were transcribed and emergent themes summarised using a grounded theory approach.

Results: (a) There was considerable consensus about what PCC involves: shared communication and decision-making; partnership in decision-making; choice on a range of levels, including the service, device, appointments, and rehabilitation. (b) Adults needed comprehensible information before and after implantation to be involved in their own care and decisions. (c) The impact of CI on QOL, and the changes experienced after CI including home, social life and work were not routinely addressed, recognized, or measured using PROMS. (d) Peer-to-peer support and family involvement were considered important and often excluded.

Conclusions: Involving patients in their own care has been found to lead to improved outcomes and greater compliance with professional recommendations. The experiences of CI users in these Conversations indicate a lack of person centered CI services and use of PROMS, involving patients in their own assessments. Moving forward requires several fundamental changes: (1) Regular assessment of functional outcomes in daily life using PROMS, (2) Integration of QOL measures and real-world outcomes into routine care. (3) Inclusion of families and peer support in the CI journey. (4) Addressing psychological, emotional, and social dimensions of CI use. (5) Enhanced professional education in counselling, communication, and person-centred approaches. (6) Systemic evaluation to assess services from the CI candidate and/or user perspective. (7) Development of accessible information resources co-created with CI users.

Free paper 0711

Living with Usher syndrome: Assessment of quality of life and functioning from an International Classification of Functioning, Disability and Health (ICF) perspective

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Introduction: Usher syndrome is the leading genetic cause of deaf-blindness and exerts a multisystem impact on hearing, vision, balance, and, consequently, on participation. This study applied the ICF framework to examine functioning and quality of life in adults and minors with Usher syndrome living in Italy.

Material and methods: A cross-sectional observational study was conducted through an online questionnaire, including medical history sections that framed the diagnostic and therapeutic-rehabilitation path carried out, and other validated

instruments (WHODAS 2.0, VFS, DHI, and PSS for adults; PedsQL, VFS-P, and P-DHI for minors).

Results: There is considerable variability in access to care, with significant delays in auditory prosthetic interventions – highlighting the importance of neonatal screening. In minors, difficulties in school performance and emotional well-being were identified, which serve as negative predictive indicators for future participation. Auditory fatigue and motor instability were found to be key drivers of functioning, both of which are linked to lower quality of life and higher levels of stress. The multisensory impact of Usher syndrome affects daily activities and participation, with these domains being among the most compromised. The degree of difficulty faced by individuals is highly variable, often reaching maximal levels, underscoring the need for a more comprehensive approach to care.

Conclusions: There is a strong emphasis on the importance of early diagnosis and intervention, which should be prioritized. Incorporating quality of life questionnaires into clinical practice could enhance patient management and outcomes. It is also crucial to plan tailored healthcare, social, and environmental interventions that offer greater support to individuals with Usher syndrome, fostering better overall well-being and participation.

Free paper 0152

Local anesthetic Osia implant surgery in the outpatient clinic: The first 30 patients with 1 year follow up

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Introduction: The Osia is an active transcutaneous bone conduction hearing implant, manufactured by Cochlear. It is a slim device, which does not require the drilling of a bed in the skull cortex. Surgical insertion involves a single scalp incision, and positioning of the device in a pericranial pocket, secured onto a single implant screw. Improvements and refinements in implant design necessitate corresponding adjustments in surgical technique and culture, to improve service efficiency, accessibility, and patient experience.

The aim of this project was to pilot bone conduction hearing implant surgery under local anaesthesia, in the outpatient clinic setting.

Material and methods: A business plan was proposed and approved to set up an outpatient bone conduction hearing implant service, and approved by local governance, finance, quality and safety committees. An iterative process to service development was deployed, based on staff debriefs and patient feedback. Thirty patients were safely and successfully implanted in the outpatient setting in the first year, including four bilateral cases, using local anaesthetic without sedation.

Results: The setup, governance and logistics of the service will be described. Average skin to skin surgical time was 21 minutes. Patient satisfaction is extremely high across all domains. Patient qualititative feedback has been used to implement continous service improvement. Staff feedback has been used to implement improvements in efficiency and service delivery. After 1 year of follow up, all patients are successfully using their Osia bone conduction hearing implant(s). One patient experienced device extrusion following minor trauma, and was subsequently explanted and re-implanted using a posterior incision. No patients have experienced infective complications.

Conclusions: Modern hearing implants are specifically designed to facilitate simple and safe surgical insertion. It is imperative that surgeons adapt surgical technique and culture accordingly, to facilitate the continuous improvement and development of hearing implant services. Bone conduction hearing implant surgery in the outpatient setting is feasible, safe, and offers potential benefits for hearing implant programmes, for individual patients, and for industry partners.

Free paper 0038

Local delivery of steroids to inner ear via medical device INCAT (the Inner Ear Catheter) in partial deafness patients during cochlear implantation

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Introduction: The primary aim was to assess the effectiveness and safety of three different algorithms of using steroids and inner ear catheter (INCAT) MED-EL® in partial deafness patients who underwent cochlear implantation. The secondary goal was the assessment of the impact of the depth of INCAT on hearing preservation after cochlear implantation.

Material and methods: There were three algorithms of steroid administration: 1) methylprednisolone 62.5 mg/ml (solution), 3 patients; 2) methylprednisolone 40 mg/ml (suspension), 4 patients; 3) dexamethasone 4 mg/ml (solution), 3 patients. Pure tone audiometry (0.125–8 kHz) was performed preoperatively, 1 and 6 months post-op. Hearing preservation was assessed according to the HEARRING group formula. Impedance measurements were taken at two days, 1 and 6 months after surgery.

Results: Patients treated with methylprednisolone 40 mg/ml in suspension showed the best hearing preservation (50%

complete and 50% partial preservation) 1 month post-op and later remained the most favorable. The lowest impedance was found in this group both 1 and 6 months post-op. A shorter INCAT insertion depth appeared to be more favorable than a longer one.

Conclusions: Our results suggest that patients treated with methylprednisolone 40 mg/ml (suspension) had better hearing outcomes compared to the other two medications.

Free paper 0484

Long-term audiovestibular outcomes before and after cochlear implantation

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Introduction: Cochlear implantation is a well-established treatment for patients with severe to profound hearing loss. In addition to auditory rehabilitation, increasing attention has been directed toward the preservation of residual hearing and the potential impact of cochlear implantation on vestibular function and balance.

Objectives: The aim of this study is to evaluate changes in balance function before and after cochlear implant surgery, and to asses hearing preservation in patients with residual hearing. Associations with patient-related factors such as age and etiology of hearing loss will also be explored.

Material and methods: This retrospective and prospective study will include patients who underwent cochlear implantation at our clinic from 1996 to 2026. Audiological assessments performed preoperatively and postoperatively will be analyzed to evaluate hearing outcomes and preservation of residual hearing. Vestibular and balance function will be assessed based on standardized balance tests conducted before and after surgery. Demographic and clinical variables, including age and etiology of hearing loss, will be recorded. Information on unilateral and bilateral implantation as well as electrode type will also be collected and considered in the overall analysis.

Results: Data collection for this study is currently ongoing.

Conclusions: This study aims to provide evaluation of auditory and vestibular outcomes after cochlear implantation, with particular emphasis on vestibular function after cochlear implantation and hearing preservation in patients with residual hearing.

Free paper 0477

Long-term auditory-verbal performance and quality of life following paediatric auditory brainstem implantation

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Introduction: The auditory brainstem implant (ABI) is a neuro-prosthetic device that provides sound sensations to individuals with profound hearing loss who are not candidates for a cochlear implant (CI) because of anatomic constraints such as congenital cochlear malformations, cochlear nerve deficiency, or a severely scarred cochlea. The ABI offers a promising alternative, as it directly stimulates the second-order neurons of the cochlear nucleus, bypassing the cochlea and the cochlear nerve. Despite its growing use, data on long-term auditory, speech, and language outcomes in paediatric ABI recipients remain limited.

Aim: The aim of this study was to comprehensively evaluate the long-term auditory, speech, and language outcomes in paediatric recipients of Auditory Brainstem Implants (ABI) using standardized outcome measures, including the Categories of Auditory Performance, Speech Intelligibility Rating, Meaningful Use of Speech Scale, Meaningful Auditory Integration Scale, and LittlEARS Auditory Questionnaire. We also aimed to evaluate the impact of these outcomes on the quality of life of patients with ABI.

Material and methods: Between July 2020 and October 2024, 33 children received ABI at our tertiary care ENT hospital in India. Preoperative work up included otolaryngologic examination, audiological assessment, radiological evaluation together with assessment of language development and psychological status. The surgeries were performed with a paediatric neurosurgeon. Initial stimulation was done 5 to 6 weeks postoperatively.

Conclusions: ABI is an acceptable and effective treatment modality for paediatric population with severe inner ear malformations. The study has shown a positive correlation between Quality of Life & habilitation scores over long time of ABI use. Among the habilitation scores, auditory scores correlated better than speech scores, which suggest that children with ABI have good auditory awareness with modest speech & language skills.

Clinical significance: One of the largest series in the world currently analyzing the long-term outcomes in ABI children. There is a trend of ongoing improvement in all the habilitation measures, which suggest that ABI children continued to improve using their implants over a period of time.

Free paper 0071

Long-term cognitive trajectories after cochlear implantation in the elderly

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Introduction: Hearing restoration by cochlear implantation (CI) yields benefits beyond hearing. Short-term benefits on cognition are well-known, but long-term data are limited and inconsistent. Therefore, we analyzed a large sample of CI recipients with a focus on cognitive changes in the long-term follow-up up to 9 years after implantation.

Material and methods: 75 CI recipients aged ≥50 (mean 65.4 SD = 9.2) were tested in attention, (delayed) recall, working memory (OSPAN) and verbal fluency pre-implantation as well as 1, 2, 5 and up to 9 years post-CI. Besides, patients' demographics cognitive reserve index (CRI) was recorded. Multilevel mixed models with linear and quadratic interaction coefficients were applied.

Results: After a booster effect 1 year after implantation, mostly pronounced in attention, cognitive gains sustained through a mean of 99.3 (SD = 9.6) months with no significant decline (all $p > 0.12$), except for verbal fluency which decreased between 2 and 5 years ($p < 0.023$). Post-CI scores remained significantly better than pre-implantation across all domains. Age did not affect cognitive trajectory patterns (all $p > 0.21$). Education (>12 years) was associated with improved linear cognitive gains in episodic memory ($p = 0.024$). Working CRI significantly modified trajectory curvature in attention ($p = 0.012$), and education CRI modified working memory trajectories ($p = 0.048$).

Conclusions: Cognitive benefits after CI exceed short-term duration. However, there are domain-specific patterns and CI trajectories are highly individual. Considering the multifactorial nature of cognitive aging, multicenter studies with larger sample sizes and extended follow-up visits are needed to clarify the mechanisms behind the impact of CI on cognition.

Free paper 0143

Long-term efficacy of Chinese domestic cochlear implants: A 15-year in-depth follow-up in post-lingual deafened patients

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Objective: To comprehensively evaluate the long-term effectiveness of the Nurotron cochlear implant (CI) system, a Chinese domestic brand, we conducted a 15-year post-activation follow-up study of 60 adult patients with post-lingual deafness who received Nurotron CIs.

Material and methods: All participants underwent a thorough assessment of safety and efficacy. Safety evaluations comprised overall postoperative clinical status, skull radiographs to verify electrode positioning, longitudinal monitoring of electrode impedance across channels, perioperative and long-term complications, and device wearing time as well as usage patterns. Efficacy measures included aided hearing thresholds, speech recognition (disyllabic words and sentences), Mandarin tone recognition, music contour segregation, and patient-reported outcome questionnaires.

Results: Over the 15-year follow-up period, electrodes remained well positioned and the impedances of all 24 electrode channels stayed within normal ranges. No serious adverse events were reported. Aided hearing thresholds were maintained within functional hearing levels throughout follow-up. Speech recognition scores for disyllabic words and sentences stabilized above 85% from four years post-activation onward. Compared with the 10-year assessment, Mandarin tone recognition scores further improved to 55.40% at 15 years post-activation ($p = 0.015$). Mean Categories of Auditory Performance (CAP) scores exceeded level 6. Quality of life showed marked improvement compared with the preoperative baseline, and overall satisfaction with the CI approached 80%.

Conclusions: Participants demonstrated sustained and substantial gains in auditory and speech performance and in quality of life following cochlear implantation, with outcomes tending to stabilize over time. The 15-year post-activation results support the long-term safety and effectiveness of the Nurotron CI system.

Free paper 0109

Long-term experience with cochlear implant reimplantation and reliability at a large German CI center

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Introduction: The aim of this study was to analyze the causes, timing, and postoperative speech perception outcomes of cochlear implant (CI) reimplantation in a large patient cohort over the past 30 years, as well as to assess and compare implant survival rates and reliability.

Material and methods: A retrospective analysis was conducted of more than 4,000 CI recipients treated between 1993 and 2024, including 214 children and adults who underwent reimplantation. Causes of reimplantation, manufacturer-related information, and clinical data were collected and compared. Speech perception was assessed using the Freiburg monosyllabic word and number tests before and after reimplantation. Implant survival was analyzed using Kaplan–Meier analysis for a follow-up period of up to 30 years.

Results: Children did not exhibit an increased reimplantation rate. The overall reimplantation rate in the total cohort was 5%. The most common cause of reimplantation was device failure, with 48% of cases occurring within the first five years after implantation. The second most frequent cause was medical complications, with the risk of reimplantation decreasing as time since initial implantation increased. Regarding speech perception, no significant differences were observed before and after reimplantation, either in the total cohort or in subgroup analyses, including cases involving technological upgrades. Twenty-year implant survival rates reached up to 96%.

Conclusions: No significant age-related differences in reimplantation rates were observed between children and adults. Device failure was the predominant reason for reimplantation, and in most cases, patients chose the same manufacturer for the replacement device. The probability of reimplantation decreased over time. As no average improvement in speech perception was observed after reimplantation – including cases involving technological upgrades – the indication for reimplantation should be considered carefully. Long-term implant survival rates exceeded 90% for all manufacturers, although there were significant differences between them.

Free paper 0015

Long-term hearing outcomes following cochlear implantation in far advanced otosclerosis

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Objective: To evaluate the long-term auditory performance at 5 years in patients with far advanced otosclerosis after cochlear implantation compared to controls.

Material and methods: *Study design* – a retrospective cohort study. *Setting* – the study was conducted at a single tertiary medical center. Patients with far advanced otosclerosis were compared to a control group of post-lingually deafened patients, selected from the same cochlear implant database. The following data were collected from medical records: age, sex, etiology, duration of hearing deprivation, prior stapes surgery, age at implantation, side of implantation, computed tomography scan findings, surgery details, postoperative complications and hearing test results.

Results: 41 patients with otosclerosis and 73 control cases were included in this study. The mean speech comprehension score at 5 years was 48.63% ± 24.66 in the otosclerosis group compared to 48.17% ± 23.08 in the control group ($p = 0.76$). Cochleostomy ($p = 0.01$), scala vestibuli insertion ($p < 0.001$) and post-operative dizziness ($p < 0.01$) were more common in the otosclerosis group. Facial nerve stimulation was observed in both groups: otosclerosis group 4 cases (9.8%), control group 4 cases (5.48%) ($p = 0.39$).

In the otosclerosis group, at 5 years, the average speech comprehension in patients with a previous stapedotomy was 39.3% ± 23.9 and 57.52% ± 22.45 in patients without previous stapedotomy ($p = 0.02$).

Conclusions: Cochlear-implanted patients with otosclerosis achieve satisfactory long-term audiometric outcomes, though with higher surgical challenges and complication rates compared to other etiologies. Notably, we found that a history of stapedotomy can negatively impacts long-term auditory outcomes after cochlear implantation.

Free paper 0317

Long-term results for intraoperative verification of the coupling efficiency of the Vibrant Soundbridge using auditorily evoked brainstem responses

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Objectives: The Vibrant Soundbridge (VSB) is an active middle ear implant for the treatment of adults and children with sensorineural, conductive, or mixed hearing loss. Depending on the hearing loss and middle ear physiology, the VSB actuator can be coupled to different structures in the middle ear using special couplers. Auditory Brainstem responses (ABR) provide a reliable method for intraoperative assessment of the implant actuator's coupling efficiency. This study evaluates the achievable quality of the coupling when verified by intraoperative ABR monitoring.

Material and methods: ABRs were recorded intraoperatively via the VSB. For this purpose, a standard ABR system stimulated the implant's actuator coupled to the middle ear structures and registered ABRs via scalp electrodes. A broadband chirp was used as an acoustic stimulus. Aided hearing thresholds and the postoperative vibrogram thresholds were evaluated.

Results: Intraoperative measurements were performed in more than 130 patients, using different coupling methods to place the actuator of the implant. Aided hearing thresholds could be determined intraoperatively in all patients. There was a high correlation between intraoperatively determined ABR thresholds and preoperative bone conduction thresholds (PTA4). Postoperative vibrogram thresholds showed similarly strong correlations. Overall, all couplers demonstrated good coupling efficiency.

Conclusions: The presented results show that ABR can be measured intraoperatively in patients implanted with a VSB. These measurements allow for a reliable estimation of the coupling efficiency between the actuator and the middle ear structure and thus for the possibility of repositioning intraoperatively in the event of insufficient coupling. The results show that intraoperative measurements already allow for a

good prediction of the hearing outcome at the time of the first fitting.

Free paper 0403

Long-term safety and efficacy of the Bonebridge BCI 601: A decade of experience with active transcutaneous bone conduction

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Introduction: The MED-EL Bonebridge® (BB) BCI 601 represents a significant advancement in auditory rehabilitation technology, as it is the first active transcutaneous bone conduction implant to be introduced. It has been developed to address conductive and mixed hearing loss, as well as single-sided deafness, with the objective of providing audiological benefits that are not associated with the complications that are commonly encountered with traditional devices. However, there remains a paucity of comprehensive long-term clinical data over the entire expected lifespan.

Objectives: The objective of this retrospective multicentre study was to verify the long-term safety and audiological performance of the BCI 601 implant, with a minimum follow-up of five years and an extension of nearly eleven years post-implantation.

Material and methods: Audiological and safety data from 186 implanted ears (151 adults, mean age 40 years; 35 children, aged 5–17 years) were retrospectively analysed across four clinical centres in Germany and Austria. Audiometric evaluations encompassed pure-tone average (PTA4) thresholds, sound field hearing thresholds, and speech perception (word recognition scores, WRS). Device safety was appraised through the documentation of complications, explantation rates, and survival analyses (Kaplan-Meier method).

Results: The Bonebridge® exhibited substantiated long-term audiological enhancements. Subsequent to a period of at least five years following the initial implantation, a substantial enhancement in hearing thresholds was observed, with adult subjects demonstrating an average increase of 23.44 dB and children exhibiting a notable increase of 27.69 dB. Concurrently, a marked progression in speech comprehension was evident, with adult subjects demonstrating an increase of 58.22% and children displaying an impressive 80.00% improvement. It was observed that bone conduction thresholds remained clinically stable over the observation period. This finding serves to confirm that there was minimal impact on inner ear function. The overall complication rate was found to be low, and implant survival was high (89.4% at 10 years), with technical failures accounting for only 2.5% of cases.

Conclusions: The Bonebridge® BCI 601 demonstrates exceptional long-term safety, stability, and audiological efficacy over a decade of use, highlighting its suitability as a robust and durable treatment option for conductive hearing loss, mixed hearing loss, and single-sided deafness.

Free paper 0061

Long-term safety and hearing benefits of an active transcutaneous bone-anchored implant: Results from a 24-month multi-center investigation

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Introduction: A novel active transcutaneous bone-anchored hearing implant system was assessed for safety and performance in a multi-center clinical investigation and obtained regulatory clearance in 2024. This abstract presents safety and performance outcomes up to 24 months post-implantation in 51 participants with conductive or mixed hearing loss (CHL/MHL) or single-sided deafness (SSD).

Material and methods: At implantation, surgical parameters, e.g., preoperative planning, anesthesia type, and surgery time were assessed. Audiological measures, e.g., sound-field thresholds and speech recognition as well as quality of life using validated instruments such as Glasgow Benefit Inventory (GBI), Speech, Spatial and Qualities of Hearing Scale (SSQ12), and International Outcome Inventory for Hearing Aids (IOI-HA) were obtained at three, six, twelve, and 24 months post-implantation.

Results: The cohort comprised adults with a mean age of 50 years (range: 24–77 years); 51% CHL, 25% MHL, and 24% SSD on the implanted side. Mean surgery time was 58 minutes (range: 23–85 minutes), with general anesthesia used in

most cases and local anesthesia in two. Although pre-operative imaging was routine in some clinics, more than half of the procedures were performed without it. The mean aided 4PTA threshold at 24 months was 25.3 (±4.6) dB HL, compared to 59.0 (±9.2) dB HL unaided preoperatively, resulting in a mean functional gain of 33.7 (±9.3) dB HL. Mean speech recognition in quiet improved from 46.2% (±36.2%) unaided pre-operatively to 98.2% (±3.1%) aided at 24 months. Participants reported increased quality of life with a mean GBI total score of 29.2 (±17.0) at three months. SSQ12 total scores improved for all participants, with a mean increase of +2.7 (±1.3) at twelve months. The mean IOI-HA total score was 4.3 (±0.5) at 24 months. No related serious adverse events were reported.

Conclusions: Significant long-term improvements in hearing and patient-reported outcomes, and quality of life were observed after implantation with the new active transcutaneous bone-anchored implant. The results confirm the effectiveness and safety for intended users with CHL/MHL and SSD. The implant is small, minimally invasive to place, and can be safely implanted without preoperative imaging.

Free paper 0111

Long-term stability and performance of the Bonebridge® implant in a pediatric population: A 12-year follow-up

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Introduction: The active bone conduction implant program in Chile began in 2013 at the Dr. Luis Calvo Mackenna Hospital, coinciding with the global launch of the Bonebridge® system. This allowed for the establishment of a pioneer cohort of pediatric patients with permanent conductive hearing loss due to microtia and aural atresia. Given that international evidence on the performance of these devices with follow-ups exceeding a decade is extremely limited, this study aims to evaluate the long-term audiological stability, safety, and efficacy of the implant.

Material and methods: An observational, longitudinal study with intra-subject comparative analysis was conducted. Thirteen pediatric patients implanted between 2013 and 2015 were re-evaluated during the second semester of 2025. Audiological and clinical variables were analyzed comparing two time points: T0 (1 month post-activation) and T1 (12 years post-activation). Outcome measures included free-field thresholds (PTA), functional gain, speech audiometry (monosyllables), PEACH scale, and user satisfaction. The paired Student's t-test was used for statistical analysis ($p < 0.05$).

Results: Of the initial cohort, 86.7% ($n = 13$) completed the mean follow-up of 11.2 ± 0.8 years. The average aided threshold remained stable between T0 (25.2 ± 3.4 dB HL) and T1 (25.7 ± 4.0 dB HL), with no significant differences ($p = 0.56$), demonstrating stability in bone transduction. Mean functional gain at T1 was 42 ± 4.8 dB. Monosyllable recognition showed a significant long-term improvement, increasing from 75% at T0 to 88% at T1 (Delta = 13; $p = 0.01$). PEACH scale scores remained high (>85%) in both quiet and noise. 100% of subjects upgraded their processor to SAMBA 2 after a mean of 8 years. There were no extrusions or internal technical failures; the most frequent minor complication was magnetic detachment of the external processor (69%).

Conclusions: This series represents one of the longest global follow-ups with Bonebridge® in children. Results confirm the system offers stable, safe, and effective hearing rehabilitation after more than a decade. Improved speech discrimination suggests the device provides sufficient auditory input to support long-term maturation. Systematic monitoring is indispensable for managing technological upgrades and ensuring adherence during the transition to adulthood.

Free paper 0292

Long-term voice effects of partial deafness cochlear implantation

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Introduction: Partial deafness (PD), as other types of hearing impairments, may lead to disturbances in voice acoustics. Changes in voice of PD patients were proved by the research conducted at Institute of Physiology and Pathology of Hearing in Warsaw. Partial deafness cochlear implantation (PDCI) first performed by professor Henryk Skarżyński, gave PD patients a chance to regain hearing at high frequencies and enabled them to improve their voice quality.

Objective: The purpose of the study was to analyze voice acoustics of patients six years after PDCI (long-term effects) and compare them to short-term effects measured nine months after PDCI. All patients underwent a two years rehabilitation program after implantation.

Material and methods: Using multi-dimensional voice program by Kay Pentax, objective voice analysis was performed in a group of 16 adults patients six years after they underwent PDCI. Then, the results were compared to those achieved nine months after PDCI. The control group consisted of 16 adult individuals, with normal hearing and voice disorders excluded.

Results: Compared to the values of voice parameters measured 9 months after PDCI that proved voice quality improvement, those achieved 6 years after PDCI presented further changes. They were mainly related to frequency,

amplitude, noise, subharmonics, irregularities and voice breaks. Compared to short-term results, F0 presented a decrease. Decreases were also noted for Jita, Jitt, RAP, PPQ, however the changes were not of statistical significance. The remaining frequency parameters, namely sPPQ and vF0 decreased statistically. Amplitude parameters also decreased, all of them achieving statistical significance, whilst short term analysis revealed statistical importance only for ShdB decrease. Directions of changes are consistent through all parameters measured. Noise parameters also improved, and changes in two of them NSH and SPI achieved statistical importance. NSH, DSH, DUV decreased whilst DVB and NVB achieved zero. Long-term voice effects show the stabilization of voice parameters as the result of regaining auditory control over voice.

Conclusions: PDCI improves voice quality and the improvement level increases with the time after PDCI. Post PDCI rehabilitation, ensuring appropriate CI functioning and expected auditory benefits, is an important part of treatment to bring satisfactory overall results.

Free paper 0037

Lost in translation: Speech-in-noise in multilingual patients with CI – Key findings and clinical implications

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Introduction: Understanding speech in noisy environments demands substantial cognitive resources, and this challenge becomes even more pronounced when communication occurs in a nonnative language. For multilingual people with cochlear implants (PwCI), clinical testing is often performed in the dominant language of the treatment setting, which may not reflect their everyday listening experiences across languages. The present study examines how PwCI and normal-hearing (NH) listeners perform on a speech-in-noise task in their native language compared with a foreign language, and how much mental effort they report during these tasks.

Material and methods: PwCI and NH completed the Oldenburg Sentence Test (OLSA) in both German and English. The SNR_{50} and the subjectively perceived mental effort, measured using the Rating Scale Mental Effort (RSME), were assessed.

Results: A total of 28 individuals with German as a first language and English as a foreign language (14 PwCI, 14 NH) were included. Among PwCI, the German version of the OLSA was significantly more intelligible than the English version ($p = 0.010$), whereas no significant difference was found for NH between language conditions. Listening effort was significantly higher during the English version of the OLSA in both PwCI ($p = 0.003$) and NH ($p = 0.003$). No correlation was found between self-assessed English language proficiency and perceived effort in either group.

Conclusions: The findings indicate that multilingual PwCI require particular attention in communication settings, especially in situations involving background noise or the use of a non-dominant language. Given their increased vulnerability to speech-in-noise difficulties and heightened listening effort, clinical assessments and interventions should be adapted to account for individual linguistic and cultural profiles. Optimizing acoustic environments, supporting the use of top-down comprehension strategies, and providing structured, context-rich communication can significantly reduce comprehension breakdowns. These insights highlight the importance of tailoring clinical management to the everyday listening demands and multilingual realities of PwCI.

Free paper 0315

Loudness perception in children: Evaluating a novel pattern for measuring electrically compound action potentials

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Introduction: Cochlear implants (CI) need to be customized to every recipient. Lately, objective measures such as electrically evoked coumpound action potentials (ECAPs), have been used to assist fitting. In clinical practice, this measurement is sometimes affected due to tolerance of the stimuli level. Here, we compare 2 stimulation patterns (standard vs rhythmic), and their relation to loudness in a paediatric population.

Material and methods: 15 children, all MED-EL users, with a mean age of 5.9 ± 2.6 years, were measured. Children were categorized into a direct feedback group ($N = 5$), consisting of participants capable of providing reliable feedback, and an indirect feedback group ($N = 9$) whose participants could not offer consistent bahavioural responses. Hearing threshold (THR) and maximum acceptable loudness (MAL) was determined for electrodes 6 and 10 using a linear vs a non monotonic (rhythmic) amplitude growth function.

Results: Both groups showed higher behavioural THR for the rhythmic pattern compared to the standard one. In the direct feedback group THR increased by 21% on electrode 6 and 7% on electrode 10. In the indirect feedback group, increases were larger, being 33% and 31% for electrode 6 and 10 respectively. In the direct feedback group, the rhythmic pattern resulted in a higher maximal accepted loudness (MAL), with an 11% increase on electrode 6 and an 8% increase on elecrode10. In the other group, the rhythmic patern did not produce significant changes in MAL for electrode 6 and electrode 10. Regarding ECAP threshold determination, comparison between the stimulation paradigms, showed no difference. Interestingly, in the direct feedback group, the MAL correlated significantly to the upper limit of their clinical map, while there was no significant correlation for the indirect feedback group.

Conclusions: The indirect feedback group, results did not show differences in loudness to either stimulation pattern,

possibly due to their inconsistent responses. The direct feedback group, showed reduced loudness percept to the rhythmic pattern for both THR and MAL. As well the MAL correlated with the upper limit of their clinical map.

Free paper 0126

Magnetic resonance imaging in cochlear implant patients: Safety and clinical implications

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Magnetic resonance imaging (MRI) is an essential diagnostic tool, but its use in cochlear implant (CI) recipients is associated with complications such as pain and implant magnet dislocation. With increasing numbers of CI users and continuous advances in implant technology, a reassessment of MRI safety and clinical practice is required. This study aimed to summarise current evidence on MRI-related complications in CI patients, focusing on magnet dislocation, pain, and the impact of implant design and procedural standardisation. Data from two separate studies were synthesised: a large, retrospective, single-centre analysis of MRI examinations in 711 CI users, and a prospective, observational study of 37 MRI examinations performed under strictly standardised conditions, including prophylactic head bandaging and mandatory pre- and post-MRI examinations. The outcome measures included rates of magnet dislocation, assessed pain intensity using the Visual Analogue Scale (VAS), MRI discontinuation and influencing factors, such as implant model and procedural management. In the retrospective cohort, magnet dislocation occurred in 7% of MRI examinations, exclusively in older generations of implants with non-rotatable magnets. Pain was the most frequent complication, occurring in 30–40% of scans and representing the leading cause of MRI discontinuation. In the prospective study, magnet dislocation was observed in one of 37 MRI examinations (2%), rising to 3% (1/33) when implants with self-aligning magnets were excluded. Notably, no magnet dislocations occurred in implants with rotating or self-aligning magnets. The median pain score during MRI was 7 on the VAS scale, and 10.8% (4/37) of examinations were discontinued due to pain. Minor complications included temporary erythema or pressure marks in seven patients. No demagnetisation or implant failure was observed. An MRI scan is feasible and safe for CI recipients when implant-specific conditions and standardised protocols are applied, and when the procedure is supervised by specialists experienced in CI. Modern self-aligning magnet designs significantly reduce the risk of magnet dislocation, potentially eliminating it altogether. However, older implant generations are still associated with some risk, which highlights the importance of careful patient counselling and close interdisciplinary collaboration.

Free paper 0636

Management of uncontrollable facial stimulation in CI patients

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Introduction: Non auditory stimulation of the facial nerve after cochlear implantation remains a rare but sometimes uncontrollable complication, which may result in the deactivation of some or most electrodes.

Material and methods: We report on a couple of unexplainable cases of facial stimulation which required re-implantation in a variety of different cochlear implant designs and brands. The potential patient related reasons for non-auditory stimulation and the recommended solutions and options will be discussed. The current algorithm for problem solving are presented and the brand specific options evaluated. These include variation of the routine stimulation parameters like stimulus amplitude, frequency, pulse width, etc. Different stimulation modes, return electrodes and brand specific stimulation methods are also recommended to resolve the issue. Additionally, the use of peri-modiolar electrodes are thought to minimise the unwanted effect and are generally preferred in cases like otosclerosis where a facial stimulation is more likely to occur.

Results: Our experience in these cases will be presented and the relevance of the above-mentioned recommendations will be analysed. The most effective algorithm for assessing and controlling the non-auditory stimulation will be presented.

Conclusions: Our results show that a peri-modiolar electrode alone could no resolve the problem and the choice of bipolar over monopolar stimulation is the most effective way to control the problem.

Free paper 0329

Maximum output, dynamic range and speech recognition of Vibrant Soundbridge implanted patients using forward stimulation

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Introduction: The maximum output (MO) of a hearing implant and the dynamic range (DR) available to a patient are key parameters that determine speech recognition in patients and treatment success. MO and DR were successfully determined for patients implanted with the Vibrant Soundbridge (VSB) with the floating mass transducer positioned in the round window niche (reverse stimulation). The aim of this

study was to determine MO and DR in VSB implanted patients with forward stimulation including incus, oval window (OW) and stapes head (SH) vibroplasty.

Material and methods: For the retrospective analysis, the data of 202 implanted ears (Incus, $n = 138$; OW, $n = 40$; SH, $n = 24$) were selected and analyzed following the method of Busch et al. 2024 and Maier et al. 2024 to determine frequency-dependent MO and covered DR for each patient based on the patient's individual bone conduction threshold and Vibrogram threshold. Mean values (± standard deviation) of MO and DR were calculated across the frequencies 0.5, 1, 2, und 4 kHz. The individual mean DR was correlated with the patient's individual WRS determined in quiet.

Results: The MO frequency dependency was similar for all coupling types with a maximum found at 1.5 kHz. Mean MO was 79.8 ± 7.8 dB HL, 79.5 ± 9.7 dB HL and 84.5 ± 8.6 dB for the incus, OW and SH coupling, respectively. The relationship between WRS and DR was best described by a sigmoidal growth function ($R^2 = 0.587$). The mean WRS increases continuously with increasing DR from 15.0% (DR bin 0–10 dB) to 51.7% (DR bin >10–20 dB), 70.6% (DR bin >20–30 dB), 86.8% (DR bin >30–40 dB), 91.1% (DR bin >40–50 dB), and 92.8% (DR bin >50–60 dB) with significant improvement in neighboring DR bins up to bin 5 (>40–50 dB).

Conclusions: The individual MO and DR can be determined from patients' clinical data. Only minor differences in WRS vs DR were found between forward and reverse stimulation. We suggest that data for forward and reverse stimulation should be pooled for future analyses of patient outcomes and definition of evidence-based indication criteria.

Free paper 0206

Measuring what matters: Patient-reported outcomes in cochlear implantation

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Introduction: Cochlear implantation aims to restore speech perception and improve quality of life. While audiological assessment has achieved remarkable standardization with internationally harmonized test batteries used across language regions, patient-reported outcome measures (PROMs) lack comparable consensus. Despite their recognized importance in capturing subjective hearing abilities and real-world quality of life, widely adopted PROM protocols remain absent, limiting meaningful comparison of patient-centered outcomes. This study reports implementation and early results of a standardized PROM protocol at a Swiss CI center.

Material and methods: Since 2022, bilingual (German/French) PROMs have been integrated into clinical care at the Bern CI Center. Three validated instruments were selected: PROMIS-10 Global Health, SSQ-12 (Speech, Spatial and Qualities of Hearing), and TQ-12 (Tinnitus Questionnaire). PROMs are administered electronically via tablet preoperatively and at 6, 12, and 24 months post-implantation, with direct integration into the CI database. Data from 182 adult CI recipients were analyzed.

Results: Implementation achieved 100% compliance by embedding PROM administration into routine visits. Preoperative data revealed considerable variability in subjective hearing handicap and tinnitus burden, even among patients with similar audiometric profiles. Post-implantation, significant improvements were observed in subjective hearing abilities (SSQ-12), while global health measures (PROMIS-10) showed initial improvement within 6 months followed by plateau. Tinnitus severity (TQ-12) decreased in most patients, though some experienced deterioration. Correlation between objective speech testing and subjective satisfaction remained modest, highlighting PROMs' complementary value.

Conclusions: This study demonstrates feasibility and clinical utility of routine PROM integration in CI care. High compliance through digital implementation confirms that systematic PROM collection is practical. Our findings confirm that objective audiometry alone provides incomplete outcome assessment. PROMs reveal listening effort, real-world communication abilities, and tinnitus burden that influence satisfaction and device usage. The dissociation between audiometric performance and subjective benefit underscores the need for patient-centered assessment. PROMs support shared decision-making, personalized rehabilitation, and quality assurance. Our experience supports adopting standardized PROMs in CI centers to ensure comprehensive care addressing both hearing performance and quality of life.

Free paper 0583

Meludia – Music training for improved speech perception in cochlear implant users

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Introduction: Cochlear implantation (CI) and rehabilitation have become standard procedures in hearing restoration. Integrating musical elements into auditory training enhances speech comprehension and auditory-cognitive skills. Teresa Schneider, speech therapist and head of the therapy at an Austrian center for the hard of hearing, presents the music training program Meludia as a complement to traditional speech comprehension exercises.

Objective: Exploring how Meludia enhances speech comprehension in CI users, particularly in noisy environments, recognizing speech melody, improving attention span and boosting auditory memory. Prosody serves a bridge between music and language and is applied in a targeted way. By improving the various parameters of prosody on a nonverbal level with musical exercises, they directly positively affect the same parameters in speech.

Material and methods: During a first session, the speech therapist assesses the user`s comprehension and identifies prosodic weaknesses. Structured Meludia exercises are then introduced to train these areas nonverbally. Later, corresponding speech exercises are conducted. Meludia is used both

independently at home and in therapy sessions. Progress is periodically evaluated to adjust training focus.

Results: After two years of using Meludia in auditory training units, it has shown to be both enjoyable and effective for CI users of all ages and levels of experience. The program improves speech comprehension and enhances key auditory sub-skills, such as prosody recognition, attention, and auditory memory. Furthermore, users exhibit a high degree of engagement in practice by acknowledging their progress, which increases motivation to practice autonomously. The enjoyment gained from the musical exercises enhances motivation and involvement, making it a valuable complement to rehabilitation programs for cochlear implant recipients.

Conclusions: Meludia provides an innovative and engaging approach to hearing rehabilitation, demonstrating that music training can complement traditional therapy in improving speech understanding and auditory perception. Because of this, it has become an integral part of our CI rehabilitation and component of independent practice for CI users in daily training routines.

Free paper 0148

Microphone potential recordings in the first segments of the cochlea

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Introduction: The first 8–10 mm of the cochlea can be divided into three direction changing segments. The hook region (HR) is a chimney shaped part from the round window to the scala tympani. The initial segment of the basilar turn (IsBT) will be defined as a minimal direction change from the midline of the cochlea of maximal 11°. Next, in the turning area (Ta) the change of angle is much more significant with 65–80°. We aim to analyse the electrode trajectory in hearing preservation insertion of the cochlea implant array.

Material and methods: In ten patients we measured microphone potentials during insertion and analysed the three segments mentioned above on the CT scan preoperatively. The electrode insertion took place with OTOARM/ OTODRIVE with a speed of 0.1 mm/s. The OTODRIVE control software was used to quantify the electrode position. The preoperative CT scan image analysis was performed with OTOPLAN 5.

Results: Over all patients, the mean size of the HR was 1.17 mm (±0.21), IsBT 8.14 mm (±2.49) and Ta 4.14 mm (±1.42). The maximum amplitude of the CM before opening the round window membrane was on average 3.8 µV and 6.2 µV after opening. In this part of the cochlea low frequency CMs of 500 Hz were encountered in only 4 out of 10 patients. The difference between minimal and maximal CMs' amplitudes of the HR segment was on avrage over all patients 7 µV (±8.22), 13.63 µV (±17.90) for the IsBT and 7.45 µV (±8.84) of the Ta segment.

Conclusions: In the HR segment we saw the smallest CM variation followed by Ta and IsBT. Surprisingly, the turning area showed little amplitude variance, which leads to the conclusion, that the length of the segment is more important than the directional change regarding the amplitude variance of CMs in the cochlea. Therefore, the OTOARM/OTODRIVE slow insertion appears to be less traumatic for the turning area than expected.

Free paper 0055

Middle ear pressure monitoring as an objective tool for cochlear implant fitting

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Introduction: The stapedius reflex (SR) is a bilateral protective response to intense acoustic stimuli and serves as an objective indicator of auditory function. In cochlear implant (CI) users, SR thresholds correlate with maximum comfortable loudness levels, making SR assessment a valuable tool for objective fitting. Conventional SR detection relies on impedance audiometry, which requires specialized equipment and in-clinic sessions. This study investigates the feasibility of detecting SR via direct middle ear pressure monitoring, with the goal of enabling future integration into CI systems.

Material and methods: A prospective observational feasibility study was conducted in adult patients undergoing tympanotomy for transtympanic corticosteroid injection and CI implantation. A pressure transducer was inserted into the middle ear, and contralateral acoustic stimulation was delivered using a tympanometry device. To enhance signal clarity, stimulation was synchronized with the ECG R-peak, and a custom filtering algorithm was applied to suppress heartbeat-induced artifacts. Reflex detection was evaluated across 32 frequency-intensity combinations (500–4000 Hz, 80–110 dB).

Results: Middle ear pressure changes consistent with SR were detected in 83.3% of cases where a reflex was elicited. The average threshold difference between tympanometry and pressure detection was minimal (<1 dB), indicating comparable sensitivity. The method also provided indirect confirmation of middle ear sealing via heartbeat artifacts, which is critical for reliable measurement.

Conclusions: These findings demonstrate the feasibility of SR detection via middle ear pressure monitoring. This approach could enable objective, implant-integrated reflex assessment in CI users, particularly in populations with limited ability to communicate, such as infants or individuals with cognitive impairments. Future developments may support remote and user-independent CI fitting, improving accessibility and personalization of auditory rehabilitation.

Free paper 0250

Modified drilling technique for easier round window access

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Introduction: Posterior tympanotomy remains the standard approach for cochlear implant (CI) electrode insertion via the round window (RW) access. Anatomical variations often block the view, hinder facial recess navigation, and make the procedure difficult for early-career surgeons as well as those in low-volume centers. In this report, we present a modified drilling trajectory that improves consistency and safety.

Objective: Our practice has evolved a modified drilling technique in the posterior tympanotomy approach, allowing easy and consistent access to the round window. This method focuses on optimizing the visual axis and drilling direction, enabling safer facial recess navigation and smoother electrode insertion. Sharing this technique may help surgeons, particularly early-career surgeons or those from low-volume centers, achieve more predictable surgical exposure.

Material and methods: This approach enhances posterior tympanotomy by lifting the limitations of standard mastoidectomy, making the facial recess axis more vertical. Drilling begins with a 45°-angled cutting burr to remove bone around the chorda tympani anteriorly. Drilling then proceeds downward toward the middle of the RW niche, using a 20–30° angulation relative to the external auditory canal. The visual axis aligns through the expanded recess, which reduces bone removal near the facial nerve and sinus tympani while facilitating electrode insertion.

Results: In our practice, the technique provides reliable round window exposure, easier facial recess navigation, and smoother electrode paths. It shortens drilling complexity, reduces surgical time, and lowers the risk of anatomical damage. The technique performs effectively for surgeons of any experience level.

Conclusions: The modified drilling method improves the axis and trajectory for predictable round window access in CI surgery via simplified posterior tympanotomy. It enables novice surgeons and low-volume centers to achieve reproducible outcomes, thereby enhancing CI accessibility.

Free paper 0087

Modified subtotal petrosectomy in cochlear implantation

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Objectives: There are many pathological and clinical conditions in which the presence of the middle ear may pose a threatening condition, and eliminating it may help to definitively solve the problem, reducing risks for the patient. Chronic ear disease, petrous bone cholesteatoma, and meningoencephalic herniation are among these conditions. The technique of subtotal petrosectomy (SP), associated with cochlear implantation (CI), was described to overcome clinical challenging conditions. With the aim of providing protection against infection and extrusion of a CI, SP was proposed for many complex clinical cases.

Material and methods: Patients ($n = 36$) that underwent subtotal petrosectomy with closure of the external auditory canal and obliteration of the cavity with fat/cartilage and fascia in combination with CI were analyzed. All patients underwent otological examination and preoperative audiological assessment, speech discrimination score, and auditory brainstem responses. All patients underwent both gadolinium-enhanced MRI and HRCT of the temporal bone.

Results: The most frequent indication for subtotal petrosectomy was the existence of a previous canal wall down technique (17 cases). The second most frequent group was patients with middle ear disease (18 cases). Under the term middle ear disease, we have grouped all the entities that could affect the middle ear function and negatively influence the clinical outcome of the CI. These entities included recurrent acute otitis media (RAOM) and otitis media with effusion (OME), tympanic membrane perforation or retraction, chronic supurative otitis media (CSOM), and cholesteatoma chronic otitis media (CCOM). All these cases were implanted simultaneously to SP. The third most common indication, with 1 patient, was cochlear ossification. In all cases, complete insertion of the electrode array was achieved.

Conclusions: SP is an accurate, and sometimes difficult, technique that increases surgical time, but it provides a safe and sterile environment, and excellent promontorial access for complex cases of cochlear implantation for all ages. Among these indications are chronic ear disease, inner ear malformations, very advanced otosclerosis, temporal bone fractures, vestibular schwannoma, and other tumors. The rate of complications compares favorably with standard techniques. SP should be strongly considered when approaching cases of cochlear implantation with unfavorable conditions.

Free paper 0740

Molecular biomarkers of neuroplasticity in prelingual deafness treatment by cochlear implantation in plasma (MMP-9) and in perilymph proteome

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Introduction: Congenital deafness treatment with cochlear implantation (CI) is a standard therapy with, in overall,

very good results, however, in some cases implanted children do not reach the age norm in verbal communication. Molecular biomarkers of neuroplasticity would allow to implement better clinical management, taking into account individual, personalized needs, giving them better chances of spoken language rehabilitation.

Objective: The objective of the study was to verify the prognostic value of plasma level of matrix metalloproteinase 9 (MMP-9), measured at CI, to the outcome of speech and language rehabilitation after 18 months of CI use. The second objective was to identify the possible proteomic biomarkers of neuroplasticity out of perilymph content.

Material and methods: We performed a prospective longitudinal study analysis of plasma activities of MMP-9 at CI activation, 8, and 18 months after CI activation in the cohort of 61 children, diagnosed with bilateral profound sensory- neural hearing loss, aged below 2, treated with CI. Language acquisition was assessed with Little Ears Questionnaire (LEAQ). We studied associations between plasma activities of MMP-9 in the aforementioned intervals and LEAQ scores over follow-up intervals. We performed Enzyme-Linked Immunosorbent Assay (ELISA) to assess the level of MMP-9 in blood plasma.

Results: Correlation analysis shows that there is a significant relation between plasma level of MMP-9 measured at cochlear implantation and LEAQ score in 18 month follow up (rho = –0.25, $p < 0.05$). Further steps to identify biomarkers were done with the inner ear fluids, sampled during cochlear implantation. We present preliminary data on perilymph proteome research. 5 pairs perilymph- blood plasma sampled form the same patient up to 2 year old, during CI were assessed by mass spectrometry (MS). Correlations between perilymph proteome and CI linguistic outcome measured up to 14th month after CI activation were found. We have found 1608 proteins in perilymph samples, out of which 362 and 1246 were up- or down regulated with statistical significance <0.05 depending on auditory outcome.

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Free paper 0216

More than 20 years of cochlear implantation in adults with acquired single-sided deafness or asymmetric hearing loss: Long term clinical outcomes of 78 subjects implanted at the Antwerp University Hospital

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Introduction: Although the benefits of cochlear implants (CI) use for adults with USNHL are well documented, long-term data remain scarce on clinical outcomes and hours of daily audio processor use.

Objective: To evaluate long-term outcomes and device use in all adults with USNHL who received a CI at The Antwerp University Hospital.

Results: All 78 patients with USNHL who underwent CI were included in the study analysis, comprising 59 individuals with single-sided deafness (SSD) and 19 with asymmetric hearing loss (AHL). The most common etiology (32%) was idiopathic sudden deafness. All but 2 patients reported preoperative ipsilateral tinnitus, with an average visual analog scale rating of 7 out of 10. CI use significantly reduced ipsilateral tinnitus loudness, lowering the score to 2.2/10 in the CION condition. In the postoperative CIOFF condition, the average score was 6.21. In the AHL group, 21% experienced progression of contralateral hearing thresholds to levels meeting CI criteria. The greatest benefit for speech perception in noise was demonstrated for the binaural head shadow effect, with a difference of –7.15 dB in the SSD group and –11.73 dB in the AHL group when comparing aided and unaided conditions. The SSD group achieved a mean localization error of 25.4° in their best aided condition, whereas the AHL group reached 42.5°. During follow-up, 8% of the cohort discontinued CI use, on average 47 months after implantation. Factors anecdotally reported from clinical experience as potential predictors for non-use included a) ipsilateral hyperacusis, b) ipsilateral long deafness duration, c) severe depression, and d) the postoperative occurrence of more severe medical conditions not related to the implantation hindering CI use.

Conclusions: CI is a durable treatment option for USNHL, when inclusion criteria are stringent. Long-term follow-up demonstrates CI use significantly improves auditory outcomes in USNHL and suppresses ipsilateral tinnitus.

Free paper 0325

Multi probe tone electrically evoked stapedius reflex measurements for optimizing fitting in cochlear implant recipients

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Introduction: Cochlear implant (CI) fitting presents a challenge for defining the individual electrical dynamic range (EDR) of the user. When based on subjective feedback, CI users need to report on loudness. This task can be particularly difficult for patients without prior auditory experience or without the ability to report accurately. The electrically evoked stapedus reflex (ESRT), can assist fitting, as it has been widely shown to correlate well with the upper end of the EDR, mainly for a 226 Hz probe tone. Here we compare ESRTs simultaneously recorded with four different probe tones. Additionally, we investigate differences in the ESR amplitude growth functions between the different probe tones.

Material and methods: Seventeen experienced CI users participated in the study, aged 3 years and 4 months to 73 years and 5 months. All implanted with MED-EL CIs. 300 ms long bursts of biphasic pulses were applied to three contacts (apical, medial and basal) using the MAESTRO clinical software. Responses to four probe tones (226, 678, 904 and 11304Hz) were registered simultaneously with a Sentiero

Desktop hardware. ESRT was defined as the lowest stimulation level producing at least a 0.02 cc deflection. Saturation level was defined as the level where the biggest amplitude was found or limited by the maximum acceptable stimulation level of the subject.

Results: Probe tone showed a significant effect on success rate as well threshold determination, being the best at 678 Hz because of requiring less stimulation level to obtain ESRTs. ESR responses were more stable and bigger for 678 Hz probe tone compared to 226 Hz. Reflex amplitude growth functions showed variations among subjects and accross the different probe tones, affecting the slope and the absolute values.

Conclusions: These findings suggest that probe tone frequency substantially affects ESRTs, with higher probe tones than 226 Hz, offering potential advantages for CI fitting.

Free paper 0125

Multidimensional predictors of satisfaction and efficacy in adult cochlear implant users: The dominant role of work-related impact via random forest analysis

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Introduction: Cochlear implantation (CI) acceptance rate among adult candidates remains low. It is of importance to explore in depth the reason for this phenomenon, especially work-related impact.

Material and methods: Based on the paradigm of Patient-Reported Outcome Measures (PROM), an online questionnaire survey was setup. Two terminal indices were post-operative auditory performance (CAP, 0–9) and post--operative CI satisfaction (SAT, 1–10). Work-related information, such as job category, economic status, verbal communication requirement, social partners, and influence of CI on working were collected. Other multidimensional patient-reported outcomes including general status, lifestyle, daily wearing time were also included. Random Forest was used to identify key factors among the work-related factors mentioned above that affect the terminal indices.

Results: 547 questionnaires were collected and 471 valid questionnaires were qualified and analyzed. Results showed that CAP was 5.67 ± 2.14, SAT was 7.04 ± 2.26. According to the analysis, Physical labor (23.7%) had a lower CAP (t =3.756, $p < 0.001$) than the others. This might because of a shorter daily wearing time ($Z = 10.103$, $p < 0.001$) leading to insufficient rehabilitation training and utilization. Meanwhile, their education levels were generally low ($\chi^2 = 76.611$, $p < 0.001$) leading to low adaptability and poor cognition. On the other hand, those who actively socialized with strangers during working would achieve higher CAP ($F = 2.013$, $p = 0.044$) and SAT ($F = 2.775$, $p = 0.006$). These participants also had higher necessity to verbal communication in working hours (Fisher exact test, $p = 0.001$). Based on random forest model, key predictive factors were identified that "a positive influence of CI on working" (17%), "actively socialized with strangers during working" (13%), and "low economic burden" (13%) was conducive to CAP. "Positive role of CI to socialization during working" (28%), "a positive influence of CI on working" (11%), and higher "income level" (9%) was conducive to SAT.

Conclusions: According to our nationwide cross-sectional survey, we suggested that when facing adult CI candidates with job demands, attention should be paid to their job nature, economic status, and social needs, as these factors may significantly influence the final outcomes. Preoperative fully consideration and information should be paid. This will help improve the satisfaction and efficacy of this group of people.

Free paper 0272

Multimodal brain MRI predicts speech outcomes after cochlear implantation in adults with acquired deafness

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Introduction: Outcomes following cochlear implantation (CI) remain highly variable, particularly in adults with acquired hearing loss, and the sources of this variability are only partially understood. Sensory deprivation such as deafness is known to induce neuroplastic changes, and brain plasticity plays a crucial role in adaptation to the CI. We hypothesize that preoperative MRI, integrating structural and functional neuroimaging, can improve the prediction of CI outcomes.

Material and methods: Sixty-five adults with bilateral severe-to-profound hearing loss who were candidates for CI were included. All participants underwent preoperative MRI, including 3D T1-weighted imaging to assess gray matter (GM) thickness and volume, diffusion-weighted imaging (DWI) to evaluate white matter (WM) microstructure, and functional MRI. Correlations were examined between neuroimaging measures, together with demographic and preoperative behavioral variables, and postoperative speech understanding with the CI. Speech comprehension was assessed under both auditory-only and audiovisual conditions, the latter reflecting everyday communication demands and remaining essential for CI recipients.

Results: Better postoperative speech perception was associated with greater preoperative cortical thickness in the left temporal and inferior frontal regions, areas critically involved in language processing. Increased GM volume in additional frontal regions involved in cognition was also correlated with CI outcomes. Moreover, localized WM microstructural properties, particularly higher fractional anisotropy in the left arcuate fasciculus, significantly predicted CI performance. Importantly, combining neuroimaging markers with behavioral and clinical variables substantially improved outcome prediction compared with behavioral measures alone.

Conclusions: Brain structure and function play a critical role in determining CI outcomes. Integrating multimodal neuroimaging data with clinical and behavioral measures provides a powerful approach to estimate individual CI success, identify patients at risk for poorer outcomes, and guide personalized rehabilitation strategies. Further research, particularly in postlingual deafness, is needed to clarify the origins and clinical relevance of these neural markers.

Free paper 0172

Music therapy for CI users: A new concept centered on anatomy-based fitting

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Introduction: For the past 10 years, the ENT Department at the University Clinic St. Pölten, Austria, has offered music therapy (MT) as part of a holistic, multidisciplinary outpatient rehabilitation program for cochlear implant (CI) recipients. In the 21th century, medicine in total is rapidly moving towards the direction of personalized and individualized treatment options. In audiology, the variety of sensorineural hearing loss cases has driven the development of advanced technologies – especially those using artificial intelligence – that enable anatomy-based fitting (ABF) strategies for cochlear implants and speech processors.

Objectives: This study evaluates the effect of ABF on audiological outcomes, focusing particularly on its impact on music therapy. It compares how ABF influences music perception, sound quality, and speech recognition versus conventional fitting methods.

Material and methods: All patients over 18 years of age with single-sided deafness or asymmetrical sensorineural hearing loss who received cochlear implants between 2024 and 2025 were included. Participants were divided into two groups: (1) ABF group, utilizing digital radiological imaging and frequency channel detection, and (2) non-ABF group, using standardized logarithmic frequency mapping. Both fitting strategies were applied during the initial CI activation. Outcomes were evaluated at 3 and 6 months post-activation through speech recognition tests (CVC monosyllables), structured music perception assessments, and sound quality questionnaires.

Results: A total of 40 patients were tested, with 20 participants in the ABF fitting group and 20 in the non-ABF fitting group. Results will be presented comparing speech recognition performance, music perception, and reported sound quality satisfaction between the two groups.

Conclusions: Anatomy-based fitting may promote a more natural integration of music perception in CI users and highlights the crucial role of music therapy in the rehabilitation of CI recipients.

Free paper 0534

Near-infrared spectroscopy measurements with cochlear implanted populations: A systematic review

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Functional near-infrared spectroscopy (fNIRS) is a modern neuroimaging technology that measures brain oxygenation via hemodynamic response. It is uniquely compatible with cochlear implants because of it's silent, portable and non-invasive way of use. This method is free from electromagnetic interference, so it is referred in the literature as a CI compatible tool to explore neurocognitive responses of cochlear implant users. Some authors also claim that this method is quite comfortable for very young participants. Functional near-infrared spectroscopy is referred to assess cortical plasticity and auditory cortex activation in CI recipients. Some scholars also emphasized it's importance to explore language development at very young ages. It means, that this device is applicable especially for prelingual CI-users who can not be invited to interactive linguistic test methods. This presentation aims to give a systematic review on the application of functional near-infrared spectroscopy to measure neurocognitive changes of cochlear implanted populations. Following the guidelines of Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA 2020) the following terms were the items of search in PubMed and Cochrane databases: cochlear imaplantation and/or near-infrared spectroscopy. As a result there were 663 papers listed on PubMed. All of them were published in English. After the exclusion of duplicates and other non-relevant items, the rationale of this review is to compare the different studies and to summarize the possible methods for future reference.

Free paper 0362

Neural Health Index to explain variability in speech outcomes: Findings from Nexa™ electrode-neural interface research

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Introduction: Cochlear implant (CI) recipients exhibit a wide variability in speech outcomes, making it challenging for clinicians to assess expected performance and personalize rehabilitation strategies. Therefore, advanced diagnostic and predictive tools are needed during aftercare by the clinician to support effective troubleshooting, guide personalized counseling, and improve patient outcomes. The objective was to develop and validate a data-driven Neural Health Index (NHI) model using objective measurements at the Electrode-Neural Interface (ENI) and to quantify its ability to explain variability in speech recognition outcomes.

Material and methods: Data from 46 adult CI recipients implanted with the Nexa device in feasibility studies were used to train and validate nonlinear machine learning algorithms. The main input for the model were threshold levels of auditory nerve eCAPs measured with Neural Response Telemetry. The amplitude growth functions (AGF) and eCAP thresholds (TNRT) were measured at each intracochlear electrode using Masker-Probe paradigms in monopolar (MP) and focused multipolar stimulation (FMS) configurations. As TNRTs are influenced by electrode positioning, the modiolar proximity for each electrode was measured based on CT scans and used as an additional control parameter. Different combinations of eCAP based metrics and modiolar proximity were used as features for the machine learning algorithms. Speech outcomes for speech in quiet (CVC words) at approximately 6 months post activation or later were used as target metric.

Results: The group consisted of 22 native speakers in English and 24 in Dutch. Model performance was evaluated using the coefficient of determination (R^2) between predictions of the NHI model and the clinically measured CVC scores. For the English-speaking group an R^2 of 0.51 and for the Dutch group an R^2 of 0.7 could be achieved respectively.

Conclusions: These promising results indicate that the NHI captures clinically relevant information about the ENI and explains a substantial proportion of speech outcome variability. The NHI can assist clinicians in decision-making, supporting more personalized fitting, and improving CI recipient outcomes.

Free paper 0194

Neural speech tracking as an objective predictor of speech intelligibility in children with cochlear implants: Results from the CORGEE clinical trial

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Objectives: The efficacy of pediatric cochlear implantation is typically evaluated using measures of speech perception, speech production, and language development. However, assessing speech intelligibility in young children remains challenging, as behavioral speech audiometry, the current clinical gold standard, depends on language abilities, attention, and task comprehension. Consequently, reliable assessment is often not feasible in children under 3–4 years of age or in those with additional developmental challenges, despite this being a critical period for auditory neural plasticity and device optimization. Objective measures that reflect speech understanding could therefore provide important complementary clinical information. Neural speech tracking (NST), quantified as the alignment between cortical responses and the temporal envelope of continuous speech, has emerged as a promising approach. The CORGEE clinical trial investigated whether NST can be used to predict speech intelligibility in children with CIs.

Material and methods: The CORGEE clinical trial, is a multicenter clinical trial including children with hearing loss, with a subgroup of pediatric CI users ($N = 11$). During testing, children listened to continuous natural speech presented at different intelligibility levels while watching an age-appropriate animated movie. EEG was recorded in a child-friendly clinical setup and analyzed in real time using the CORGEE system, which translates this novel NST methodology to clinical practice by means of automatic and easy-to-use clinical software. Additionally, behavioral speech intelligibility measures were collected and compared with objective NST outcomes.

Results: Preliminary results demonstrate that reliable NST responses can be obtained in children with CIs in a clinical context. NST, particularly in the delta frequency band, showed correspondence with behavioral speech intelligibility, indicating the potential of NST to reflect speech processing abilities in pediatric CI users.

Conclusions: These findings provide clinical evidence that NST can serve as an objective indicator of speech intelligibility in pediatric CI users. By translating NST methodology into real-time clinical software, CORGEE offers a promising complementary or alternative tool to behavioral speech audiometry, particularly for young or hard-to-test children, and may support outcome evaluation, counseling, and cochlear implant fitting during early auditory development.

Free paper 0565

Neurocognitive involvement in cochlear implant recipients: Insights from Functional Head Impulse Test, Reading Span Test, and QuickSIN – Preliminary study

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Introduction: The functional Head Impulse Test (fHIT) is an innovative method for evaluating vestibular function. The test measures the ability to identify the orientation of a briefly presented Landolt C optotype during passive head impulses, thereby reflecting not only peripheral vestibular function but also central processing in cortical regions linked to attention and working memory. Thus, fHIT provides valuable insights into cortical integration. Speech-in-noise perception (QuickSIN-TR) and cognitive capacity (Reading Span Test) are also critical for effective auditory rehabilitation. Examining these domains together in pediatric cochlear implant users may help reveal important interactions between sensory and cognitive systems.

Material and methods: This study comprised a total of thirty participants aged 10–18 years, including fifteen cochlear implant users and fifteen age-matched normal-hearing peers. All participants underwent a comprehensive assessment consisting of the functional Head Impulse Test (fHIT), the Turkish Quick Speech-in-Noise Test (QuickSIN-TR), the Reading Span Test (RST) to evaluate verbal working memory,

and the Montreal Cognitive Assessment (MoCA) for global cognitive screening.

Results: fHIT correct recognition scores were significantly lower among cochlear implant users compared to individuals with normal hearing ($p < 0.05$). QuickSIN-TR results demonstrated a statistically significant reduction in speech-in-noise perception in cochlear implant users ($p < 0.001$). Similarly, Reading Span Test performance was markedly reduced in this group ($p < 0.05$). Moreover, a weak negative correlation was identified between QuickSINTR outcomes and fHIT recognition accuracy ($r = –0.326$).

Conclusions: The weak negative correlation between QuickSIN-TR results and fHIT scores suggests a modest inverse relationship between speech-in-noise perception and visual recognition during head impulses. These findings highlight that auditory rehabilitation should not be confined solely to peripheral hearing functions but should also incorporate multisensory integration. Expanding rehabilitation protocols to include vestibular and cognitive assessments in pediatric cochlear implant users may facilitate a deeper understanding of sensory-cognitive interactions and contribute to improved clinical outcomes.

Free paper 0743

Nexa™ electrode-neural interface research: From evidence gaps to shaping future innovation in cochlear implant care

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Introduction: Cochlear implantation has transformed hearing outcomes for individuals with severe-to-profound sensorineural hearing loss. However, variability in patient outcomes remains a challenge and current clinical practices often do not account for individual anatomical, electrophysiological, or neural health differences. Significant research gaps remain in our ability to assess cochlear health, personalise programming, and optimise device-coding fitting strategies.

Objective: The Nexa Electrode-Neural Interface (ENI) Research Program is a global, multi-study research initiative established to explore feasibility-level concepts in cochlear implantation. It aims to inform hypothesis-generating evidence around future-focused innovations in diagnostics, stimulation, and individualised care.

Material and methods: The program comprises four exploratory studies: FOCUS, evaluating the feasibility and functional impact of focused multipolar stimulation (FMS); NEUROFI, also assessing FMS and electrophysiological and imaging biomarkers as potential indicators of cochlear and neural health; SASC, understanding the power and performance trade-offs relating to FMS; and, OFIT, assessing the potential of objective intraoperative and postoperative measures to guide fitting decisions.

Results: At time of abstract submission, some studies and data acquisition are ongoing. Preliminary insights have highlighted areas requiring further exploration and have informed the development of targeted research priorities. These will help shape innovations on advanced platforms like the Nucleus® Nexa™ System, particularly in enabling individualised fitting and performance optimisation. An overview of gaps, emerging trends, and lessons learned to date will be presented at the conference.

Conclusions: The Nexa-ENI Research Program provides a collaborative, multi-centre platform for early-stage exploration of emerging concepts in cochlear implantation. By addressing key evidence gaps in neural health, personalised fitting, and performance optimisation, the program lays the foundation for future translational research anchored in scientific rigour, global partnership, and clinical relevance. The future directions of research with the Nexa™ System will be shaped by the findings of this program.

Free paper 0385

Novel: Multifrequency monitoring of the hearing trauma in combination with fluoroscopy in long FLEX electrode

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Introduction: Indications for cochlear implantation increasingly include patients with residual acoustic hearing. Implant-based intracochlear electrocochleography (ECochG) offers real-time feedback during electrode insertion, but cannot by itself reveal the mechanical electrode movements that may cause intracochlear trauma. We combined perioperative ECochG with intraoperative fluoroscopy, operative microscope video, and postoperative cone-beam CT (CBCT) to correlate electrode motion and surgical maneuvers with ECochG changes and subsequent residual hearing outcomes.

Objectives: To identify instances of mechanical trauma or obstruction during electrode insertion, characterize intraoperative ECochG response patterns, and determine which surgical steps are associated with loss of residual hearing.

Material and methods: Ten consecutive adults with electroacoustic stimulation (EAS)–range or borderline EAS–range hearing underwent cochlear implantation with a FLEX28 electrode. Preoperative cochlear anatomy and estimated insertion depth were assessed with OTOPLAN v.5.0 to guide monitoring. Intracochlear ECochG was recorded during insertion using Maestro AS software with a SPL chirp stimulus. ECochG recordings were synchronized with intraoperative fluoroscopy and microscope video; postoperative CBCT documented final electrode position. Audiometric thresholds were obtained preoperatively and at intervals up to one year postoperatively to quantify residual hearing change.

Results: Full round-window insertions were achieved in all 10 patients. Measurable ECochG responses were obtained in every case but exhibited heterogeneous temporal profiles. Time-synchronized monitoring allowed correlation of ECochG amplitude reductions with specific electrode motions and surgical maneuvers. Reduction or loss of ECochG amplitude strongly predicted subsequent deterioration in residual hearing. ECochG declines were observed both during electrode advancement and, in some cases, before final insertion – implicating additional intraoperative events.

Conclusions: Combining perioperative ECochG with fluoroscopy, microscope video, and postoperative CBCT provides actionable insight into which insertion steps and electrode movements are associated with reduced ECochG signals and loss of residual hearing. These multimodal observations can inform refinements in surgical technique to improve hearing preservation. Larger studies with longer follow-up are required to validate these findings and translate them into standardized intraoperative guidance.

Free paper 0428

Osia® system outcomes in Colombia: A Large Multicenter Cohort (2019–2025)

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Introduction: Large multicenter series of active transcutaneous bone-conduction implantation remain limited. We report overall outcomes of the Osia® system from a nationwide multicenter Colombian cohort, including indication-specific surgical and audiologic findings. To describe surgical workflow characteristics, audiologic outcomes, and patient-reported outcomes following Osia® implantation across indications in a large multicenter cohort.

Material and methods: Prospective, descriptive multicenter cohort including consecutive patients implanted between December/2019 and March/2025 for conductive hearing loss (CHL), mixed hearing loss (MHL), or single-sided deafness (SSD). Surgical workflows metrics (soft-tissue thickness, implant length selection, operative time, and flap reduction) were summarized by indication. Audiologic outcomes were assessed in free field using PTA4 (0.5, 1, 2, 4 kHz), comparing unaided with aided thresholds at 3 and 12 months. Functional gain (FG) was defined as unaided minus aided PTA4. Patient-reported outcomes (PRO) was assessed with the Client Oriented Scale of Improvement (COSI), including top priority domains and mean improvement ratings.

Results: A total of 1385 patients were implanted (CHL = 759; MHL = 521; SSD = 105), with ages ranging from 5 to 82 years. Transitions from prior bone-conduction systems were observed in 10.9% of CHL, 14.6% of MHL, and 9.5% of SSD. Surgical parameters demonstrated consistent and reproducible workflows across indications. Mean soft-tissue thickness was 4.9 mm in CHL, 5.8 mm in MHL and 5.7 mm in SSD. Mean operative time was 52, 54 and 49 minutes for CHL, MHL and SSD, respectively. Flap reduction required in 3.3% of cases for CHL and MHL and 3.8% in SSD. Across the cohort, implant length selection was predominantly 4 mm (70%). Across the cohort, mean unaided PTA4 improved from 68.1 dB HL preoperatively to 26.0 dB HL at 12 months, corresponding to a FG = 42.1 dB. At 12 months, FG by indication was 35.6 dB (CHL), 43.6dB (MHL), and 81.6 dB (SSD). PRO assessed using COSI demonstrated high perceived benefit across indications (CHL = 4.53/5, MHL = 4.39/5, and SSD = 4.1/5), with speech in noise identified as the most

frequent top-priority domain (49.5%-CHL, 58.6%-MHL, and 56.9%-SSD).

Conclusions: In a large multicenter cohort, Osia® implantation was reproducible within surgical workflows, with infrequent flap reduction where reported, and delivered clinically meaningful functional gains and strong patient-reported outcomes across indications.

Free paper 0340

Oticon Sentio outcomes in patients aged 12 years and above: The Birmingham Children's Hospital experience

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Introduction: The Oticon Sentio is an implantable active transcutaneous bone conduction implant indicated for individuals aged 12 years and over with conductive or mixed hearing loss and single-sided deafness. In contrast to percutaneous devices, Sentio allows the skin to remain intact, with the proposed advantage of reducing long-term soft tissue complications.

Birmingham Children's Hospital is a tertiary referral centre for paediatric hearing implantation in the United Kingdom. It was the first hospital in the United Kingdom to implant the Oticon Sentio in a paediatric patient in October 2024 and is well-positioned to report early clinical experience. Birmingham Children's Hospital is also taking in the multicentre paediatric trial for children below the age 12.

Material and methods: We present an initial case series of paediatric patients implanted with the Oticon Sentio. We report data for patient demographics, indications, operative considerations, safety outcomes, unaided and aided word recognition scores, daily device usage, the Sentio patient questionnaire, Glasgow Benefit Inventory, and Vanderbilt Fatigue Scale scores reported by both parents and children.

Results: To date, six patients have undergone implantation; data are reported for five patients, as one transitioned to adult care. Ages ranged from 13 to 17 years. Indications were heterogeneous and included unilateral microtia with canal atresia, unilateral cholesteatoma, loss of pinna and external auditory canal following a burn injury, and Trisomy 21 with bilateral conductive hearing loss and and bilateral otitis externa and narrow external auditory canals. All patients had conductive hearing loss. A lazy S-shaped incision post-auricular incision was designed. In the patient with microtia, a retrosigmoid J-shaped incision was planned collaboratively with a reconstructive plastic surgeon to avoid compromising future auricular reconstruction. No post-operative complications were observed. Early outcomes demonstrate device usage ranging from 4 to 12 hours per day. Improved aided word recognition scores were observed post-implantation, with a mean improvement of 47% ($n = 3$). Patient-reported outcomes indicate positive cosmetic outcomes, overall satisfaction with the Sentio experience and improved quality of life.

Conclusions: This early case series demonstrates favourable surgical, audiological, and patient-reported outcomes following paediatric implantation of the Oticon Sentio. Ongoing follow-up will further define its role in this population.

Free paper 0673

Our experience with cochlear implantation in malformed cochlea and speech outcome: A case series

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Introduction: Inner ear anomalies, particularly those involving the cochlea and vestibular system, and hypoplastic or aplastic cochlear nerve significantly impact auditory and vestibular function.

Objectives: To assess and compare speech outcomes of patients with malformed cochlea who underwent cochlear implantation.

Material and methods: All participants in this study were prelingually deaf children with inability to respond to loud sounds since birth, with ABR confirmed profound sensorineural hearing. Preoperative imaging revealed malformed cochlea or hypoplastic cochlear nerves, but with guarded prognosis and considering laws of land, these patients underwent cochlear implantation. The children were given rigorous Audio-verbal therapy, and speech outcomes were followed up with rCAP scores. 19 participants were included in the analysis (26 ears). In past 10 years, 300 Cochlear implantation cases have been operated and managed at our institute.

Results: The children at majority had developed auditory awareness. Speech scores have improved from the immediate postoperative period (rCAP 1.5 ± 0.3) to one year post-implantation (rCAP 3.4 ± 0.8). At 3 years post-implantation, rCAP > 5 was achieved in 12 children. Better outcomes were noted in patients with hypoplastic cochlear nerve with normal cochlea. Speech Intelligence rating scale at 1 year was 2.3 ± 0.5.

Conclusions: Cochlear implantation in a malformed inner ear or cochlear nerve hypoplasia can deliver a good outcome but requires dedicated postoperative audio-verbal therapy. Also, diligent preoperative workup and analysis of an aided audiogram showing improvement in hearing, despite radiology showing nerve hypoplasia/ narrow IAC, were critical for optimising patient outcomes.

Free paper 0131

Our surgical approach in children with atresia

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Introduction: The incidence of auricular malformation, including aural atresia, is approximately 1 in 10,000 to 1 in 20,000 newborns, predominantly unilateral and more common in males and on the right side. The Vibrant Soundbridge (VSB) offers physiological hearing rehabilitation through selective stimulation of the affected side. Successful VSB implantation depends on optimal coupling of the Floating Mass Transducer (FMT). The VSB BERA measurement via the AcoustiAP system (MED-EL) provides an objective assessment of coupling quality both intraoperatively and postoperatively.

Material and methods: A retrospective analysis was conducted on all VSB implantations for aural atresia performed in Marburg. In some cases, intraoperative coupling was evaluated with AcoustiAP (MED-EL) and was reassessed during follow-up for implanted patients.

Results: From 2008 to 2024, 81 patients received VSB implants, including 26 with aural atresia (13 adults aged 19–43 and 13 children aged 1.5–17 years). Intraoperative coupling quality was measured using AcoustiAP (MED-EL). Initial results show a strong correlation with bone conduction thresholds, validating the method as a reliable indicator of coupling quality. Adults demonstrated monosyllabic word recognition between 75% and 90% at 65 dB postoperatively.

Conclusions: This retrospective analysis confirms the VSB as an effective and physiological solution for hearing rehabilitation in aural atresia. Unlike bone conduction systems, the VSB provides selective, unilateral stimulation, enabling more natural sound perception. Early implantation particularly benefits language and social development in children, while VSB implantation also proves successful for hearing rehabilitation in adults.

Free paper 0533

Outcome in bilateral electric-acoustic stimulation (EAS) in comparison with bimodal EAS users and different groups of CI stimulation

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The use of combined electric-acoustic stimulation (EAS) is an established treatment in patients with partial deafness and residual hearing in the low frequencies. The aim of the present study was to compare speech perception and sound localization abilities in bilateral and bimodal EAS subjects with groups of bilateral or bimodal CI. Freiburg monosyllabic scores in quiet were compared between ears with CI stimulation ($n = 1666$) and ears with EAS stimulation ($n = 109$). Speech reception thresholds (SRTs) in continuous noise using German matrix test were compared between ears with CI ($n = 880$) and ears with EAS ($n = 85$) in monaural and binaural conditions with either continuous or modulated noise. SRT scores in different spatial noise conditions and for different noise characteristics in free-field and under reverberation were evaluated for smaller subgroups of CI and EAS users. Additionally, mean error in sound localization was assessed. Under monaural test conditions, groups of EAS users achieved significantly higher speech perception scores in quiet (5 percentage points) and significantly better SRTs in continuous noise (1.6 dB), while still more than 5 dB worse than normal hearing subjects. Under binaural test conditions, bilateral EAS users had better SRTs compared to bilateral CI users in continuous and modulated noise. Bimodal and bilateral EAS users showed a tendency of better SRTs in in spatially separated speech in noise conditions (in free-field and reverberation) compared to bilateral CI users. Besides EAS users with contralateral normal hearing, the bilateral EAS group achieved the best performance in sound localization closest to subjects with normal hearing. Hearing performance is strongly influenced by noise type and spatial listening conditions and highly variable among and within different groups of CI and EAS users. However, the present study demonstrated that EAS users achieved significantly better speech perception compared to CI users. In binaural test conditions, the residual hearing in the second ear has a significant impact on speech perception in bimodal EAS users. Since more than 75% of our patients are still able to use EAS in the long-term, it is always desirable to aim for hearing preservation in CI surgery whenever possible.

Free paper 0573

Outcome of Vibrant Soundbridge Middle Ear Implant with short process coupler in older adults

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Introduction: Vibrant soundbridge (VSB), an active middle-ear implant, has been used since 1996 to treat mild to severe sensorineural hearing loss (SNHL). The short process (SP) coupler has made it possible to link the FMT to the incus body without requiring a posterior tympanotomy. To date, there has rarely reported the efficacy of active middle ear implant (SP coupler) in older adults with sensorineural hearing loss.

Material and methods: This cohort research comprised patients having an incus vibroplasty on each of the 45 patients. Preoperative and postoperative temporal bone CT, postoperative otoendoscopy, pure tone audiometry and speech audiometry, soundfield test, tinnitus handicap inventory (THI) were used to evaluate the functional audiological outcome.

Results: All patients with normal range of low frequency and slope type of mid-high frequency SNHL. None of the patients had any serious issues during or after the surgical procedure. Low hanged dura was identified in 2 patients. Two individuals had explants as a result of the ipsilateral brain MRI evaulation. All patients, with the exception of one, had a subjective godd hearing benefit, as evidenced by improvements in hearing thresholds in the soundfield from the from preoperative to the postoperative state. The postoperative bone conduction thresholds remained stable. For dissect the bone surrounding the short process, the micro-curette is better than drilling. Postoperative WRS, SSQ, and THI was improved significantly ($p < 0.05$).

Conclusions: The SP coupler shortens the surgical duration and lowers the danger of facial nerve and chorda tympani damage due to less intrusive surgery. When compared to the traditional lengthy incus coupling, SP coupling greatly enhances speech perception.

Free paper 0235

Outcomes of active bone conduction implants (Bonebridge, Sentio, and Osia): A clinical study in pediatric and adult populations

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Introduction: Bone conduction implants represent an innovative and increasingly used solution for individuals with conductive, mixed hearing loss, and SSD where traditional hearing aids may not be effective or suitable. Currently, access to various devices requires knowledge of the indications, criteria, capabilities and limitations of a particular solution. The Osia, Bonebridge, and Sentio implants differ in design, mechanisms of action, fitting range, and require specific anatomical conditions. Knowledge of the guidelines influences the selection of the appropriate and safe device for the patient.The aim of the study was to compare the effectiveness of three bone conduction implants (Osia, Bonebridge, and Sentio) in improving hearing in children and adults with different types of hearing loss.

Material and methods: The study involved 24 patients with conductive or mixed hearing loss who underwent implantation of one of the three BCI systems: Osia, Bonebridge, and Sentio. All patients were evaluated for quality of life, hearing levels in different acoustic conditions. Assessments were conducted in two stages: before implantation and one month post-activation.

Results: One month post-activation, mean aided free-field thresholds across frequencies 500, 1000, 2000 and 4000 Hz were for Osia: 32.4; 30.5; 33.8; 41.9 dB HL; Sentio: 33.6; 29.3; 30.7; 41.1 dB HL; Bonebridge: 44.3; 36.2; 31.6; 39.2 dB HL. Speech discrimination in free-field conditions improved significantly: Osia from 1.7% to 94%, Sentio from 5.5% to 94.5% and Bonebridge from 3.3% to 91.5%. Matrix test results indicated improvements in speech-in-noise perception, with SNR improving from +3.5 dB to –1.3 dB (Osia), 0.4 dB to –2.1 dB (Sentio) and +2.6 dB to –2.3 dB (Bonebridge). APHAB questionnaire results demonstrated notable reductions in perceived hearing difficulties, particularly in the subscales of Ease of Communication, Background Noise and Reverberation across all devices.

Conclusions: Active bone conduction implants (Bonebridge, Sentio, and Osia) are an effective form of rehabilitation for children and adults with various types of hearing loss. The choice of the appropriate BCI system depends on the results of the hearing test, age, anatomical conditions and the individual needs of the patient. All implant systems provided significant improvements in hearing thresholds, speech discrimination and speech-in-noise perception.

Free paper 0526

Outcomes of second and third revision cochlear implantation

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Introduction: Revision cochlear implantation (RCI) is increasingly encountered as cochlear implant use expands worldwide. While first-time revision outcomes are generally favorable, a subset of recipients undergo more than one revision in the same ear (re-RCI), representing a clinically vulnerable and understudied population. Data regarding the characteristics and outcomes of re-RCI cases remain limited.

Material and methods: A retrospective chart review was conducted of all RCI procedures performed at a tertiary cochlear implant center between 1989 and 2024. Re-RCI was defined as more than one reimplantation in the same ear. Demographic, clinical, surgical, and audiological data were collected and compared between re-RCI cases and single RCI cases. RCI indications were categorized as device-related or non-device-related. Surgical success was defined as reinsertion with no more than two extracochlear electrodes. Speech perception outcomes were assessed using individualized within-subject comparisons between pre-symptom baseline and measurements obtained at least six months post-revision. Clinically meaningful change was defined as greater than 10 percent in phoneme scores or a 10 dB change in speech reception threshold when phoneme testing was not feasible.

Results: Among 243 RCIs in 200 patients, 26 patients (13 percent) underwent re-RCI in 29 ears. Most re-RCI cases occurred in pediatric patients and females, with no significant

demographic differences compared with single RCI cases. Re-RCI cases demonstrated a higher prevalence of inner ear malformations and congenital infections. Device-related failure, predominantly soft failure, was the leading indication in both groups. Manufacturer conversion occurred more frequently in the re-RCI group but was not associated with inferior speech perception outcomes. Surgical success rates were high and comparable between groups (93.1 percent re-RCI vs 94.8 percent RCI). More than 85 percent of ears in both groups demonstrated improved or unchanged speech perception following revision, with no significant between-group difference.

Conclusions: Re-revision cochlear implantation is uncommon but primarily affects pediatric patients and those with complex etiologies. Despite increased clinical complexity, re-RCI is associated with high surgical success and favorable speech perception outcomes comparable to single RCI. These findings support the safety and effectiveness of repeated cochlear reimplantation and underscore the importance of long-term monitoring and individualized counseling for this high-risk subgroup.

Free paper 0282

Outcomes of speech recognition in relation to daily cochlear implant use in bilateral and bimodal cochlear implant users

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Introduction: The speech recognition outcome in cochlear implant (CI) users varies due to various factors. The degree and duration of ipsilateral hearing loss, but also the health status of the contralateral ear (normal hearing (NH), asymmetric hearing loss (AHL) or symmetric hearing loss (SHL)) and the use of a hearing aid (HA) may also influence the CI-outcome and duration of cochlear implant use. This study compares the datalogging entries of adult bilateral (CI+CI) and bimodal (CI+HA) CI users, in order to identify potential differences in hearing behavioural patterns and speech recognition scores.

Material and methods: We analyzed 250 adult cochlear implant users retrospectively. All subjects had bilateral hearing impairment. Inclusion criteria included postlingual hearing loss, German as a first language, correct cochlear electrode placement, and no other known pathological findings. Datalogging and speech recognition outcomes (Freiburg monosyllabic speech test at 65 dB) were recorded after six months of CI experience. Of the participants, 203 used hearing aids, while 47 had bilateral implants.

Results: The average daily CI use differed between the groups: 14.1 ± 1.5 h/day (CI+CI) and 12.0 ± 3.4 h/day (CI+HA). Speech recognition varied: 74.8 ± 14.5%, 61.8 ± 22.0% for bilateral and bimodal, respectively. A positive correlation was observed in both groups between speech recognition and daily CI use (CI+CI: $r = 0.3$, CI+HA: $r = 0.44$). There was also a negative correlation (r = –0.23) between CI use and speech scores on the contralateral hearing-aided side in the bimodal group (CI+HA). No such correlation was found in the bilateral (CI+CI) group. Additionally, no significant difference was observed in daily usage or speech scores between the two CIs in the bilateral group.

Conclusions: In both groups, CI recipients who use their device for longer each day tend to have better speech recognition in quiet environments. Daily CI use also depends on the health and provision of HA of the contralateral ear. For bimodal listeners, CI usage time is longer when contralateral hearing is worse. However, our data does not indicate whether longer daily use leads to better speech recognition or vice versa.

Free paper 0159

Patient navigation promotes timely pediatric hearing health care: A community-based randomized controlled trial

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Introduction: Delays of early identification and intervention of infant hearing loss results in speech and language impairments and educational challenges. Despite Early Hearing Detection and Intervention (EHDI) guidelines recommending diagnosis of infant hearing loss by 3 months of age, many infants are lost to follow-up which results in delayed cochlear implantation. To address these delays, we developed a community-based patient navigation (PN) program to decrease non-adherence of infant diagnostic hearing testing. This research evaluates the effectiveness of a PN intervention to decrease non-adherence of hearing care through a randomized controlled trial.

Material and methods: Infants-parent dyads were included as participants upon referral from an abnormal birth hearing test to one of ten state-funded EDHI clinics. The intervention was launched at each of the clinics in a progressive stepwise fashion separated by 6-month intervals. Non-adherence of infants for diagnostic testing follow-up by 3 months of age was the primary outcome. Sociodemographic data were evaluated as predictors of non-adherence.

Results: Overall, 979 infants were referred to study clinics during the control condition period and 1,720 infants were referred to study clinics during the PN intervention period ($N = 2{,}699$). A total of 213 infant-parent dyads were recruited and received the intervention and 2,486 infant-parent dyads did not receive the intervention. The intervention did not significantly reduce non-adherence on a clinic-level during the intervention period compared with control period (aOR 0.785, $p = 0.34$, 95% CI = 0.46–1.35). Of dyads that received the PN intervention, the odds of non-adherence were significantly reduced by 59% compared with those that did not receive PN (aOR = 0.41, $p = 0.0002$, 95% CI = 0.30–0.58). The

strongest sociodemographic predictor of non-adherence to infant diagnostic testing was maternal education level. Infants of mothers with a graduate degree had an 85% lower of non-adherence (aOR = 0.15, $p < 0.0001$, 95% CI = 0.09–0.27).

Conclusions: Infant-parent dyads that receive patient navigation are less likely to be non-adherent to diagnostic testing within 3 months after birth. Patient navigation can provide critical information and support of EHDI and recommendations in a patient-centered and culturally acceptable fashion. Patient navigation deserves further attention throughout the diagnosis and treatment process to decrease non-adherence and promote positive hearing and speech outcomes.

Free paper 0260

Perception of harmonic musical intervals by cochlear implant users

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Introduction: The perception of musical intervals is a fundamental component of melody and harmony. Intervals may be presented melodically, as successive tones, or harmonically, as simultaneous tones, with the latter playing a crucial role in the perception of consonance and chordal structure. In the chromatic scale, intervals are measured in semitones, and their perceived pleasantness (consonance or dissonance) depends on the frequency ratios between tones. Cochlear implant users are likely to perceive harmonic intervals differently from normal-hearing individuals due to technological limitations in transmitting the spectral and temporal complexity of musical sounds. The aim of the study was to evaluate the perception of consonant and dissonant harmonic intervals in normal-hearing individuals and cochlear implant users.

Material and methods: Non-invasive psychoacoustic testing was conducted using a series of paired stimuli. Each stimulus consisted of two simultaneously presented tones forming a harmonic interval. The ratio of fundamental frequencies corresponded to one of 13 interval values, ranging from 0 (perfect unison) to 12 semitones (perfect octave). Participants were asked to indicate which of the two presented intervals was perceived as more pleasant. The ranking of intervals from most unpleasant to most pleasant was determined using a procedure described by Long et al. Adult participants included normal-hearing individuals and cochlear implant users.

Results: Harmonic interval perception differed significantly between cochlear implant users and normal-hearing participants.

Conclusions: These findings provide a foundation for future research on harmonic interval perception and its potential implications for auditory rehabilitation and music-based therapeutic interventions.

Free paper 0302

Perimodiolar position and its correlation with outcomes in single-sided deafness treated with cochlear implants

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Introduction: Cochlear implantation has emerged as an effective treatment option for children with acquired single-sided deafness (SSD). However, variability in speech perception outcomes remains, and the role of electrode positioning, particularly proximity to the modiolus and related frequency mismatch, requires further investigation. The aim of this study was to evaluate long-term speech perception outcomes in pediatric SSD patients implanted with perimodiolar electrodes and to analyze the impact of modiolar distance and intracochlear position on performance.

Material and methods: This observational, descriptive, cross-sectional study included 21 children with acquired SSD implanted with slim perimodiolar cochlear implant electrodes (CIX32 in all cases) at a tertiary referral center. Speech detection thresholds and disyllabic word recognition at 65 dB SPL were assessed under three listening conditions: azimuth (S0), signal directed to the cochlear implant side (SCI), and signal directed to the normal-hearing ear (SNH). During testing, the normal-hearing ear was masked using white noise set at +10 dB above hearing threshold and occluded with an earplug. Speech testing was conducted using the cochlear implant wireless system. Outcomes were analyzed up to 24 months after sound processor activation, with extended longitudinal data available in a subset of patients.

Results: All participants demonstrated significant improvements in speech perception across all tested conditions. Word recognition in noise improved from 42.76% at 6 months to 76.38% at 48 months in the S0 condition, from 50.00% to 78.10% in the SCI condition, and from 38.48% to 66.48% in the SNH condition. Shorter electrode-to-modiolus distance and favorable intracochlear positioning showed the strongest and most consistent correlations with improved speech perception scores. Mean daily sound processor use was 11 hours.

Conclusions: Cochlear implantation with perimodiolar electrodes provides sustained improvement in speech perception in children with acquired SSD. Optimal modiolar proximity and intracochlear electrode positioning are key factors influencing long-term auditory outcomes, supporting the importance of atraumatic, perimodiolar electrode placement in this population.

Free paper 0133

Personality, social support, and socioeconomic status shape preoperative quality of life in cochlear implant candidates

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Introduction: Psychological and personality traits may influence how patients perceive hearing-related disability and anticipated benefits, but have not been considered in preoperative cochlear implantation (CI) assessment. Understanding the relationship between personality traits and preoperative quality of life (QOL) metrics may improve counseling, expectation guidance, and guide postoperative management.

Material and methods: Prior to CI, candidates completed the Type D Scale-14 (DS14), a validated self-reported personality questionnaire identifying Type D ("distressed") personality, and Cochlear Implant Quality of Life-35 (CIQOL-35), a validated assessment of QOL in adult CI users. The CIQOL-35 contains six domains: communication, emotional well-being, entertainment, environmental sound, listening effort, and social interaction. Demographic, audiometric, and speech perception data were included from routine evaluation. Socioeconomic distribution (SES) was determined via zip codes.

Results: Forty preoperative CI candidates were included (67.5% female). D (Type D) personality was identified in 14 patients (35.0%). Marital status included married/partnered (55.0%, $n = 22$) and unpartnered (single, widowed, divorced) (45.0%, $n = 18$). By SES, 15 patients (37.5%) were identified in the high, 18 patients (45.0%) in the middle, and 7 patients (15.6%) in the low incomegroups. On preoperative CIQOL-35, D participants had lower emotional (38.9 vs 54.9, $p < 0.001$) and social (46.0 vs 60.7, $p = 0.008$) scores; other domains did not differ. Married non-D participants had above-average emotional ($Z = +0.64$, $p = 0.016$) and social ($Z = +0.68$, $p = 0.015$) scores, whereas married D participants remained below average in the emotional sub-domain ($Z = -0.60$). D participants in low-income groups demonstrated a "double jeopardy" effect, exhibiting deficits across emotional ($Z = -1.54$, $p = 0.002$), listening effort ($Z = -1.31$, $p < 0.001$), environmental ($Z = -0.96$, $p < 0.001$), and social ($Z = -0.83$, $p < 0.001$) domains. High socioeconomic status was protective for D participants (Emotional $Z = -0.67$). Dizziness, tinnitus, amplification use, and audiological and speech perception tests, including the contralateral ear, did not reveal significant associations to QOL amongst the personality types, confirming that QOL deficits were independent of physical hearing capacity.

Conclusions: Type D personality is associated with significantly lower preoperative emotional and social CIQOL scores, independent of objective hearing measures. Marital status and high SES partially mitigate these deficits, while low SES exacerbate them.

Free paper 0692

Photon-counting computed tomography in otolaryngologic imaging: Clinical experience with NAEOTOM Alpha Prime

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Introduction: CT imaging of the temporal bone is used to evaluate the middle ear, the bone structure of the cochlea, temporal bone fractures as a diagnostic tool after mechanical injuries, and for postoperative evaluation. The latest technologies introduced by manufacturers, such as photon-counting computed tomography (PCCT), offer greater diagnostic accuracy, which can be seen when comparing these images with those obtained from conventional CT scanners.

Material and methods: A key feature of the PCCT scanner is an X-ray detector made of a TeCd single crystal, which allows each photon to be counted along with information about the quantum energy, which in turn allows the X-ray beam spectrum to be separated into several energy ranges. The morphological cross-sections obtained in the image reach a spatial resolution of 0.11–0.178 mm, thus enabling the visualization of smaller structures, including the ossicles of the middle ear and the anatomy of the inner ear. In postoperative examinations, CT is used to assess the position of the electrode and determine the location of individual contacts, and in middle ear surgery, the exact position of the implanted implants.

Results: When comparing images obtained with conventional CT scanners to images obtained with PCCT, PCCT scans are characterized by higher spatial resolution, higher contrast, and reduced artifacts, while also limiting the dose of ionizing radiation. In addition, a single scan provides a complete set of spectral information: e.g., virtual monoenergetic images (VMI), iodine density maps, images of the decomposition (separation) of desired materials from the image (e.g., calcifications, uric acid deposits), and reduction of artifacts from metallic implants.

Conclusions: Photon-counting CT technology represents a new era in computed tomography. Its use in temporal bone examinations offers new diagnostic possibilities in otolaryngology. A comparison of PCCT images with those obtained using conventional CT scanners shows much better diagnostic images, opens up new directions for research and applications of this technology in otolaryngology, and thus allows for faster and more accurate diagnosis of patients with hearing disorders.

Free paper 0613

Photon-counting CT: New perspectives in cochlear implantation

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Introduction: Accurate determination of the cochlear duct length (CDL) is essential for individualized selection and optimal positioning of cochlear implant electrodes. Conventional imaging techniques are limited by restricted spatial resolution, relevant radiation exposure, and metal artifacts. Photon-counting detector computed tomography (PCCT) represents a novel CT technology that enables high-resolution imaging while simultaneously reducing radiation dose. The aim of this study was to evaluate the potential of PCCT for cochlear imaging in the context of cochlear implantation under both experimental and clinical conditions.

Material and methods: PCCT was employed for pre- and postoperative cochlear imaging in experimental and in clinical settings. CDL measurements were performed using standardized manual and automated methods in OTOPLAN and were compared with established CT techniques, including multi-slice CT and flat-panel volume CT. In addition, image quality, metal artifacts, reproducibility, and different radiation dose protocols were systematically analyzed.

Results: PCCT demonstrated high spatial resolution combined with excellent dose efficiency. CDL measurements proved to be accurate and highly reproducible, including in the clinical setting. Data obtained from clinical use confirmed the strong transferability of the experimental findings. Measurement accuracy was at least comparable to that of established high-resolution CT techniques, while radiation exposure was reduced by more than 80% compared with standard protocols.

Conclusions: Photon-counting CT opens new perspectives for cochlear imaging in cochlear implantation. Initial clinical experience demonstrates successful translation of this technology from experimental to clinical application and highlights its considerable potential for anatomy-based cochlear implant planning and future cochlear implant workflows.

Free paper 0287

Pivotal multicentre randomised controlled trial of a dexamethasone-eluting slim straight electrode (CI622D) vs standard electrode (CI622) in newly implanted adults with bilateral moderately severe-to-profound sensorineural hearing loss: A 6-month interim analysis

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Introduction: Strategies to mitigate the inflammatory response (fibrosis) following cochlear implantation is an active area of research. The aim of this ongoing study is to assess if passive elution of dexamethasone using the investigational drug-eluting slim straight electrode (CI622D) reduces fibrosis, while maintaining the safety and hearing performance benefits of the standard electrode (Cochlear™ Nucleus® CI622).

Material and methods: This is a pivotal, prospective, multicentre, randomised controlled, 6-month blinded trial followed by a 6-month open-label phase in adults aged ≥18 years with post-lingual, bilateral, moderately severe to profound sensorineural hearing loss (defined by a four-frequency, pure-tone average threshold over the range 500 through 4000 Hz of >55 dB HL). Participants were randomised 1: 1 to receive either the investigational (CI622D) or the control (CI622) device. The primary endpoint was intracochlear monopolar 1+2 (MP1+2) electrode impedance, compared between CI622D and CI622. Improvement in speech perception performance for open-set monosyllabic word recognition in quiet at 6 months in those randomised to CI622D was the secondary inferential endpoint of interest. Safety outcomes were also assessed.

Results: Of the 52 participants randomised, 50 were implanted with CI622D ($n = 24$) or CI622 ($n = 26$). Among those implanted, mean (SD) age was 65.2 (16.4) years and demographics and baseline characteristics were well balanced between arms. As the study is ongoing, we are unable to present comprehensive results at the time of abstract submission. Initial observation of the 6-month primary endpoint is promising for the comparison of the mean MP1+2 electrode impedance measurements between participants implanted with CI622D and CI622. Similarly, the mean change from baseline in speech perception performance for open-set monosyllabic word recognition in quiet in those implanted with CI622D is also favourable. One possibly procedure-related serious adverse event was recorded.

Conclusions: Complete findings will be presented during the conference. These data will inform additional clinical investigations on the role of dexamethasone in cochlear implantation.

Free paper 0612

Placement of the MP1 return electrode closer to the cochlea to manage facial stimulation in cochlear implants

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Introduction: Although uncommon, facial nerve stimulation (FNS) can limit cochlear implant (CI) performance or even lead to device non-use. Transimpedance matrix (TIM) measurements allow clinicians to distinguish between (1) Labyrinthine Segment Stimulation: Direct stimulation of the nerve's labyrinthine portion which occurs when a focal dehiscence in the bony cochlear wall creates a "current sink" (2) Tympani segment stimulation: Where the current stimulates the tympanic segment while returning to the extracochlear ground. To address FNS caused by tympanic segment stimulation clinicians can implement an intracochlear return electrode to contain current spread. However, this often introduces significant signal distortion, potentially compromising the overall auditory outcome of the implant. In the present study, the placement of the MP1 return electrode was modified and repositioned near the cochlea to limit current spread and manage FNS.

Material and methods: A 65-year-old male with bilateral Meniere's disease underwent a simultaneous right-sided labyrinthectomy and CI622 cochlear implantation. Postoperatively, the patient experienced severe FNS, preventing comfortably loud volume and resulting in zero open-set word recognition. TIM measurements showed no focal current sink. Pseudomonopolar stimulation minimized FNS and introduced significant distortion and failed to restore speech perception. A revision was performed using a CI632 perimodiolar array under electromyography monitoring. During the procedure, the MP1 return electrode was strategically repositioned at various locations near the cochlea to limit current spread and mitigate FNS.

Results: After establishing a baseline FNS threshold of 180 CL (Electrode 4, 200 μs) with the existing device, several MP1 ground electrode positions were tested. Replacing the lateral wall array with a perimodiolar electrode did not, by itself, limit FNS when using traditional ground placement. Relocating the MP1 ground electrode in the area of the vestibule yielded the most significant improvement. This configuration raised the FNS threshold to 210 CL, representing a ~75% increase in current delivery into the cochlea without eliciting facial stimulation.

Conclusions: Relocating the MP1 return electrode closer to the cochlea in CI patients experiencing severe FNS from tympanic segment stimulation effectively minimizes facial nerve activation. This modification increases the available dynamic range, improving both loudness levels and overall cochlear implant outcomes.

Free paper 0176

Positive intra-operative electrocochleography track patterns with the HiFocus SlimJ electrode array are associated with stable and improved hearing preservation rates

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Introduction: Preservation of residual low-frequency hearing is a key consideration for electroacoustic stimulation in cochlear implantation. Intra-operative electrocochleography (ECochG) offers real-time insight into cochlear function during electrode insertion, and prior work suggests certain ECochG track patterns may relate to postoperative outcomes. However, longitudinal evidence linking intra-operative ECochG patterns to hearing preservation at 12 months, particularly with contemporary electrode arrays, remains limited. This study investigates whether ECochG track patterns, classified as in Harris et al. (2024), predict 12-month hearing preservation in adults implanted with the Advanced Bionics HiRes Ultra 3D and HiFocus SlimJ array.

Material and methods: In this multi-center longitudinal study, 23 adults with unaided low-frequency thresholds ≤80 dB HL were implanted across three Spanish sites using a full-depth HiFocus SlimJ array. Intra-operative ECochG was collected from the apical electrode during insertion, using a 50 ms tone burst at 115 dB HL and 500 Hz, with eight alternating-polarity repetitions per second. No standardized intra-operative intervention was mandated; surgeons could adjust speed/vector based on feedback. ECochG waveforms were classified into four track patterns (A, C, CC, D) per Harris et al. Positive patterns (A/CC) were analysed against post-operative hearing outcomes. Post-operative hearing was assessed at 1, 3, 6, and 12 months using LFPTA (125, 250, 500 Hz) and preservation was calculated per Skarzynski et al. (2013). Statistical analyses were performed in Excel ($p < 0.05$).

Results: Positive intra-operative ECochG track patterns (A/CC) were observed to correlate with more favourable long-term hearing outcomes. Specifically, positive patterns were associated with reduced post-operative hearing loss and higher 12-month hearing preservation rates compared with negative patterns. Correlations between ECochG findings and post-operative outcomes reached statistical significance. No sub-analytic comparison between round window and extended round window approaches was performed due to sample size. The study adhered to ethical standards across sites, with informed consent obtained from all participants.

Conclusions: Intraoperative ECochG during HiFocus SlimJ insertions provides real-time cochlear function information that correlated with 12-month hearing preservation in adults with residual hearing. While observational, these findings support ECochG as a valuable intraoperative monitoring tool linked to favourable outcomes.

Free paper 0463

Posterior placement of a bone conduction implant in congenital aural atresia: Surgical technique and considerations

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Introduction: Active bone conduction implants are an important hearing rehabilitation option for patients with congenital aural atresia, particularly when conventional percutaneous devices are not desired. Anatomical variations, previous auricular reconstruction, and limited temporal bone thickness can complicate implantation and require individualized surgical strategies.

Material and methods: We describe the surgical technique used for the first reimbursed MEDEL Bonebridge implantation in Belgium in a 25-year-old female patient with congenital aural atresia and prior auricular reconstruction. Preoperative planning was performed using OTOPLAN® software to assess temporal bone thickness and identify a safe implantation site. Due to the patient's preference to avoid the reconstructed auricle, a posterior positioning of the bone conduction floating mass transducer (BC-FMT) was selected.

Results: A skin incision was made approximately 25 mm posterior to the helix at the temporal line, with a slight curvature to allow sufficient exposure of the implant site. A subperiosteal pocket was created, followed by drilling of a bony well to the level of the dura. The dura was mildly compressed but remained intact. Reduced bone thickness was accommodated by the implant wings, allowing stable fixation to the surrounding temporal bone. Care was taken to ensure correct BC-FMT orientation and secure seating within the well. Wound closure was performed in layers. Postoperative healing was uneventful, and initial device fitting was carried out two weeks after implantation.

Conclusions: This case demonstrates that posterior placement of an active bone conduction implant is a feasible and safe surgical option in patients with congenital aural atresia and altered anatomy due to prior auricular reconstruction. Careful preoperative planning and flexible surgical positioning enable successful Bonebridge implantation in anatomically challenging cases, expanding the applicability of bone conduction implants for individualized hearing rehabilitation.

Free paper 0132

Powered cochlear implant electrode insertion using OTODRIVE with FLEX electrodes

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Introduction: The OTODRIVE System is for powered cochlear implant electrode insertion to facilitate slow, steady, insertion of a cochlear implant at a speed from 0.1 to 1.0 mm/s. To report preliminary outcomes, including, physical characteristics of electrode insertion, timing characteristics, hearing preservation outcomes, and patient reported outcome measures, following cochlear implantation with FLEX electrodes using the OTODRIVE System.

Material and methods: A single-institution prospective analysis on patients 18 years or older who undergo cochlear implantation using the OTODRIVE System with a MED-EL FLEX electrode.

Results: Eight patients have been implanted with the OTODRIVE System, consisting of FLEXSOFT (4), FLEX28 (3), and FLEX26 (1). Considering all patients, the average OTODRIVE setup time before prepping the patient was 9.6 minutes (range, 5–15 minutes), though the four most recent patients have an average pre-surgery setup time of 6.3 minutes. Considering all patients, the average OTODRIVE setup time in aligning the entire system once the round window is visualized was 10.6 minutes (range, 5–20 minutes), though the four most recent patients have an average intraoperative setup time of 6.3 minutes. Removing one outlier, the very first case, the overall average electrode insertion time is 447.6 seconds (range, 288–646 seconds). The overall average insertion angle is 619.6 degrees (range, 495–685.9 degrees), with all but one patient achieving a complete insertion. Consisting of a mix of FLEXSOFT and FLEX28 electrodes, of five patients with a pre-operative low-frequency (125, 250, and 500 Hz) pure-tone average ≤65 dB, 60% had measurable low-frequency thresholds at activation. Two of the three patients with measurable low-frequency thresholds at activation had lost all residual hearing at three months.

Conclusions: The OTODRIVE System provides a unique and novel approach for motorized insertion of cochlear implants, allowing for precise orientation and coordination of the cochlear implant insertion angle relative to the basal turn with five different degrees of freedom. Complete insertions with desired angle of insertion angles are capable with the system, with comparable short-term hearing preservation rates to date to manual insertions.

Free paper 0171

Pre vs postoperative OTOPLAN comparison

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Introduction: The variation in cochlear duct length (CDL) between patients is well recognized. Previously, cochlear implant array selection did not incorporate CDL because to imaging and measurement issues. Selecting a device length that roughly matches the CDL improves speech intelligibility in quiet and noise, frequency-to-place mismatch and sound quality. Recent CDL measurement and clinical imaging resolution improvements have enhanced cochlear size estimation. Clinical approval of OTOPLAN imaging software by CAScination and MED-EL Corporation has made imaging analysis widely used to incorporate individual anatomy into cochlear implant array selection. After surgery, CT scans can be uploaded into OTOPLAN to validate electrode position and predict array contact angle insertion depths and frequencies. This data can vary contact frequency. Pre-operative MRI or CT imaging is standard for cochlear implant candidacy examinations, but post-operative CT imaging varies by clinic. Second post-operative CT scans increase radiation exposure, which may concern pediatric or high-risk patients. Using pre-operative scanning data post-operatively to improve fitting techniques is of interest. To answer that question, this study examines pre- and post-operative electrode location estimations in full cochlear implant electrode implantation patients.

Material and methods: This study compared 100 pre-operative electrode position estimates to OTOPLAN imaging software post-operative electrode location in patients implanted with different array lengths at multiple sites.

Results: Pre-operative electrode location estimates and post-operative electrode angular insertion depth (AID) when the electrode array is fully installed are closely related. Extracochlear contacts and pre-operative MR imaging increased variability. The most basal contact point linked with average discrepancies between pre-operative angular insertion prediction and post-operative AID estimation. Results indicate that pre-operative prediction of electrode position using cochlear duct length measurement may help determine post-operative electrode array location. Extracochlear contacts or the basal-most contact near the round window may impair pre-operative AID estimates. We should investigate whether pre-operative data can optimize post-operative patient frequency settings.

Free paper 0654

Precision cochlear implant surgery: Using OTOPLAN for patient-specific planning and mapping in older adults

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Introduction: Imaging provides reliable measurements of cochlear duct length (CDL) and patient-specific electrode lengths for cochlear implant (CI) surgery to maximize cochlear coverage. Post-operative imaging can also be used for anatomy-based fitting (ABF). Here we evaluate the utility of imaging software (OTOPLAN, Med-El) in the pre- and post-operative settings in older adults undergoing CI.

Material and methods: A retrospective chart review included patients with normal cochleae receiving OTOPLAN image analysis between March 2023 and November 2025 for pre-operative planning or post-operative ABF. Patients age 65 and older were identified as a subgroup to assess OTOPLAN utility.

Results: One hundred and fifty-two patients were included: 24 pediatric (median age 7.4 years, 41.7% female), 78 adults under 65 (median age 49.5 years, 53.8% female), and 50 adults age 65 and older (median age 74.6 years, 52% female). A mixed model analysis showed that cochlear duct length (CDL) did not differ across age groups ($F = 0.035$, $p = 0.965$). However, males had significantly longer CDL than females in the full cohort (237 ears; 33.18±0.23 mm vs 31.55 ± 0.24 mm, $p < 0.001$), with a more pronounced difference in the older adult subgroup (84 ears; 33.60 ± 0.32 mm vs 31.23 ± 0.31 mm, $p < 0.001$). Postoperatively among MED-EL recipients, pre-operative OTOPLAN was associated with significantly deeper angular depth of insertion (ADI) compared to no planning (~76°; Wald $\chi^2 = 15.61$, $p < 0.001$). An EMM 520.4° (95% CI: 490.4–552.2) seen in older adults' group was comparable to the pediatric group ADI but significantly shallower than that of adults ($p = 0.017$). The difference between estimated and inserted ADI was not significant across age groups (median 31.8°, IQR: 8.8°–58.4° in older adults; Kruskal–Wallis $p = 0.584$). Most notably, pre-operative OTOPLAN recipients received an electrode within EMM 3.05 ± 0.26 mm of their CDL versus 6.00 ± 0.44 mm without planning ($F = 33.654$, $p < 0.001$). The same trend was observed in older adults' subgroup, with median electrode-CDL differences of 2.43 mm (IQR: 1.55–5.50) versus 7.63 mm (5.73–9.15) with and without planning respectively ($p = 0.005$).

Conclusions: OTOPLAN is an important tool for patient-specific pre-operative planning through CDL-guided electrode selection. Post-operatively, it supports CI programming by matching electrode locations to frequency-specific cochlear areas.

Free paper 0014

Predicting hearing outcomes after cochlear implantation using synthetic CSF protein signatures from structural MRI

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Objective: Cochlear implants (CIs) are effective for severe-to-profound hearing loss when conventional hearing aids fail, but outcomes vary widely. Evidence suggests that CI outcome depends on central auditory processing and auditory pathway integrity. This study explored the role of central processing using artificial intelligence (AI) to infer synthetic cerebrospinal fluid (CSF) biomarkers from magnetic resonance imaging (MRI) and evaluate their correlation with CI outcomes.

Material and methods: In this prospective monocentric study, adults with bilateral severe-to-profound hearing loss indicated for primary CI were enrolled. Patients were classified as poor performers if, one year post-surgery, speech comprehension at 60 dB in quiet (monosyllabic and disyllabic word lists) was <50% and improvement <20%, using the CI with a contralateral hearing aid. All patients underwent high-resolution 3D T1-weighted MRI. Images were segmented into 196 cortical and subcortical volumes using deep-learning models. Dimensionality reduction and digital twin creation quantified anatomical deviations via Manifold Estimation Deviation scores. A regression model, validated against CSF standards in Alzheimer's disease, inferred synthetic biomarker levels (*p*-tau181, tau, Aβ42) from MRI, avoiding lumbar puncture.

Results: Sixty-eight patients (36 males, 32 females; mean age 64.7 ± 14.4 years) were included; none had cognitive impairment. Fifty-three (77.9%) were good performers, 15 (22.1%) poor performers; MRI was uninterpretable using AI in 4 patients. Mean biomarker values were *p*-tau181 = 20.73 ± 5.32 ng/L, tau = 226.15 ± 48.48 ng/L, Aβ42 = 1534.17 ± 322.62 ng/L. Good performers had higher inferred Aβ42 (1599.42 ng/L) than poor performers (1301.13 ng/L; $p = 0.002$). Multivariate logistic regression identified Aβ42 as a significant predictor of CI outcomes (OR = 1.004, 95% CI [0–0.007], $p = 0.03$). ROC analysis established an Aβ42 cutoff of 1457.88 ng/L, with AUC 0.74, sensitivity 71.4%, specificity 72% ($p < 0.01$).

Conclusions: AI can predict CI outcomes from MRI-derived synthetic CSF biomarkers. Poor performers exhibited lower Aβ42, suggesting that reduced Aβ42 and its extracellular deposition may damage central auditory pathways, limiting auditory performance after implantation.

Free paper 0503

Predicting speech outcomes with Focused NRT: Informing future features of the Nucleus® Nexa implant

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Introduction: Neural health is critical for cochlear implant (CI) performance, as the integrity of the auditory nerve influences how electrical stimulation is perceived and processed. Variability in neural survival contributes to differences in speech understanding among recipients. Assessing neural health could optimise coding strategies and personalise programming. However, reliable clinical measures remain limited. The Nucleus® Nexa System enables new research opportunities to provide potential future benefits for patients and professionals.

Objective: To evaluate the potential of Focused Neural Response Telemetry (focused NRT) as an objective marker to predict speech performance outcomes. It is hypothesised that a combination of objective measures including focused NRT, with reduced intracochlear current spread, offers a sensitive estimate of neural health and spatial selectivity of the electrode-neural interface.

Material and methods: Adult participants ($n = 42$) with postlinguistic bilateral sensorineural hearing loss were implanted with the investigational CI1032 CI and the CP1000 Smart sound processor (Nexa Electrode-Neural Interface Research System). Participants were fitted with a monopolar program at activation and fine-tuned according to standard clinical care. Focused NRT was measured at 5.5 months, post-activation. Correlations with phoneme discrimination in noise (Language Independent Test, LIT) and spectral resolution (Quick Spectral Modulation Detection, QSMD) were assessed.

Results: At the time of abstract submission, preliminary insights indicate that higher focused NRT thresholds are associated with poorer performance across phoneme discrimination, LIT, QSMD, and word recognition, accounting for a substantial proportion of variability. Detailed results will be presented at the conference.

Conclusions: Electrode–neural interface quality appears to influence functional outcomes, with focused NRT thresholds emerging as a potential biomarker for outcome risk

and individualized intervention strategies. These insights will inform how advanced platforms like the Nucleus® Nexa System can leverage existing capabilities to integrate objective measures as future features, enabling smarter, data-driven programming.

Free paper 0103

Preliminar result of robotic approach in CI-surgery in a pediatric population: Multicentric study

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CI is currently the therapeutic target for children with severe profound NHL where the benefit of conventional hearing aids is poor or absent. The surgical approach is to be delicate and atraumatic in order to limit possible damage to the inner ear. The electrode insertion must be slow, without oscillations, to reduce fibrotic processes. Furthermore, especially in pediatric settings, where there is a long life expectancy and a greater probability of having to replace the cochlear implant during life, it is necessary to safeguard the hair cells in order to preserve the residual hearing. At the CRR of cochlear implants of the Santobono-Pausilipon hospital in Naples is started from January 2025, a multicentric study thanks to MED-EL and their system OTOARM-OTODRIVE in the collaboration of the most important pediatric hospital of Italy.

The robotic system permits to have a precisely and controlled trajectory of insertion of the electrode in cochleostomy. The surgical insertion is defined as atramautic and reproducible. The criterias of inclusion for the study are: children in prelingual phase of their lives, up to 5 years old. The exclusion criteria are: malformation of the inner ear, children who need or needed special care at Neonatal Intensive Care, and genetic malformation. The objectives of the multicentric study are divided into: a primary objective to demonstrate the safety and effectiveness of OTODRIVE for powered electrode insertion in cochlear implantation.

Secondary objectives are: to evaluate the hearing preservation after cochlear implant surgery and the evaluation of the timing of surgery. The patients will be 25 plus 25 as a control group. The timing of the study will be 24 months. Before the surgery, all children undergo ABR, TC, RMN, OTOPLAN reconstruction, and the LittlEARS questionnaire. The post-operative tests are ECAP, ABR, and IFT. The preliminary results are: surgical timing is comparable to classical surgery. There's always been the correct and full insertion of the electrodes, and the impedance appears low and stable. In conclusion, robotic surgery has shown evidence of reduction of fibrotic damage at the cochlear level and preservation of residual hearing in the patient. The scope of this study is to demonstrate the efficiency and safety of OTOARM in the pediatric field.

Free paper 0169

Preserving what matters: Functional & structural hearing preservation in CI surgery revisited

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Objective: To quantify how surgical behaviour influences intracochlear mechanical stress during cochlear implantation, using objective multi-sensor data from a large cohort of expert surgeons.

Material and methods: Thirty internationally recognized surgeons each performed bilateral insertions in validated artificial temporal bone models. Intracochlear force, pressure, and electrode kinematics were captured, and six trauma-related metrics were combined into a composite soft-surgery score. Associations with surgical experience, self-assessment, and handling behaviours were analysed using nonparametric statistics.

Results: Marked variability was observed across all metrics. Surgeons with < 50 lifetime insertions performed significantly worse than experienced colleagues. Self-assessment showed no correlation with objective outcomes. Excessively slow insertions and frequent electrode regrasping were associated with higher pressure exposure, greater force variation, and increased intracochlear implant motion. Post-insertion handling contributed substantially to intracochlear stress.

Conclusions: Surgical behaviour decisively influences intracochlear mechanical stress in cochlear implantation. Steady, uninterrupted advancement at slow to moderate speed, avoidance of array regrasping, and careful post-insertion handling reduce mechanical load. Because self-assessment proved unreliable even among expert surgeons, structured training with quantitative feedback and intraoperative monitoring are essential to refine soft surgery technique, preserve residual hearing, and optimize hearing outcomes.

Free paper 0685

Progenitor cells in the adult human cochlea have the potential to regenerate new hair cell-like cells

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Introduction: Current interventions for hearing loss – hearing aids and cochlear implants – are only partially effective and often fail to restore natural sound perception. Regenerative strategies that restore natural hearing would,

therefore, present a potential superior solution. Recently, endogenous cochlear progenitor cells have been identified in the mammalian cochlea, uncovering potential target cells for hair-cell regeneration. Our work focuses on a subset of supporting cells that express the stem cell marker LGR5. We and others have demonstrated that LGR5+ supporting cells can regenerate into new hair cells, persist in the adult mouse cochlea, and survive both acute and chronic deafening in vivo, underscoring their promise as targets for regenerative therapies. However, how these findings translate to the human inner ear remains unknown.

Material and methods: LGR5 expression was analyzed in adult human inner ear tissue obtained within 12 hours postmortem from bodies donated to science. In parallel, we assessed the progenitor capacity of sensory epithelium from adult patients undergoing a translabyrinthine or transotic surgical approach to remove skull-base tumors. Comparative analyses were performed using organoids derived from adult mouse cochlear progenitors. Isolated cells were cultured in three-dimensional organoid systems, and key signaling pathways were modulated to promote proliferation and hair cell differentiation.

Results: Our findings demonstrate that LGR5+ hair cells progenitors are present in the adult human cochlea. Supporting cells derived from adult human inner ear tissue and adult mouse cochlea retained proliferative capacity in vitro and generated organoids. After differentiation, these organoids produced MYO7A-positive hair cell–like cells with morphological features consistent with sensory hair cells.

Conclusions: These results indicate that supporting cells with regenerative potential persist in the adult human and mouse cochlea and vestibular organ. When activated through targeted manipulation of signaling pathways, these cells can proliferate and give rise to hair cell-like cells. This highlights their promise as therapeutic target cells for future regenerative therapies to restore hearing in adults.

Free paper 0572

Programming considerations for short electrode arrays: Hearing preservation outcomes and clinical implications

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Introduction: Preservation of residual acoustic hearing has become a key goal in cochlear implantation. Numerous studies have demonstrated the benefits of combined electric–acoustic stimulation (EAS), including improved speech perception in noise, music appreciation, and sound quality. However, despite advances in surgical technique and electrode design, programming challenges can arise when residual hearing recovery times vary postoperatively. Understanding how hearing preservation outcomes influence programming strategies is essential for optimizing patient benefit.

Material and methods: This retrospective study evaluated hearing preservation outcomes and programming considerations in adult recipients who underwent cochlear implantation with MED-EL FLEX20, FLEX24, and FLEX26 electrode arrays. Postoperative audiometric thresholds were compared to preoperative measures to determine rates of hearing preservation. Programming data were reviewed to assess fitting strategies, low-frequency cutoff settings, and management approaches with short electrode array placement.

Results: Preliminary results for 48 adults who were implanted with FLEX20, FLEX24, and FLEX26 electrodes from January 2021 to October 2025; additional data for subjects seen through March 2026 will be included at the time of presentation. Functional acoustic hearing defined as a low-frequency pure-tone average (125–500 Hz) less than 80 dB HL was achieved in 83% of patients across all electrode types, with higher preservation rates generally observed in younger adults. Additional data will describe timelines of delayed or partial recovery of residual hearing and fitting strategies used to optimize EAS fittings.

Conclusions: While hearing preservation remains a key goal of short-electrode cochlear implantation, variability in outcomes necessitates flexible and patient-specific programming approaches. Fluctuating residual hearing, partial insertions, and age-related factors present unique challenges but can be successfully managed through thoughtful programming strategies.

Free paper 0375

Progress toward total implantability: Two decades of innovation and experience

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Introduction: Conventional cochlear implant systems deliver significant improvements in hearing, however the need for an external speech processor may limit usability in certain everyday situations. These include water-based and high-activity situations, and in variable environmental conditions. Important unmet needs with conventional systems are sound awareness during sleep, aesthetic discretion of hearing loss and continuity of hearing across daily living contexts. A totally implantable cochlear implant (TICI) addresses these gaps. Cochlear has been at the forefront of developing TICI expertise, building on decades of research and development in implantable hearing technologies. The aim of this presentation is to review the technical and clinical advancements across multiple generations of Cochlear's TICI systems.

Material and methods: The Cochlear TICI clinical development program, reflecting over 20 years of extensive research, comprises three feasibility studies (TIRKANDI, TICI G0, ENHANCE) with a total of 23 patients receiving investigational devices; and two pivotal studies (ENTERPRISE, ELEVATE) that are currently underway. Collectively, these

studies are addressing the challenges in designing a totally implantable hearing solution: microphone location and sensitivity, battery size and longevity, sound coding efficiency, implant package size, and surgical complexity.

Results: The technical progression of the TICI device has involved multiple advancements in implant design, battery chemistry, microphone systems, and signal processing. Cochlear's clinical development program has progressed through preclinical validation, first-in-human trials, to pivotal multicentre studies assessing safety, efficacy, and user experience. Feasibility studies have demonstrated promising speech perception outcomes and high user satisfaction in domains of convenience, confidence and lifestyle compatibility. Pivotal studies will provide further evidence on performance and safety.

Conclusions: The technical and clinical development program of the Cochlear TICI system reflects over two decades of rigorous research and development. Robust feasibility studies have provided critical insights into the safety and performance of investigational devices, informing numerous design improvements. Each generation of TICI builds on prior learnings to enhance hearing performance and user experience. Pivotal trials focus on long-term safety and reliability, which are essential to ensuring that future commercial TICI systems are supported by robust clinical evidence and meet the highest standards of performance and patient safety.

Free paper 0025

Proven hearing preservation with MED-EL FLEX electrode arrays: Real-world evidence to support hearing preservation claims

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Introduction: Preservation of functional residual hearing is a key clinical goal in cochlear implantation, to respect the cochlear anatomy, to allow improved auditory outcomes, and it supports electric-acoustic stimulation (EAS). MED-EL's FLEX electrode series is specifically designed for atraumatic, reliable scala tympani insertions to support hearing preservation (HP). This analysis uses Real-World Evidence (RWE) to evaluate HP outcomes in MED-EL cochlear implant (CI) recipients.

Material and methods: A prospectively designed, retrospective, multi-center analysis of anonymized data from the MED-EL Hearing Solutions (MEHS) registry in Germany was conducted in recipients implanted with FLEX24, FLEX26, FLEX28, or FLEXSOFT electrode arrays. HP in the low frequencies was evaluated using two standardized metrics: (1) the Vienna Consensus (VC) classification based on postoperative low-frequency Pure Tone Average (PTA) shift, and (2) the Minimum Reporting Standards for Adult Cochlear Implantation of the American Academy of Otolaryngology – Head and Neck Surgery (AAO), focusing on functional residual hearing.

Results: Across all FLEX electrode lengths, 57.4% of recipients demonstrated complete or partial hearing preservation 12–24 months post-implantation as defined by a low-frequency PTA shift ≤30 dB HL (VC criteria). Additionally, across all FLEX electrode lengths, 52.2% of recipients had functional residual hearing at 12–24 months post-implantation as defined by a PTA <80 dB (AAO criteria).

Conclusions: These real-world registry outcomes, obtained without controlling for surgeon or surgical technique, formed the primary clinical evidence package supporting U.S. regulatory approval for explicit hearing preservation marketing claims for MED-EL FLEX electrodes. The evaluation and acceptance of these data by FDA enabled MED-EL to be the first and only cochlear implant manufacturer to be granted FDA approval for residual hearing preservation. This confirms that FLEX electrodes provide a proven opportunity to preserve residual hearing, providing cochlear implant access to as many candidates as possible while optimizing outcomes for every patient.

Free paper 0298

Psychological outcomes after early cochlear implant activation in adults: A cross sectional study

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Introduction: Advances in minimally invasive cochlear implant (CI) surgery and sound processor technology have enabled activation within the first few days after implantation. While early activation may enhance patient engagement and streamline rehabilitation, its psychological impact on adult CI recipients remains insufficiently explored. Understanding early emotional responses is essential for supporting patient-centered CI care.

Objective: To evaluate anxiety and depression following early CI activation (1–3 days post-surgery) and examine their associations with audiological performance and daily device use.

Material and methods: A cross-sectional study was conducted among adult CI recipients who underwent early activation, defined as processor activation within 3 days postoperatively. A single experienced clinical psychologist administered the Generalized Anxiety Disorder-7 (GAD-7) and Beck Depression Inventory (BDI) through telephone, video, or inperson interviews. Audiological measures included pure-tone average (PTA), speech reception threshold (SRT), speech discrimination score (SDS), and daily processor wearing hours. All participants received MED-EL devices (FLEX26, FLEX28, or FORM24 electrode arrays). Descriptive statistics and Spearman correlations were used ($\alpha = 0.05$).

Results: Twenty-seven adults were included. Most participants reported minimal or mild anxiety (85.2%) and no or mild depression (74.0%). Moderate to severe psychological symptoms were uncommon. No statistically significant associations were observed between GAD-7 or BDI scores and daily device use, SRT, or SDS. PTA demonstrated small, non-significant positive correlations with anxiety ($r = 0.34$) and depression ($r = 0.36$).

Conclusions: Early CI activation was psychologically well tolerated among adult recipients, with generally low levels of anxiety and depression. Psychological symptoms were not strongly related to audiological outcomes or daily device use. These findings support early activation as a feasible and patient-centered component of CI rehabilitation. Further longitudinal and comparative studies are recommended to clarify the long-term psychological and audiological implications of early activation.

Free paper 0587

Psychophysical outcomes for variations of focused multipolar stimulation

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Introduction: The SASC (Stimulation and Sound Coding) study forms part of Cochlear's global Nexa Research Program and explores the impact of a range of configurations of focused multipolar stimulation (FMS) on auditory perception. The objective of this study was to assess the perceptual effects of FMS on psychophysical outcomes in adult CI recipients.

Material and methods: Eighteen adult participants were newly implanted with the research system comprising the Nexa cochlear implant, a modified Nucleus 7 sound processor and investigational fitting software, and participated in a clinical investigation that administered a battery of psychophysical assessments at multiple follow-up intervals within the first year of experience. Several versions of FMS, each with distinct parameter settings, were evaluated. Tests included spectral discrimination, pitch ranking, and F0 discrimination. Data were collected using standardized protocols and analyzed to compare perceptual outcomes across the different FMS configurations.

Results: Preliminary observations suggest that variations in parameter configurations for the FMS stimulation paradigm influence psychophysical outcomes. Some variability was observed across participants and test conditions. Analyses are ongoing, and further data will be presented at the time of the conference.

Conclusions: The perceptual implications of variations in FMS on psychophysical test performance are important to inform optimal configuration of the novel stimulation strategy to shape auditory experience in CI recipients. Continued investigation will clarify how specific FMS configurations affect perceptual outcomes and inform future approaches to cochlear implant programming and technology development.

Free paper 0053

Psychosocial, occupational, and financial burdens of parents of young cochlear implant users: Results of an online survey

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Introduction: Studies have shown that lifelong follow-up care for cochlear implant (CI) users can be associated with psychological, social, and financial burdens, which have so far received little attention in clinical practice. The aim of this study was to assess the psychosocial, occupational, and financial situation of parents of young children with cochlear implants.

Material and methods: Caregivers ($n = 469$) of children aged 1–12 years who had been using a CI for at least six months and were followed at Hannover Medical School were invited to participate in an online survey. Psychosocial burden was assessed using an adapted version of the Impact on Family Scale. Psychological distress was measured with the Patient Health Questionnaire (PHQ-4). In addition, participants were asked about occupational changes, financial impacts, and perceived support needs.

Results: To date, 97 parents (74 mothers, 23 fathers) have participated. Of these, 91% live with a partner and 9% are single parents. The mean age of the children was 6.2 years (SD = 2.8). Seventy-four percent of the children use bilateral CIs, and 25% have additional disabilities. According to the PHQ-4, 20.6% of parents reported symptoms of depression and anxiety. Among mothers, 5% were employed full-time, 54% part-time, and 15% identified as homemakers. Fathers were mainly employed full-time (70%), with 13% working part-time and 13% self-employed.

Conclusions: The results reveal significant psychosocial ($p < 0.001$), occupational, and financial burdens among parents of young CI users. These findings highlight the need to better integrate psychosocial aspects into clinical follow-up care and family support. Targeted education and counseling programs appear essential to address parental needs and strengthen coping resources. Such interventions may contribute to improving the long-term well-being and social participation of affected families.

Free paper 0663

Public consensus and policy decision-making in cochlear implant surgery in developing countries

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Introduction: Cochlear implantation (CI) is a transformative intervention for individuals with severe to profound sensorineural hearing loss. While outcomes in developed nations demonstrate significant gains, access to Cl in developing countries remains inconsistent and inequitable. High device costs, limited rehabilitation infrastructure, competing public health priorities, and sociocultural perceptions of deafness influence adoption rates. Public consensus, awareness levels, and governmental policy decisions are pivotal determinants of service expansion and sustainability. Understanding how societal attitudes intersect with economic and policy frameworks is essential for strengthening hearing healthcare systems in resource-limited settings.

Material and methods: A narrative review of peer-reviewed literature, governmental health policy documents, cost-effectiveness analyses, and reports from developing countries was conducted. Key variables examined included public awareness initiatives, newborn hearing screening integration, funding mechanisms(government-sponsored schemes, insurance models, public-private partnerships),accessibility of rehabilitation services, and stakeholder engagement in policy formulation. Comparative evaluation of countries with structured Cl programs was undertaken to identify enabling strategies and barriers.

Results: Substantial disparities in Cl accessibility were identified across developing regions. High upfront costs of implants and lifelong rehabilitation remain the principal barriers. Countries implementing publicly funded schemes, insurance reimbursement models, and centralized procurement strategies demonstrated improved implantation rates and better long-term outcomes. Integration of universal newborn hearing screening programs facilitated early identification and timely intervention, enhancing cost-effectiveness. Economic analyses consistently revealed that early pediatric implantation yields cost-benefit ratios through improved educational attainment, workforce participation, and reduced long-term societal burden. Public consensus was positively influenced by awareness campaigns, disability advocacy movements, and engagement of parent support groups. Conversely, misconceptions regarding deafness, limited rural outreach, and insufficiently trained professionals were hindrances.

Conclusions: In developing countries, effective policy decision-making in cochlear implantation requires alignment between economic feasibility, ethical responsibility, and public acceptance. Sustainable expansion of Cl services depends on strengthening awareness initiatives, ensuring equitable financing mechanisms, integrating universal hearing screening, and fostering multi-sectoral collaboration. Evidence-based policymaking supported by cost-effectiveness data and community engagement can enhance both access and long-term societal impact of cochlear implant programs in resource-constrained settings.

Free paper 0328

Quality of life after cochlear implantation: A comparison across patient groups

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Introduction: The criteria for cochlear implant (CI) candidacy have gradually expanded over time allowing this intervention to benefit an increasingly diverse range of patients, including those with partial deafness and single-sided deafness. As cochlear implantation reaches beyond traditional indications, the focus has shifted from clinical outcomes alone to a broader understanding of its impact on everyday life. In this context, assessing health-related quality of life (HRQoL) from the patient's perspective has become a key component in evaluating the true effectiveness of cochlear implantation. Therefore the aim of the study is to evaluate health related quality of life (HRQoL) after in different groups of cochlear implanted patients.

Material and methods: 739 cochlear implanted patients (age18–80 years) were longitudinally evaluated with the AQoL-8D – generic questionnaire for the assessment of health related quality of life. AQoL-8D was administered before surgery and at 9 and 24 months of CI use. Based on preoperative pure-tone average air-conduction threshold, study population was divided into 4 groups: (1) profound hearing loss, (2) partial deafness, (3) asymmetric hearing loss, and (4) single-sided deafness.

Results: Health-related quality of life (HRQoL), assessed using the utility index (scaled from 0 to 1), showed a significant improvement over time in all groups of CI patients: in the group with profound deafness from 0.62 to 0.69, partial deafness from 0.64 to 0.73, asymmetric hearing loss from 0.68 to 0.72, and single-sided deafness from 0.74 to 0.79.

Conclusions: The results show that cochlear implantation leads to a significant improvement in quality of life across all hearing loss configurations, supporting the expansion of CI indications to new patient populations.

Free paper 0560

Quality of life: Is there any difference between major cochlear implant brands?

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Objective: Analyze Quality of Life in patients of different CI brands using the WHOQOL-Bref, IOI-IC, and GBI questionnaires.

Material and method: Prospective, quantitative and qualitative study, randomized and analytical with cross-sectional analysis., consisting of the application of the WHOQOL-BREF, International Outcome Inventory – Cochlear Implant (IOI-CI) and Glasgow Benefit Inventory (GBI) questionnaires to aleatory randomized patients submitted to the Cochlear Implant Rehabilitation.

Results: 64 implanted patients were evaluated. The brand distribution were: 16 branded Advanced Bionics (25%); 16 patients with the Cochlear brand (25%); 16 patients with MED-EL brand (25%); 3 with the Oticon brand (4.7%) and 13 patients with the Neurelec brand (20.3%).

Conclusions: The differences in quality of life between patients of the four major cochlear implant companies were not statistically significant.

Free paper 0323

Re-exploring adult cochlear implant assessment referrals in the United Kingdom (CIRCA-2): A national multicentre retrospective observational study

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Introduction: Cochlear implant (CI) uptake across the United Kingdom remains low despite clear National Institute for Health and Care Excellence (NICE 2019) guidance and well-established clinical benefits. The original Cochlear Implant Referral Criteria Audit (CIRCA-1) identified marked inequities in access to cochlear implants in 2022, with lower referral rates among older adults, males, individuals from socioeconomically deprived areas, alongside those from minority ethnic backgrounds being less likely to be informed of their eligibility for referral. Since then, national awareness initiatives and the expansion of the existing local "CI Champions" scheme have aimed to address these inequities, improve awareness of CI candidacy, and improve the quality of discussions with patients about options for CI referral.

Aim: To reassess referral patterns for patients suitable for cochlear implantation in the UK, building on findings from the original CIRCA study.

Material and methods: CIRCA-2 is a national, multicentre, retrospective observational study. The study will include adults assessed in secondary-care ENT and Audiology departments between July and December 2025 whose audiometric thresholds meet NICE TA566 criteria. Participating centres will identify eligible patients using the British Cochlear Implant Group (BCIG) Crystal Report within Auditbase, and anonymised demographic, audiometric, and service-level data will be extracted. The primary outcomes are the proportions of patients meeting NICE TA566 criteria who were informed of their eligibility and referred for CI assessment, with comparisons made to CIRCA-1 data. Secondary analyses will examine adherence to national standards and predictors of discussion and referral using multivariable modelling.

Results: CIRCA2 is currently open and is due to complete on 31st March 2026. At the time of submission, we have 62 sites across the UK recruited. Based on the recruited sites and the data submitted in CIRCA1 we project to have >10 000 patients who meet the audiological criteria for CIs in our final analysis.

Conclusions: These findings will provide critical insight into whether recent policy and service initiatives have improved access to cochlear implantation and will identify ongoing inequities within referral pathways. Final results will be presented at CI2026.

Free paper 0597

Real-time fluoroscopic validation of the SmartNav System during cochlear implantation

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Precise intraoperative control of cochlear implant electrode insertion is critical to prevent complications such as tip fold-over, scalar deviation, or incomplete insertion. The portable SmartNav system provides real-time feedback to assist surgical decision-making. In this study, we emphasized validation of SmartNav measurements using real-time fluoroscopic imaging and comparison with the widely accepted Custom Sound EP system. SmartNav delivers continuous intraoperative analysis of insertion speed, insertion angle depth (for straight electrodes), and final electrode array position. The system also enables impedance testing, stapedius reflex telemetry, and AutoNRT® measurements, providing essential information about electrode functionality. Real-time positional analysis may help identify potential insertion anomalies immediately during surgery. The device was evaluated using three electrode types: Contour Advance, Slim Modiolar, and Slim Straight. In all cases, electrode array position was verified intraoperatively with real-time fluoroscopic imaging. Fluoroscopic findings were directly compared with SmartNav positional data to assess accuracy. Basic electrophysiological measurements obtained with SmartNav were validated against data recorded using Custom Sound EP, a commercially available and widely trusted intraoperative monitoring platform. High agreement was observed between SmartNav and Custom Sound EP in impedance values and neural response telemetry results. Furthermore, fluoroscopic imaging confirmed the positional accuracy indicated by SmartNav in all tested cases. The SmartNav system proved easy to use, required no complex configuration, and generated clear, interpretable reports that can be exported into commonly used clinical software formats. Our findings demonstrate that the portable SmartNav system provides reliable real-time intraoperative control of electrode insertion. The strong correlation with fluoroscopic imaging and Custom Sound EP data supports its clinical accuracy and suggests that SmartNav may reduce the need for additional imaging and help prevent revision surgeries.

Free paper 0600

Real-time post-insertion monitoring of angular insertion depth using SmartNav in cochlear implant surgery

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Objectives: This investigation is aimed at measuring the extent and frequency of intraoperative changes in angular insertion depth (AID) between the first insertion and the final fixation during the use of continuous real-time SmartNav monitoring in the lateral-wall arrays.

Material and methods: This is multi-centers (four hospitals) observational study of 45 ears (46 participants enrolled; 45 with complete data) who received a CI522 array (Cochlear Ltd) under continuing real-time SmartNav AID observation at a tertiary referral center (July 2025). AID was recorded at three intraoperative timepoints: (1) immediately after complete electrode insertion; (2) after mastoid lead coiling; and (3) after final periosteal closure. The primary study aim was to calculate the potential intraoperative change in AID between initial insertion and final closure. The secondary outcome measures included the 3-time-point AID trajectories, the percentage of cases whose AID did not exceed the 360–450° therapeutic range, and Placement Check success. Data was analyzed using non-parametric methods of statistics.

Results: Mean initial AID was 372.9° ± 65.1° (263°–529°) and final AID was 374.0° ± 71.9° (224°–531°). No systematic median shift was observed (Wilcoxon p=0.507; Hodges–Lehmann –2.0°, 95% CI –9.5° to 3.5°). Individual variability was notable: absolute AID changes <10° occurred in 55.6%, 10–29° in 20.0%, 30–49° in 8.9%, and ≥50° in 15.6%. At final measurement, 46.7% were within 360–450°, 37.8% <360°, 15.6% >450°, and none exceeded 580°. Placement Check success was 97.8% (44/45). Surgeon experience showed no association with AID change ($p = 0.507$; $p = 0.49$).

Conclusions: Individual AID changes were found to be significant, with 44.4% of cases exhibiting absolute shifts of ≥10° and 15.6% showed absolute changes of 50°, despite general similar trends observed at the group level. Intraoperative changes, which are difficult to predict, highlight that final array placement can be refined through real-time monitoring. Larger, multi-center studies with long-term follow-up are justified.

Free paper 0211

Relationship of the transmastoid tunnel location in VERIA technique with the facial nerve and chorda tympani nerve, depth and angle of insertion of the electrode by VERIA technique by 3D reconstruction of post operative CT scan of temporal bone

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Aim: To assess the relationship of the transmastoid tunnel with facial nerve and chorda tympani nerve, angle of insertion and depth of insertion achieved by the Veria technique by post operative 3D reconstruction of HRCT temporal bone.

Material and methods: Ten patients aged from 9 months to 70 years were implanted via the VERIA (trans mastoid tunnel) technique of cochlear implantation. All patients underwent MedEL cochlear implant device implantation. Electrodes were selected after OTOPLAN assessment to achieve complete and deep insertions. The transmastoid tunnel was drilled using a perforator parallel to the posterior canal wall and within the mastoid bone. Complete insertion was achieved in all cases.

Post op HRCT temporal bone was done and was reconstructed 3-dimensionally. The electrode position in the transmastoid tunnel drilled between the chorda and facial nerve in the recess was noted, and the depth of insertion was assessed.

Results: All ten cases showed the electrode located close to chorda tympani nerve through the transmastoid tunnel and away from the facial nerve in the recess. All ten patients achieved complete and deep insertions with the angle of insertion ranging from 540 to 700 degrees. This matched the preoperative OTOPLAN assessment.

Conclusions: The Veria (trans mastoid tunnel) technique which employs a perforator to drill in the mastoid bone and enter through facial recess shows that the tunnel is closely located to the chorda and away from facial nerve as assessed by the electrode position in the recess by post op 3D imaging. This shows the technique is safe to employ keeping in mind the safety of the facial nerve with adequate surgical training. Complete and deep insertions are achieved via this technique.

Free paper 0359

Remote programming using AB remote support and target CI 1.5: Impact on quality of life and patient experience

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Introduction: Approximately 43% of the global population lives in rural areas, where access to healthcare services is often limited, particularly for older adults. Cochlear implant users typically require multiple follow-up programming sessions, which can pose significant logistical, economic, and time-related challenges. AB Remote Support combined with Target CI 1.5 is the first platform to enable complete remote cochlear implant programming.

Material and methods: A prospective observational study was conducted across five tertiary hospitals in Spain. Participants were cochlear implant users with Advanced Bionics devices aged 13 or older and with adequate technological competence. During an initial in-person visit, patients underwent audiometry, routine programming and measurements, counseling, and completed questionnaires assessing technological capability, hearing performance (SSQ-12), and economic impact. A subsequent remote session included system connection, measurements, programming adjustments, and repetition of the SSQ-12 and economic impact questionnaires.

Results: Mean patient-related expenses decreased by 96%, from €106.79 for in-person sessions to €4.25 for remote programming. Accompaniment was required by 53% of patients for in-person visits, compared to 27% for remote sessions. Work absenteeism affected 22% of patients (mean 3.4 hours) and 31% of accompanying persons (mean 5.8 hours) for in-person visits. No patients missed work to attend remote sessions, and only 7% of accompanying persons required time off (mean 30 minutes). Nearly all patients reported comparable interaction quality and professional attention between remote and in-person programming, with all clinical needs successfully addressed remotely. Only one case of connection instability was reported, related to poor signal quality on the patient's device.

Conclusions: Remote cochlear implant programming using AB Remote Support and Target CI 1.5 is a feasible and effective alternative to in-person visits. It offers substantial reductions in cost and time burden while maintaining patient satisfaction and perceived quality of care, making it particularly valuable for patients with limited access to specialized centers.

Free paper 0397

Remote self-administered electrical loudness scaling for cochlear implant recipients using mobile platform

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Aim: Cochlear implants provide access to sound for individuals with severe-to-profound hearing loss. Optimal outcomes rely on individualized fitting and long-term aftercare, which is resource-intensive for clinicians and time-consuming for recipients. The rapidly growing CI population drives new approaches to service delivery to benefit patients. Patient-driven fitting models offer a promising strategy to reduce clinical workload while simultaneously promoting greater recipient engagement, autonomy, and satisfaction. Electrical loudness scaling (ELS) is a psychophysical method in which CI users rate the perceived loudness of electrical stimulation across a range of current levels, enabling the estimation of loudness growth functions that can be used to derive MAP-levels during CI programming. To maximize its clinical utility, ELS should be feasible for independent use outside the clinic. In this context, optimizing test duration is particularly important to ensure usability in unsupervised settings without compromising measurement accuracy. To address this need, a shortened version of the standard ELS procedure (Fast-ELS) was developed and implemented on a Mobile Research App (MRA).

Material and methods: A prospective, repeated-measures, within-subject interventional study design was employed to investigate the feasibility, accuracy, and reliability of ELS implemented on the MRA in both supervised in-clinic and unsupervised home environments. Twenty experienced adult CI recipients completed both Standard-ELS and Fast-ELS tasks using the MRA during in-clinic visits and at home. Test–retest reliability was evaluated by repeating tasks within and across sessions to ensure stable and consistent performance measures.

Results: Accuracy outcomes of Fast-ELS and Standard-ELS obtained within single in-clinic and home sessions will be

presented, together with test–retest reliability results for Fast-ELS within sessions and between sessions. Based on preliminary analysis, the Fast-ELS algorithm reduces overall test duration from 28.6 minutes for the Standard-ELS procedure to 6.8 minutes. Only 1% of measurements were early terminated due to inconsistent ratings.

Conclusions: The ability to perform ELS tasks independently at home using a mobile platform highlights the potential for integrating remote loudness scaling into routine clinical CI care reliably. This approach may facilitate more patient-led fitting procedures, improve accessibility and convenience for CI recipients, and contribute to more efficient use of increasingly limited clinical resource.

Free paper 0345

RemotECAP: Variances of electrically evoked compound action potentials (ECAPs) and impedances in cochlear implant users during different times of the day

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Objective: A recent study on cochlear implant (CI) users reported small but significant differences in electrical impedances of CIs between measurements obtained in the morning versus evening. The impedance values were higher in the morning than in the evening. The physiological causes of these fluctuations remain unclear; possible explanations include increased impedances due to prolonged non-use of the speech processor or variations in physiological parameters. The aim of this exploratory study is to investigate whether such time-of-day-dependent differences can also be found in ECAPs (Electrically Evoked Compound Action Potentials).

Material and methods: In 10 participants with a MED-EL CI, impedance and ECAP measurements were obtained three times per day (morning, midday, evening) over five consecutive days via remote measurement. During these remote sessions, participants were measured at home and guided by a clinician via a remote computer connection. ECAPs were recorded using the "AutoART" function of the MAESTRO software. Each session included one impedance measurement, followed by three AutoART recordings on six electrodes (basal, medial, apical), and concluded with another impedance measurement. Accordingly, for each participant, 30 impedance values and 45 ECAP recordings were obtained per electrode contact over the five days.

Results: Results regarding electrical impedances at individual electrode contacts confirm the findings of Mushtaq et al. (2022) that impedance values measured in the morning are higher than those obtained at midday and in the evening. In contrast, ECAP threshold values are higher at midday and in the evening compared to those in the morning. However, effect size in a linear mixed effects model is very small (0.4qu) and clinically irrelevant. There is a moderate correlation between changes in impedance values and changes in ECAP thresholds.

Conclusions: Long-term stability of objective measurement parameters such as ECAPs or electrically evoked stapedius reflex thresholds is crucial for clinical application. Possible reasons for the significant yet small effect size for the ECAP measurement will have to be evaluated. Further analyses will focus on the amplitude growth function slope and maximum amplitudes across all 10 participants, as well as the effect of the maximum tolerable stimulation level on automatic threshold determination.

Free paper 0435

Restoring sound localization in single-sided deafness through cochlear implantation: A meta-analysis

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Objective: Single-sided deafness impairs sound localization, reducing quality of life and spatial awareness. Cochlear implantation has emerged as a promising intervention, yet the magnitude of benefit and influence of rehabilitation factors remains unclear. This systematic review and meta-analysis examined localization outcomes after cochlear implantation in single-sided deafness.

Material and methods: Multiple databases were searched from their earliest available records to February 2025 for studies reporting quantitative localization outcomes in cochlear implant recipients with single-sided deafness. The primary outcome was reduction in root mean square (RMS) localization error. A random-effects meta-analysis was performed, with subgroup analyses by age, etiology, and rehabilitation factors.

Results: Forty studies (667 participants) met inclusion criteria. Cochlear implantation significantly improved localization,with a pooled RMS error reduction of 20.8° (95% CI: 17.9°–23.7°, $P < 0.001$; $I^2 = 94.2\%$). Younger patients achieved greater gains (42.4° for ≤50 years vs 15.8° for >55 years, $P = 0.032$), as did those with sudden sensorineural hearing loss compared with Ménière's disease (23.5° vs 11.3°, $P = 0.018$). Structured rehabilitation was associated with larger improvements than standard care (26.1° ± 8.2° vs 18.4° ± 7.6°, Cohen's $d = 0.977$; $P < 0.01$). Earlier activation (≤21 days) and high daily use (≥10 hours) were associated with the most favorable outcomes.

Conclusions: Cochlear implantation provides clinically meaningful localization improvements in single-sided deafness, though performance remains below normal hearing levels. Outcomes are optimized by structured rehabilitation, earlier activation, and consistent device use. These findings support cochlear implantation as an effective intervention and inform evidence-based rehabilitation strategies.

Free paper 0545

Results of EAS performed in Japan using long electrodes: A multicenter retrospective survey

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Electric-acoustic stimulation (EAS) is now the standard treatment for patients with high-frequency hearing loss. Traditionally, EAS has been performed using medium-length electrodes of approximately 24 mm. However, high-frequency hearing loss is generally progressive, with most EAS candidates experiencing an average annual decline of about 2 dB. Recent studies have shown that this natural deterioration is closely associated with the underlying etiology of hearing loss. Genetic factors are the most common cause of hearing loss in EAS patients, with causative genes identified in approximately half of cases. Because hearing loss related to these genes is typically progressive, identifying the etiology is crucial for predicting future audiometric outcomes. Therefore, treatment strategies should be based not only on current hearing levels but also on anticipated hearing progression. Patients with residual hearing should be evaluated with consideration of their expected natural course. A growing body of evidence indicates that longer electrodes provide superior speech perception outcomes compared with shorter electrodes. From this standpoint, optimal EAS treatment may require the use of longer electrodes that cover the entire cochlea. We have previously reported that residual hearing can be well preserved even with long electrodes in EAS, findings that are supported by a recent systematic review. Based on this accumulated evidence, all FLEX electrodes were approved for EAS in Japan in August 2023 and became eligible for national health insurance reimbursement. Following this approval, the use of FLEXSOFT, FLEX28, and FLEX26 electrodes in EAS has increased, replacing the previously preferred FLEX24 electrode. In the present study, we conducted a retrospective multicenter survey to investigate electrode length selection in EAS procedures performed in Japan after August 2023. We also compared hearing preservation outcomes between patients receiving FLEX28 electrodes ($n = 40$) and those receiving FLEX24 electrodes ($n = 50$), which had been predominantly used before approval. The results showed no significant difference in hearing preservation rates between EAS using FLEX24 and FLEX28 electrodes.

Free paper 0648

Revision cochlear implant surgery: An unwanted reality

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Revision cochlear implant surgery represents an increasingly encountered yet challenging reality in contemporary otology practice. Although cochlear implantation is a highly successful intervention for severe-to-profound hearing loss, device-related and biological complications necessitate revision in a small but significant proportion of cases, with device failure rates approximating 2%. This presentation outlines the indications, surgical dilemmas, and practical strategies in revision CI surgery, based on multicentric experience of 2300 cochlear implants. In our series, 41 patients have undergone revision surgery for various reasons. Common indications for revision included hard and soft device failure, infection, implant extrusion, misplaced electrodes, magnet displacement, etc. Hard failures are confirmed through integrity testing, whereas soft failures require high clinical suspicion and multidisciplinary assessment. Surgical decision-making is complex and involves preserving flap vascularity, managing fibrosis and neo-osteogenesis, preventing further cochlear trauma, and safeguarding the integrity of the existing device. Representative cases of all these conditions are discussed including carotid canal electrode insertion, device failure requiring surgery with different companies, infections, displaced magnets. Causes, management and tips and tricks are highlighted for all. Revision cochlear implant surgery demands surgical precision, sound judgment, and perseverance. The guiding principle remains: never celebrate too early, never lose hope too early, and never leave the patient.

Free paper 0413

Robotic assistance in cochlear implantation: A large animal model study

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Objectives: Preservation of residual hearing remains a major objective in modern cochlear implantation. Alongside technological advances, refinements in surgical technique are crucial to minimize trauma during electrode insertion. Robotic systems have recently been introduced to assist in this process, enabling highly controlled, slow, and atraumatic insertion of electrode arrays. The present study evaluates the impact of robotic-assisted insertion on cochlear structures and residual hearing, in comparison with conventional manual techniques.

Material and methods: Twelve normal-hearing pigs were implanted with cochlear devices approved for human use. In six animals, electrode insertion was performed using a purpose-designed robotic system, while in the remaining six, insertion was carried out manually by an experienced surgeon. Electrophysiological assessments, notably impedances, auditory brainstem responses (ABRs), and electrically evoked compound action potentials (eCAPs) were conducted pre- and postoperatively. Following implantation, the inner ears were harvested and examined histologically to assess potential insertion-related trauma.

Results: Postoperative impedance values were significantly lower in the robotically inserted group. ABRs indicated a trend toward better hearing preservation, with smaller threshold shifts in the robotic group. eCAPs demonstrated greater stability of the IPG effect over one week, along with a larger increase in amplitude growth. Histological analysis

confirmed intact basilar membranes in all specimens; however, intracochlear hydrops was observed in 3 of 6 manually inserted cases and in none of the robotically inserted cases.

Conclusions: Robotic cochlear implantation results in a reduced intracochlear trauma and supports both structural and functional hearing preservation. The use of implants approved for human application enhances the translational relevance of the pig, suggesting promising transferability of the findings to clinical practice.

Free paper 0232

Robotic cochlear implant surgery: What has been achieved and what awaits exploration

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Over the years our group has contributed convincingly to the devellopment of robotic cochlear implantation resulting in the largest series of HEARO patients reported in literature. In this presentation the imlprovement made in the past will be adressed to discus the journay on how we now reached an automated surgery with a device that drill a planned trajectory and insert an electrode at a steady set spead. Furthermore the future hurlde are discussed to improve and standardize the outcomes of cochlear implantation.

Free paper 0052

Safety and effectiveness of the NSP-100A off-the-ear cochlear implant sound processor

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Introduction: The NSP-100A, a self-developed off-the-ear (OTE) cochlear implant system by Nurotron, incorporates advanced sound scene recognition algorithms.

Objective: This study aims to evaluate its performance in various auditory environments.

Material and methods: A prospective, single-group target value study was conducted from June 2024 to September 2024 across three centers. Seventy participants, aged 12 months or older, who had been using CS-10A or CS-20A cochlear implants for over six months, were enrolled. The study assessed speech recognition scores, user experience, and safety of the NSP-100A system.

Results: All 70 participants completed the study without dropouts. Significant improvements were observed in speech recognition scores in both quiet and noisy environments with the NSP-100A. The Nijmegen Cochlear Implant Scale and user experience surveys indicated high satisfaction levels. No adverse events were reported.

Conclusions: The NSP-100A cochlear implant system demonstrates superior performance in speech recognition and user satisfaction, making it a viable option for individuals with hearing impairments.

Free paper 0458

Safety and outcome of piezoelectric active transcutaneous bone conduction implants for children younger than 5 years: A prospective cohort study

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Objective: This study aimed to examine auditory outcomes in young children implanted with active bone conduction implants.

Material and methods: *Study design* – prospective cohort study. *Setting* – a single tertiary referral academic center. *Patients* – 14 patients younger than 5 years of age who were implant with a piezoelectric active transcutaneous bone conduction implant (OSI) with a follow-up of at least 1 year. *Interventions* – demographics, surgical techniques, duration of surgery, hospital stay, auditory outcomes, postoperative complications, and device use were collected. After OSI surgery, patients were followed up for 1-week post-surgery, with devices switched on at 3 weeks postoperatively. Surgery and audiology follow-up occurred at 1, 3, 6 months, and 1 year. *Main outcome measures* – perioperative course, surgical complications, aided audiograms, and speech discrimination scores were obtained 6 months and 1 year after implantation.

Results: Fourteen children received 18 implants (4 patients received bilateral simultaneous implants). The median implantation age in this study was 4.07 years (IQR = 0.875). The indication for implantation was congenital conductive hearing loss (cCHL) due to external auditory canal atresia in 15/18 ears, and congenital single-sided deafness (SSD) in 3/18 ears. No patients experienced serious intraoperative or postoperative complications. For patients with cCHL, there was a significant postoperative improvement in hearing, marked by a median pure-tone average gain of 45 dB. All 14 patients regularly used their sound processors, with a median utility time of 10.6 h/day. There was no decline in the auditory performance in any ear throughout the median follow-up period of 2.36 years.

Conclusions: Active transcutaneous piezoelectric bone conduction implants are a safe option for young children and provided significant and stable improvements in auditory function.

Free paper 0537

Satisfaction with cochlear implants in postlingually deaf adults and its psychological determinants from the perspective of an 11-year longitudinal study

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Introduction: Satisfaction with cochlear implants (CI) is an important measure of the effectiveness of this treatment method. Research points to psychological, not solely audiological, determinants of CI satisfaction. There are relatively few longitudinal studies on this topic.

Aim: The aim of the study is to assess CI satisfaction and its psychological determinants, i.e., mental distress, stress coping strategies, and self-esteem from an 11-year perspective. The question was asked whether they change and whether the relationships between CI satisfaction and the above-mentioned psychological factors change over this time period.

Material and method: The longitudinal study included adults with postlingual profound hearing loss. Study 1 was a postal survey involving 98 CI users. Study 2, conducted after 5 years, included 54 respondents from Study 1, and Study 3, performed after another 6 years, included 27 respondents from Study 2. The analysis of the results included those CI users who participated in all three studies. Each time, the participants were asked to complete the following questionnaires: GHQ-28, Brief Cope, and RSES, as well as a personal inquiry form asking for sociodemographic data and including one question related to CI satisfaction (VAS).

Results: It was found that CI satisfaction, assessed at three time intervals, did not change significantly. Similarly, speech understanding results did not change. Psychological distress (GHQ-28) and most stress coping strategies (Brief COPE) remain at the level of the general Polish population, with the exception of significantly higher religion and denial coping. In turn, global self-esteem (RSES) remains significantly lower than in the general population at every time point. In the last of the three measurements, CI satisfaction correlates negatively only with religion coping, while no correlation was found with other psychological determinants that were significant in the first study.

Conclusions: CI satisfaction and speech understanding, as well as levels of mental distress, self-esteem, and most stress coping strategies, show stability. CI satisfaction in the latest measurement shows a significant correlation only with religion coping. This result may suggest the "autonomization" of CI satisfaction, but it may also be related to the relatively limited size of the study group.

Free paper 0043

Segmenting cochlear diameter: A novel approach to understanding cochlear growth and its impact on electrode design

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Introduction: Cochlear duct length (CDL) estimation plays a crucial role in cochlear implant (CI) planning, guiding electrode selection and optimizing frequency mapping. Traditional methods rely on the A value (cochlear diameter) measured from computed tomography (CT) scans. However, this assumes uniform cochlear growth across individuals. This study introduces a novel segmentation of the A value into two components: A1 (round window to medial wall of the basal turn) and A2 (remaining lateral distance), aiming to better characterize cochlear anatomical differences between children and adults and refine CI surgical planning.

Material and methods: A retrospective study of patients who underwent CT scans of the temporal bone between June 2023 to June 2025 in a high volume tertiary centre centre. We excluded scans of patients of ages between 6–18 years and scans with cochlear anomalies. The images were then uploaded the the OTOPLAN software (v3) and the following data were recorded: age at CT scan, sex, measurements of the cochlear width, height, A value (diameter), and CDL. The A value was divided into A1 and A2. Statistical comparisons were performed to assess differences between pediatric and adult cochlear dimensions.

Results: The study included 181 ears (85 children, 96 adults), Adults had significantly longer CDL compared to children (34.34 mm vs 32.19 mm, $p < 0.001$). This was evident by a greater cochlear width and diameter (A value) ($p < 0.001$). However, there was no significant difference in cochlear height ($p = 0.247$). Notably, while A1 remained constant across age groups, adults had a significantly longer A2 compared to children ($p = 0.015$). This suggests that cochlear growth primarily occurs in the lateral direction (A2) rather than the medial aspect (A1), which remains stable from childhood to adulthood.

Conclusions: This study challenges the assumption that cochlear growth is uniform by demonstrating that the increase in CDL and cochlear diameter with age is driven by lateral expansion (A2) rather than medial structures (A1). These findings have critical implications for CI electrode selection, especially in children. Future research should study the impact of cochlear growth on electrode position.

Free paper 0326

Selective effects of anatomy-based frequency mapping on music sound quality in cochlear implant users

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Objective: To determine whether anatomy-based frequency allocation improves perceived music sound quality compared with standard cochlear implant (CI) processing and to assess the influence of electrode insertion depth.

Material and methods: Ten adult CI users implanted with MED-EL FLEX28 electrodes (mean age 65.7 ± 14.6 years; mean CI experience 4.4 ± 0.5 years) and nine normal-hearing controls participated. CI users were tested in a within-subject design with standard clinical fitting and anatomy-based fitting derived from postoperative CT-based insertion depth analysis using OTOPLAN® (mean insertion depth 494.4° ± 87.9°, range 376.1°–638.5°). Music perception was assessed using a Multiple Stimuli with Hidden Reference and Anchor (MUSHRA) paradigm. Fifteen-second excerpts from five genres (classical, country, jazz, pop, rock) were presented as an unfiltered Original, five high-pass filtered conditions (200–1000 Hz), and an Anchor condition. Sound quality was rated on a 0–100 scale. Statistical analyses included paired Wilcoxon signed-rank tests, Kruskal–Wallis tests with Dunn post-hoc comparisons, linear mixed-effects models, and Spearman correlations between insertion depth and MUSHRA scores.

Results: Normal-hearing listeners achieved the highest sound quality ratings across all conditions. CI users showed reduced sound quality, particularly under high-pass filtered conditions. Anatomy-based fitting resulted in significantly higher MUSHRA scores compared with standard CI processing in the Filter_600 ($V = 6486$, $p = 0.0186$) and Filter_1000 ($V = 6166$, $p = 0.0402$) conditions, with mean improvements of approximately 4–6 points. No consistent advantage of anatomy-based fitting was observed for the unfiltered Original condition. Approximately 50% of CI and 40% of CI_anat participants failed to reliably identify the hidden reference (Original score <90), contributing to increased variability. Genre-dependent effects were observed, with rhythmically structured music (country, pop) rated higher than classical music. Correlations between electrode insertion depth and perceived sound quality were weak and inconsistent ($\rho \approx 0.16–0.20$).

Conclusions: Anatomy-based fitting provides modest, condition-specific improvements in perceived music sound quality when low-frequency information is partially reduced but offers limited benefit for unfiltered music. Electrode insertion depth alone is not a strong predictor of music perception, highlighting the relevance of individualized frequency allocation over anatomical depth parameters.

Free paper 0209

Self-esteem and perceived social support in adolescents with hearing loss and normal-hearing peers: The role of family and friends support

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Introduction: Adolescence is a critical period for self-esteem development, and communication barriers related to hearing loss (HL) may influence adolescents' psychosocial functioning. This study aimed to compare self-esteem and perceived social support between adolescents with HL and their normal-hearing (NH) peers, and to examine the contribution of perceived social support to self-esteem.

Material and methods: A total of 175 adolescents aged 12–18 years participated, including 95 adolescents with HL [50 cochlear implant (CI) and 45 hearing aid (HA) users] and 80 NH controls. Self-esteem was assessed using the Rosenberg Self-Esteem Scale, and perceived social support using the Multidimensional Scale of Perceived Social Support. Group differences in self-esteem and perceived social support were examined across the CI, HA, and NH groups. In both the HL and NH groups, the associations between self-esteem and perceived social support were explored, and regression models were used to evaluate the predictive contribution of the perceived social support subdomains (family, friends, and significant others) to self-esteem.

Results: The NH group demonstrated higher self-esteem and perceived social support than both the CI and HA groups ($p < 0.001$), with no differences between the CI and HA groups ($p > .05$). In both the HL and NH groups, self-esteem was positively correlated with total perceived social support ($p < 0.001$). In the HL group, the regression model including perceived social support subdomains explained 28.6% of the variance in self-esteem ($p < 0.001$), with family and friends support emerging as significant independent predictors. In the NH group, the same model explained 17.6% of the variance in self-esteem ($p < 0.001$); however, none of the individual support domains independently predicted self-esteem.

Conclusions: Adolescents with HL, regardless of amplification type, demonstrate lower self-esteem and perceived social support compared to their NH peers. While perceived social support is related to self-esteem across groups, the contribution of specific support sources, particularly family and friends, appears to be more pronounced in adolescents with HL. These findings highlight the importance of family- and peer-focused psychosocial support in adolescents with HL.

Free paper 0094

Sensitivity for interaural time differences with fine structure coding in bilaterally cochlear implanted children

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Introduction: The ability to perceive interaural time differences (ITDs) is very important for sound localization. Compared to their normal-hearing peers, children with bilateral cochlear implants (biCI) show significantly reduced or even no sensitivity to ITDs. One possible reason for the poorer ITD sensitivity, especially for ITDs in the temporal fine structure, might be the lack of bilateral synchronization of stimulation pulses by the two CIs in the majority of clinical sound processors. In contrast to these processors, current MED-EL CI processors use fine structure coding strategies (FS4, FS4-p), which encode fine structure information of the low-frequency sound signal components and present it via the four most apical stimulation electrodes in the cochlea. In contrast, CIS-based strategies also implemented in these processors as well as other clinical CI processors do not encode fine structure information.

Material and methods: In this study, we investigated the ITD sensitivity of biCI children to a low-frequency tone burst with two different onset and offset ramp durations, 4 and 100 ms, using the sound coding strategies FS4 and HDCIS with SONNET 2. The audio stimuli were presented bilaterally via the processors' audio inputs, and ITD sensitivity was tested using a 2AFC lateralization task.

Results: In total, ten biCI children were included. For tone bursts with 4 ms ramps, containing onset and ongoing ITD information, all children showed a good and significantly better ITD sensitivity with FS4 compared to HDCIS, with some children even showing no sensitivity under HDCIS. The ITD sensitivity for tone bursts with 100 ms ramps, i.e., with only ongoing ITD information, was worse compared to 4 ms. While around half of the children showed ITD sensitivity with FS4 for 100 ms ramps, this sensitivity was completely lost in all children with HDCIS for those ramps.

Conclusions: In contrast to HDCIS, FS4 enabled biCI children to achieve significantly better sensitivity to ITDs in low-frequency tones. In addition, biCI children showed an improvement in their ITD sensitivity when receiving both onset and ongoing ITDs compared to ongoing ITDs only. These findings highlight the importance of fine structure coding strategies for biCI children to improve spatial hearing.

Free paper 0374

Sentio implantation in young children – Initial results from a prospective multi-centre study

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Introduction: The Sentio active transcutaneous bone conduction system received CE mark and FDA approval in July 2024 for use in adults and children 12 years and over. It is indicated for patients with conductive or mixed hearing losses or for those with single-sided deafness. This prospective study evaluates the safety and performance of the Sentio system in children from 3–11 years of age with the aim of expanding the indicated age range for the device. We will present the available results from the study and provide surgical tips for implanting the device in younger children.

Material and methods: A prospective, multicentre clinical investigation including a total of 50 children, 3–11 years old, is being performed at eight university hospitals across Europe (UK, Spain and the Netherlands) to evaluate the Sentio system in the paediatric population (clinicaltrials.gov identifier: NCT06976086). Study objectives include clinical and audiological outcomes at 3 months post implantation, subjective assessments of quality of life, listening fatigue and satisfaction. Study participants will be monitored for 12 months after implantation.

Results: To date, 33 patients have been recruited to the study, of whom 21 have undergone implantation with a total of 24 implants, including three bilateral cases. Surgeries have been carried out under general anaesthesia and taken 25–92 minutes (median: 50). Although the shorter fixation band has been used more frequently, the longer fixation band (45 mm) has been very effective when the skull is thinner. There have been no major intra- or post-operative complications only minor skin issues reported post-operatively in 4 cases. Device fitting has proceeded well and sound processor usage hours are high, averaging 10 ± 5 hours per day (range: 4–17 hours). Patients and parents are pleased with the device and early patient reported outcomes suggest an improvement in quality of life.

Conclusions: The small size of the implant, its low profile when recessed and the flexibility of fixation to the skull are factors that enable straightforward and safe implantation. Patient and parent satisfaction is high. These results support a lowering of the indicated age range for this new active transcutaneous system for young children.

Free paper 0421

Sequential bilateral cochlear implants in prelingually deaf children

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Introduction: For many years, unilateral cochlear implantation (CI) has been the standard of care for children with profound bilateral sensorineural hearing loss, providing essential auditory stimulation that supports auditory development and spoken language acquisition. However, this approach does not offer the benefits of binaural hearing, such as sound localization and speech understanding in noise. In addition, prolonged unilateral stimulation may lead to asymmetric auditory pathway development, with lasting aural preference and reduced capacity for effective bilateral integration. The study aims to evaluate long-term speech discrimination in children following sequential bilateral cochlear implantation.

Material and methods: 46 bilaterally implanted children (sequential procedure) participated in the study. Their mean age at first CI was 1.6 years old and mean age at second CI was 7.5 years. The mean interimplant delay was 5.9 years. Speech perception ability was assessed with Adaptive Auditory Speech Test. The test was performed in quiet and in noise for each implant separately and in bilateral condition. The test was conducted in anechoic chamber, speech and noise were presented in front of patient. Children were tested at 4, 8 and 14 months of bilateral CI use.

Results: The significant improvement of speech performance in bilateral condition over time was observed in quiet as well as in noise. SRT in quiet improved by 8.9 dB and in noise by 3.3 dB SRN. Strong asymmetry in speech perception between the ears was observed at 4 months of bilateral CI use. Although the asymmetry greatly decreased over 14 months of bilateral stimulation, the differences in performance between the ears remain significant.

Conclusions: The results of bilateral cochlear implantation in sequential procedure show the preference toward first implanted ear, nevertheless the bilateral benefit was observed.

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Free paper 0415

Should D/deaf adults in the U.K. be offered one or two cochlear implants on the National Health System?

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Introduction: In the U.K., children are eligible for bilateral cochlear implants (CIs) through the NHS, whereas adults are typically offered unilateral implantation under current NICE guidance (2019). This project contributes to the evidence base for future NICE guidance review. This project aimed to (1) quantify spatial hearing outcomes and real-world listening experiences in >100 bilateral CI users using one versus two implants, and (2) capture the views of 140 CI users and 73 CI professionals regarding bilateral CI for adults, through two national surveys.

Material and methods: 16-month project (Funder: Cochlear Ltd; IIR2564; Ethics: ERGO 103285, 102254, 102255, 103001). *Part 1*: 105 users (75 adults, 30 adolescents) were assessed using one and two implants on a spatial hearing test battery (speech in noise under fixed and roving spatial conditions, standard speech and noise from the front, and sound localisation at 30° separation), patient reported outcome measures (EQ5D5L, SSQ12, and YBHRQL), and participant feedback on test relevance. *Part 2*: Two anonymous national online surveys of adult CI users and CI professionals across the UK and Channel Islands.

Results: Part 1 – the smallest bilateral benefit was observed for standard speech and noise from the front (mean improvement 1.6 dB SNR). Larger benefits were seen for spatial speech-in-noise tests (3–3.9 dB SNR), increasing to 6.9 dB SNR when speech and noise were presented to opposite ears. Sound localisation improved by 35% with two implants. All questionnaires showed improved quality of life with bilateral CI use, and participants reported that spatial tests better reflected everyday listening than standard clinical measures. *Part 2* – surveys were completed by 140 CI users and 73 professionals. Strong support for bilateral implantation in adults was evident (95% of users; 90% of professionals). Key themes included equity of access, comparable real-world listening demands for adults and children, and recognition of funding and historical evidence constraints.

Conclusions: Bilateral cochlear implantation provides substantial benefits for spatial hearing, speech-in-noise perception, localisation, and quality of life that are not captured by standard clinical tests. Combined with strong stakeholder support, these findings strengthen the evidence base for future NICE guidance on bilateral implantation for adults.

Free paper 0150

Sign language does not impair the development of oral language in prelingually deaf children with cochlear implant

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The impact of sign language (SL) in the linguistic development of children with cochlear implants (CI) has been a subject of extensive debate. Previously, it has been asserted that exposure to sign language (SL) could impede the acquisition of auditory-verbal language post-implantation, a claim that has significantly impacted clinical and educational approaches. However, this assumption is still up for debate. Our study reexamines this clinically significant question through a cross-sectional comparative design, assessing oral language development in 88 children with cochlear implants aged 4 to 14 years, differentiating between those exposed to sign language ($n = 48$) and those not exposed ($n = 40$). Trained speech-language pathologists specialized in pediatric hearing loss performed comprehensive evaluations including receptive and expressive oral language (Évaluation du Langage Oral – Libanais), narrative skills (Multilingual Assessment Instrument for Narratives, MAIN), and sign language skills (lexical, syntactic, and narrative domains). Parental questionnaires offered additional information regarding developmental and familial linguistic backgrounds. Across all age groups and linguistic domains, no significant differences emerged between children exposed to sign language and those using oral-only communication, even after controlling confounding variables such as age at implantation and hearing age. Significantly, among the signing group, proficiency in sign language showed a positive relationship with oral language outcomes. These findings align with usage-based and bimodal bilingualism theories, emphasizing that the quality and consistency of language input, rather than its sensory modality, enhance linguistic development.

Free paper 0024

Speech Perception in newly cochlear implanted adults: Behavioral vs stapedial reflex thresholds based programming

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Introduction: Cochlear implants (CIs) are broadly regarded as an effective therapeutic technology for individuals with a severe to profound hearing loss. Hearing abilities, which differ greatly among CI users, are largely influenced by the stimulation levels of the CI. These levels are usually set with behavioral measures whose reliability depends on CI users' language, cognitive and sound loudness judgment skills. The electrically evoked stapedial reflex threshold (eSRT), which is the spontaneous contraction of the stapedius muscle in response to loud sounds, has also been used to set the stimulation levels of the CI. Even though eSRTs are faster to measure, are more consistent and can optimize speech perception, they remain clinically underutilized.

Objective: To compare speech perception of newly implanted adults whose cochlear implant was fitted with behavioral measures vs with eSRTs.

Material and methods: Forty-four newly implanted CI adult users participated in this study. The stimulation levels of their CI were fitted using behavioral measures on the one hand (program A) and using eSRTs on the other hand (program B). Half of the participants used the program A for about four weeks and then the program B for another four weeks. The other half did the opposite. Programs A and B were compared before and after the eight-week period in terms of speech recognition, speech syllable discrimination, aided hearing thresholds, sound quality, and subjective preference.

Results: Speech recognition, sound quality, and aided hearing thresholds were similar between programs A and B. The percentage of participants who preferred the program A over the program B or vice versa or who did not have any clear preference of one program over the other was equivalent.

Conclusions: ESRTs based programs yielded similar speech perception than behavioral measures-based programs. ESRTs should be used more largely in clinical practice, especially with difficult to test CI users.

Free paper 0192

Subjective hearing performance, wellbeing, and work related outcomes in cochlear implant users

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Introduction: While audiological outcomes after cochlear implantation are well documented, less is known about work related aspects, perceived stigma, and professional career development in cochlear implant (CI) users. Patient reported outcome measures such as the Speech, Spatial and Qualities of Hearing Scale (SSQ12) and the WHO-5 Wellbeing Index provide valuable complementary information. This ongoing multicenter study aims to evaluate subjective hearing performance, psychological wellbeing, and work related outcomes in CI users. First results from one center will be presented.

Material and methods: An ongoing cross-sectional survey includes MEDEL cochlear implant users. Demographic data and patient-reported outcomes are collected using the SSQ12 and WHO5 questionnaires. In addition, a detailed studyspecific questionnaire addresses the primary objective of the study, focusing on employment status, workplace communication, perceived stigma, and the impact of cochlear implantation on professional career development.

Results: To date, 117 respondents have completed the survey, data collection is ongoing (70 male, 59.83%; 47 female, 40.17%). The mean age was 59.1 years. SSQ12 data were available for 103 participants, with a mean total score of 5.00. Subscale means were 4.67 for *Speech*, 4.70 for *Spatial hearing*, and 5.61 for *Qualities of hearing*. The WHO-5 Wellbeing Index ($N = 117$) showed a mean score of 15.46 (61.85%), indicating overall good subjective well-being. The SSQ12 and WHO-5 results are in line with published CI cohorts. Detailed analyses of workrelated outcomes, perceived stigma, and professional career aspects are ongoing and will be presented at the conference.

Conclusions: Interim results from this ongoing study suggest that cochlear implant users report moderate to good subjective hearing performance and favorable levels of well-being. The forthcoming analyses of work-related and stigma-associated outcomes will provide important insights into the broader social and professional impact of cochlear implantation and may inform future rehabilitation strategies and counseling.

Free paper 0127

Successful hearing rehabilitation with the fully implantable cochlear implant TICI

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The fully implantable cochlear implant 'Total Implantable Cochlear Implant' (TICI) represents a revolutionary new development. It combines the stimulation implant, microphone and signal processing unit, enabling hearing without external components. As part of a multicentre European study, five patients underwent TICI treatment at the University ENT Clinic in Würzburg. The patient group comprised two women and three men aged 48 ± 20 years. The preoperative PTA4 was 95.25 ± 7.02 dB HL and monosyllable comprehension with a hearing aid was 12 ± 21% (65 dB SPL). The duration of the operation was 136 ± 7.1 min. There were no intraoperative or postoperative complications. All patients were treated with a FLEXSOFT electrode. The insertion angle of the apical electrode contact was 652 ± 54°, which corresponds to a frequency of 216 ± 60 Hz. At the 6-month follow-up, patients achieved a free-field threshold of 32.5 ± 3.9 dB SPL, monosyllabic word recognition at 65 dB HL of 69.0% ± 18.5%, and an SRT of 0.87 ± 5.34 at 65 dB SNR in the OSLA. The patients reported perceiving the body's own background noise, but after the initial fittings, they no longer found it disturbing; in some cases, they even found it pleasant and natural. These results show that TICI is a safe form of treatment. The high effectiveness of the system is particularly evident in its excellent speech comprehension. The approximate doubling of the operating time can be considered acceptable, taking into account the implantation of several components. The developed system thus represents a significant positive advancement in the field of cochlear implants.

Free paper 0183

Surgical & audiological outcome of pediatric ci surgery in IEMs compared to normal inner ear

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Objective: We look into pediatric 266 cochlear implant cases which were followed for 8 years and focused on: i type of inner ear malformations, incidence of aberrant mastoid segment of the facial nerve & gusher, the hearing level at time of surgery, the prevalence of intra-operative ECAPS, and the post-operative performance. All factors were analysed and compared in the the 2 groups: the children with normal inner ear and those with inner ear malformation (IEM).

Material and method: The study included 235 prelingual deaf children who were implanted in the cochlear implant unit at King Fahad University Hospital – Imam Abdulrahman Bin Faisel University. Subjects were using either Cochlear Nucleus or MEDEL cochlear implant devices. We had 171 (64.5%) subjects with normal inner ear anatomy and 94 (35.5%) subjects with inner ear malformations (IEMs), and they were classified into 6 groups according to inner ear anatomy. Aberrant facial nerve was diagnosed in the HRCT-TB (using Telmesani classification), and a gusher was reported in the electronic files and intra-operative videos. Intraoperative electrically evoked compound action potential (ECAP) responses were analyzed and compared in all subjects.

Results: Type III B aberrant facial nerve, which forces the surgeon to perform another approach, was significantly higher in inner ear malformation, with a difference between the two groups (Type III B 0.58% in NL & 1% in IEMs). Gusher was significantly higher in IEMs cases (0.58% in NL IE & 9.8% in IEMs) correlating the gusher to the size of the cochlear aperture in the HRCT-TB was analysed and significant things were noted. Measurable ECAP responses can be elicited in patients with IEMs in most of the channels. Severe malformations can affect the prevalence of measuring ECAP and getting an identifiable waveform morphology. The aided threshold resposenes in IEMs cases were similar to NL IEs, except for (mean of all IP I) was lower aided threshold.

Conclusions: Aberrant facial nerve is more common in IEMs. Gusher incidence is significantly higher in IEMs and is directly related to the size of the cochlear aperture. Intraoperative audiological assessment is more challenging in IEMs. Children with IEMs have relatively similar audiological outcomes compared to NL IEs.

Free paper 0432

Surgical and audiological outcomes of Osia® in children under 12 years: A large multicenter series

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Introduction: Conductive and mixed hearing loss (CHL/MHL) in childhood may restrict consistent access to speech, adversely affecting language development, academic performance, and social participation. Active transcutaneous bone-conduction implants such as Osia® bypass outer- and middle-ear pathology while providing stable amplification.

Objective: To describe surgical characteristics, audiological outcomes, and patient-/family-reported benefit in children under 12 years implanted with Osia®.

Material and methods: This retrospective, multicenter study included children <12 years with CHL/MHL implanted between 2020 and 2024. Collected variables comprised etiology, soft-tissue flap thickness, implant length (3 vs 4 mm), preoperative PTA4 (air- and boneconduction), and post-implant outcomes at 3 and 12 months: functional gain (FG) and effective gain (EG). Subjective benefit was assessed using the Client-Oriented Scale of Improvement (COSI), capturing individualized priority goals and post-implant ratings.

Results: Most children presented with CHL (90%), and 10% had MHL. Malformations of the external and middle ear were the most frequent etiologies (85.7% and 78.1%, respectively). Mean age was 8.0 years in the CHL group and 8.9 years in the MHL group. The 3-mm implant was used most commonly. Mean soft-tissue ("middle flap") thickness was approximately 4.9 mm (range: 2–8 mm). Flap reduction was performed in 11 children with CHL (2.49%) and in 0 children with MHL (0%). At 12 months, mean FG was 37.2 dB for CHL and 44.6 dB for MHL, achieving aided thresholds in the mid-20 dB HL range. EG at 12 months was –13.8 dB (CHL) and 2.4 dB (MHL), consistent with baseline between-group differences in bone-conduction thresholds. In COSI, *Speech in Noise* and *Social Settings* were the most frequently prioritized goals (approximately 29–34% each), with high post-implant ratings (approximately 4.4–4.8/5).

Conclusions: In children under 12 years, Osia® provides clinically meaningful audiological benefit and strong patient-centered improvements, particularly for challenging listening and social communication contexts, supporting early pediatric candidacy evaluation and timely intervention for CHL/MHL.

Free paper 0521

Surgical and electrophysiological experience with the semi-robotic OTODRIVE/OTOARM system

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Introduction: Modern cochlear implant treatment places particular emphasis on a surgical approach that preserves structure and function. Robot-assisted insertion of cochlear implant electrodes is considered to have an advantage over manual insertion in terms of atraumaticity. The new OTODRIVE/OTOARM system enables tremor-free insertion at a speed of 0.1 mm/sec.

Objective: The aim of the study was to comparatively evaluate electrophysiological parameters during robot-assisted treatment.

Material and methods: In a comparative study of 40 patients with manual and robot-assisted insertion of a FLEX28 insertion, we compared intraoperative ECAP and impedances as well as impedance behavior over time. Furthermore, considerations were made to improve surgical procedures.

Results: Intraoperative ECAP and impedance measurements show no difference between manual and robotic insertion. Lower impedances are found after robotic insertion in the further course. In individual cases, good residual hearing results can be found.

Conclusions: Electrophysiological data indicate a reduction in intracochlear trauma through robot-assisted CI electrode insertion.

Free paper 0011

Surgical approaches and complications in OSIA: A systematic review

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Introduction: The Osseointegrated Steady-State Implant (OSIA) is an active transcutaneous bone conduction system offering effective hearing rehabilitation via a piezoelectric actuator and osseointegrated anchor, while preserving skin integrity. Despite the growing adoption of OSIA, the literature regarding optimal surgical approaches and complication patterns remains fragmented.

Objective: To systematically evaluate intraoperative and postoperative complications associated with OSIA implantation, with specific focus on incision orientation, patient age, and prior surgical history.

Material and methods: A systematic review was registered with PROSPERO and conducted per PRISMA guidelines. PubMed, EMBASE, and CENTRAL were searched for studies published from January 2016 to April 2025. Fifteen eligible studies were included, encompassing 784 OSIA implants across prospective and retrospective cohorts.

Results: OSIA implantation was associated with a low pooled intraoperative complication rate of 0.77% and a postoperative complication rate of 5.25%. Most complications were mild and manageable, with no cases requiring permanent device removal. Incisions placed across the device had a significantly higher complication rate (14.4%) compared to incisions placed around the device (4.6%). Pediatric-predominant cohorts experienced more complications (10.2%) than adult-predominant cohorts (4.3%). Patients with prior mastoidectomy had a complication rate of 12.0%.

Conclusions: OSIA is a generally safe hearing solution, but surgical planning should consider patient-specific factors and incision orientation. Incisions placed across the device are linked to higher complication rates. These findings support evidence-based risk stratification and preoperative counseling.

Free paper 0002

Sustainability in the healthcare environment

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We are facing a climate crisis. Our greenhouse gas (GHG) emission has spiked by 12% from 2010 to 2019. We have had an increase in temperature of 1.1°C between 2011 and 2020. Healthcare is the fifth largest producer of GHG. A Health Care Without Harm (HCWH) report found that high-income countries have exceptionally high levels of health-related carbon emissions. The U.S. contributed 27%, China with 17%, the European Union with 12%, Japan with 5%, Russia with 4%, India, Brazil, South Korea, Canada, and Australia each contributing 2%, and the remaining 25% coming from other countries. This presentation will consider the impact of healthcare, particularly for cochlear implantation, on sustainability. This paper will focus on two things. Part one is a review of healthcare and sustainability literature. This will include reviewing the Sustainable Development Goals (SDG) goals from the United Nations, defining and setting up a Green Team, and what is being done in the healthcare environment. Part two is a survey of health professionals to ascertain what they currently do and where they could go in the future. Most literature on sustainability on healthcare are review articles. The survey here will provide evidence of what people are doing._Data from members of the HEARRING group will be reviewed and analysed according to their focus on sustainability. Their ideas for the future will also be reported on. This will link in with the review, which will show us what we can do to contribute to planetary health. Examples of this will be creating a GreenTeam, and developing ideas based on applicable SDGs. Every drop creates an ocean. What we do personally and in our professional environment will make a difference to us, and to those who come after us. Health professionals will know what SDGs are. They will know how to create a Green Team. They will understand the impact healthcare has on the environment. Results discussed in this paper should help us as health professionals move forward in their sustainability practises.

Free paper 0273

Targeted auditory rehabilitation employing direct audio input in children with single-sided deafness using a cochlear implant

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Introduction: Rehabilitation of children with SSD (CHwSSD) using a cochlear implant)CI(poses significant challenges and underscores the need to develop a dedicated and structured protocol for the rehabilitation of this unique group. Audio streaming, a technological innovation implemented in CIs, enables isolated training of the implanted ear without the involvement of the normal hearing (NH) ear. The growing number of CHwSSD receiving CI, together with the lack of evidence-based rehabilitation guidelines, were the main incentives for this study.

Objectives: To introduce an auditory rehabilitation protocol designed exclusively for CHwSSD using CI and to evaluate outcomes following its implementation.

Material and methods: The protocol was implemented in 33 CHwSSD implanted at a mean age of 4.2 years (range: 0.9–8.8), with a mean duration of CI use of 2.5 years (range: 0.5–4.6). Outcomes included results of speech perception tests, cortical auditory evoked potentials (CAEPs), parental questionnaire (Speech, Spatial and Qualities of Hearing Scale; SSQ), and CI data-logging information.

Results: The protocol included 12 consecutive therapy sessions focused on: (a) Isolated training of the implanted ear by means of audio streaming to promote audibility and speech perception abilities, (b) Binaural training involving stimulation of both the implanted and NH ears to promote binaural processing, and (c) Post-therapy follow-up visits conducted every 3 months. Most children (82%) attained word identification abilities with the CI (open (67%) or closed (15%) set), while 18% reached the level of detection. Speech-evoked CAEPs were elicited in 82% of the children, suggesting good audibility at normal conversational levels. The mean daily duration of CI use was 7.5 hours, and the mean SSQ score was high (7.1).

Conclusions: The newly developed protocol addressed the unique challenges involved in the assessment and rehabilitation of CHwSSD using a CI. The findings support the feasibility and efficacy of the protocol, which may serve as a guideline for clinicians rehabilitating this group.

Free paper 0712

Teleaudiology for adult cochlear implant follow-up: Feasibility and clinical impact of remote check

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Introduction: Regular follow-up is essential for cochlear implant (CI) users to ensure optimal device performance and auditory outcomes. However, access to in-person care can represent a major burden for patients living far from reference centers, requiring long travel times, financial costs, and significant personal effort. Teleaudiology offers a potential solution to improve access to care while maintaining clinical quality.

Objective: To evaluate the feasibility of Remote Check, a validated teleaudiology tool, as an alternative to in-person follow-up visits in adult cochlear implant users.

Material and methods: Thirty-eight adult CI users with unilateral or bimodal fitting were enrolled. All participants had more than six months of implant experience, a sound processor, and a smartphone compatible with Remote Check. Patients attended a routine in-clinic follow-up visit, during which they were instructed on the use of Remote Check, and subsequently completed the assessment remotely from home. Remote Check includes photographic inspection of the implant site, questionnaires, pure-tone audiometry, speech-in-noise testing, and automatic collection of internal and external device status and processor usage data. Outcomes included diagnostic agreement with in-person visits, clinical time savings, avoided travel distance, usability (Mobile Health App Usability Questionnaire, MHAQ), and patient satisfaction (ESC-8 scale). A Remote Check–focused questionnaire was also used to collect qualitative patient feedback.

Results: Diagnostic agreement between remote and in-person assessments was 100% for verification of internal and external implant components. Remote audiometric results were slightly better in all patients, consistent with previous validation studies. A total of 9.5 hours of clinical time were saved. The average travel distance avoided was 72 km per patient (range 2–232 km), corresponding to 2,733 km avoided overall. Usability scores were excellent (MHAQ: 1.7/7), and patient satisfaction was high (ESC-8: mean 29/32). Patient feedback highlighted the benefit for those traveling long distances.

Conclusions: Remote Check is a feasible and effective alternative to in-person follow-up for adult cochlear implant users. It maintains diagnostic reliability, significantly reduces clinical time and patient travel, and achieves high levels of usability and satisfaction. The tool will be integrated into our hospital care pathway, enabling more efficient resource allocation and supporting service growth.

Free paper 0339

Temporoparietal fascial flap for reconstruction of exposed cochlear implant

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Introduction: Cochlear implantation is an established intervention for the management of severe to profound sensorineural hearing loss. In children, bilateral implantation offers improved sound localisation, sound in noise and speech and language development. Despite excellent outcomes cochlear implantation is not without potential complications. Soft tissue breakdown over the implant or electrode is rare but potentially catastrophic as exposure can lead to infection, biofilm formation and device failure ultimately requiring device explantation. Aggressive management of soft tissue breakdown should be employed with a multidisciplinary approach. This series reports two paediatric cases of cochlear implant exposure successfully salvaged using a Superficial temporoparietal fascia flap (TPFF).

Material and methods: We present a case series of two paediatric cochlear implant recipients under ten years of age who developed implant exposure secondary to soft tissue breakdown.

Results: Two patients presented with exposed cochlear implants: one following progressive postauricular swelling and wound dehiscence, and the other following traumatic injury. Multidisciplinary assessment by ENT and plastic surgery teams led to surgical salvage using a TPFF. In both cases, meticulous debridement was performed with preservation of the implant. A Y-shaped incision was designed. The TPFF was raised based on the superficial temporal vessels and tunnelled inferiorly and inset in a double-breasted fashion to provide robust, well-vascularised coverage. Donor sites were closed primarily with full-thickness skin grafts. Postoperatively, both patients received intravenous followed by oral antibiotics. One patient developed a small seroma requiring drainage; no infections, flap failures, or device-related complications occurred. Average inpatient stay was seven days, and durable soft tissue coverage was achieved in both cases.

Conclusions: TPFF reconstruction is a reliable and robust technique for salvaging exposed paediatric cochlear implants. Early recognition and aggressive management with a multidisciplinary surgical approach can preserve the device and help avoid explantation and further re-implantation.

Free paper 0188

The application of intracochlear ECochG realtime monitoring in minimally invasive cochlear implant surgery

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Objective: To preliminarily explore the application of real-time intracochlear electrocochleography (ECochG) monitoring during cochlear implantation.

Material and methods: A total of 63 patients (68 ears) undergoing cochlear implantation were enrolled. Based on preoperative low-frequency residual hearing, patients were divided into two groups: Group A (low-frequency residual hearing group, with an average threshold of ≤80 dB at 125 Hz, 250 Hz, and 500 Hz; 31 patients, 33 ears) and Group B (no low-frequency residual hearing group; 32 patients, 35 ears). During electrode insertion, ECochG were measured in real time using monitoring software from the apical electrode to track changes in CM wave amplitude. Postoperative electrode positioning and low-frequency hearing preservation were evaluated.

Results: (1) Among the 68 ears, real-time intraoperative ECochG monitoring was successfully performed in 65 ears. (2) In Group A, measurable CM waves were detected in 22 ears, including: ascending Type A (6 ears), descending Type C (5 ears), and fluctuating Type CC (11 ears). No response (Type D) was observed in 10 ears. The CM amplitude in Group A ranged from 4 to 220μV. In Group B (33 ears), measurable CM waves were detected in 3 ears, including: ascending Type A (1 ear; peak amplitude: 240μV) and fluctuating Type CC (2 ears; peak amplitudes: 6.5 μV and 8 μV). No response (Type D) was observed in 30 ears. (3) In Group A, the preoperative average low-frequency hearing threshold was 75 dB for Type A, with a postoperative average low-frequency threshold shift of 15 dB; for Type C, the preoperative average threshold was 78 dB, with a postoperative shift of 22 dB; for Type CC, the preoperative average threshold was 77 dB, with a postoperative shift of 17 dB. No significant differences were observed in preoperative or postoperative low-frequency thresholds among CM waveform types. Electrode translocation into the scala vestibuli was observed in 2 ears of Type C, but not in Types A or CC.

Conclusions: Preoperative low-frequency residual hearing influences the intraoperative ECochG detection rate. Real-time intracochlear ECochG monitoring provides feedback to guide adjustments in electrode insertion.

Free paper 0646

The BEARS approach: Virtual reality training to improve spatial hearing for young bilateral cochlear implant users

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Introduction: Older children and teenagers with bilateral cochlear implants (BCIs) often have poor spatial hearing because they cannot fuse sounds from their two ears. This deficit jeopardizes speech and language development, education, and social well-being. The lack of protocols for fitting BCIs and rehabilitation resources for spatial-hearing training contribute to these difficulties. The Both Ears (BEARS) training suite, is a set of virtual-reality games to train spatial hearing in young people with BCIs. The games are played using a virtual-reality headset (or iPad) and headphones.

Material and methods: The games were developed using the principles of participatory design and action research, in which a series of formalised development cycles were conducted with stakeholder workshops to trial aspects of BEARS, reflect, and in turn inform changes in the game implementations for the next phase of development. The stakeholders were BCI users between 8 and 25 years old, audiologists, rehabilitationists, teachers and families. The cycles for each of the three BEARS domains (localisation, spatial speech-in-noise, and spatial music) were customized to focus on elements prioritised by stakeholders. Development finished when participants agreed that the final games were appropriate and ready for use by patients.

Results: The main areas of modification were: (1) to increase the variety of immersive scenarios to cover age range and interests, (2) increase the number of difficulty levels to ensure small improvements were measurable, (3) provide positive feedback, and rewards, and (4) develop an additional iPad implementation for those struggling with headsets due to age or balance issues.

Conclusions: The BEARS training suite meets the needs of the young people in the intended age range (8–16). Participants informed us that game-based training was relevant to their lives and was enjoyable. Tools like BEARS should empower patients to take control of their own healthcare outcomes.

Free paper 0234

The Bonebridge hearing implant in clinical practice: Safety and effectiveness in 325 patients

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Introduction: Hearing loss is often associated with a lower quality of life, leading to communication difficulties, social isolation, and stigma. The scale of difficulties faced by people with hearing loss has, over the years, driven professionals to seek increasingly advanced treatments. Rapid technological advancements have enabled the development of implantable devices for patients who do not benefit from or cannot use traditional hearing aids. The Bonebridge implant is a major advancement in bone conduction technology, offering a safe and effective hearing loss solution. However, limited sample sizes in studies highlight the need for further research on its long-term efficacy and safety. The aim of this study is to evaluate the safety, efficacy, and audiological outcomes of the Bonebridge implant in a large cohort of patients with different types of hearing loss.

Material and methods: A total of 325 patients across a wide age range underwent Bonebridge implantation. Pre- and post-implantation evaluations included pure-tone audiometry, speech recognition tests, and free-field audiometry. Word recognition was measured using the Polish Monosyllabic Word Test, while speech reception in noise was assessed using the Polish Sentence Matrix Test. Subjective benefit was assessed using the APHAB questionnaire. Follow-up tests were performed 6 months after activation.

Results: Revision surgery was required in 7 patients (2.1%) due to complications, including implant removal in one case. The APHAB questionnaire showed improved hearing function, and all hearing tests, such as free field thresholds, speech discrimination, and matrix tests, showed significant improvement after implantation.

Conclusions: Active bone conduction implantation is an effective method for the rehabilitation of conductive hearing loss, mixed hearing loss, and unilateral deafness. The large cohort study confirms significant hearing improvements and subjective benefits. The low complication rate supports the reliability of the Bonebridge system.

Free paper 0321

The Bulls-i trial: When is residual hearing compromised, during surgery or afterwards?

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Introduction: In addition to serving as an indicator of minimally traumatic implantation, preservation of residual hearing also enables natural sound perception and facilitates electrical-acoustic stimulation. Several potential sites of damage that may result in residual hearing loss have been identified, including the approach to the cochlear lumen and insertion of the electrode. Promontory ECochG may be used to monitor cochlear functions throughout phases of surgery, including the opening of the cochlea and insertion of the sheath of the Slim Modiolar Electrode (SME) insertion tool. The goal of this study is to use intra-operative promontory ECochG threshold measurements and pre- and postoperative audiometry to determine the stage of surgery at which the cochlear function is potentially compromised in patients implanted with the SME electrode.

Material and methods: In a prospective multicenter clinical study (Bulls-i trial), 48 adult patients with significant residual hearing at the lower frequencies (<80 dB HL at 500 Hz) indicated for cochlear implantation were included. All participants will be implanted with a Nucleus 632 or 1032 with the SME. Surgical procedures are strictly defined to avoid differences between clinics. Intra-operative promontory ECochG is performed (acoustic broadband clicks) to assess thresholds at baseline, after the extended round window or cochleostomy approach, insertion of the sheath of the insertion tool, insertion of the electrode, and positioning of the lead in the mastoid. Pure tone audiometry was performed after approximately 1 week and 3 months postoperatively.

Results: Preliminary results will be presented of 20 patients. In 18 of these patients reliable promontory ECochG thresholds could be obtained. A significant intraoperative decline (>5 dB loss) was observed in 3 patients (17%) of the patients during the surgical steps as described above. The postoperative tone audiometry at 3 months showed a (near) complete loss in approximately one third, partial loss in one third and (near) complete preservation (<10 dB loss FI^{low}) of residual hearing in the remainder third of the patients.

Conclusions: Partial or complete loss of residual hearing using the SME is not uncommon and more often occurs in the period after implantation than during the implantation procedure itself.

Free paper 0039

The clinical effect of steroids for hearing preservation in cochlear implantation: Conclusions based on three cochlear implant systems and two administration regimes

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Objective: The main aim of this study was to assess the clinical effect of steroids (dexamethasone and prednisone) on hearing preservation in patients who underwent cochlear implantation with different cochlear implant systems (Oticon®, Advanced Bionics®, MED-EL®).

Material and methods: 147 adult patients met the inclusion criteria and were enrolled to the study and divided into three groups depending on the brand of cochlear implant they received and participated in all follow-up visits regularly. They were also randomly divided into three subgroups depending on the steroid administration regime: (1) intravenous dexamethasone (0.1 mg/kg body weight twice a day for three days); (2) combined intravenous and oral steroids (dexamethasone 0.1 mg/kg body weight twice a day plus prednisone 1 mg/kg weight once a day); and (3) no steroids (control group).

Results: The results were measured by pure tone audiometry (PTA) at three time points: (i) before implantation, (ii) at processor activation, and (iii) 12 months after activation. A hearing preservation (HP) figure was also calculated by comparing the preoperative results and the results after 12 months. Further measures collected were electrode impedance and hearing threshold in the non-operated ear. The highest HP measures (partial and complete) were obtained in the subgroups who were given steroids. Of the 102 patients given steroids, HP was partial or complete in 63 of them (62%). In comparison, partial or complete HP was achieved in only 15 patients out of 45 (33%) who were not given steroids. There were differences between the three cochlear implant groups, with the MED-EL and Advanced Bionics groups performing better than the Oticon group (45% and 43% of the former two groups achieved partial or complete HP compared to 20% in the latter). Hearing thresholds in the non-operated ear were stable over 12 months. Generally, impedance was slightly lower in the 12-month follow-up in comparison with the activation period, with the exception of the Oticon group.

Conclusions: Pharmacological treatment with steroids in patients undergoing cochlear implantation helps to preserve residual hearing.

Free paper 0635

The correlation between asymmetric cochlear implant depth of insertion and interaural cochlear dimension variability

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Objective: Asymmetric angular depth of insertion (aDOI) in bilateral cochlear implantation is extremely common, and can result in asymmetric stimulation of cochlear nerves. We previously assessed if aDOI asymmetry affects functional outcomes and bineurality and showed that while auditory performance is associated with the depth of the deeper electrode, academic aptitude was associated with the degree of symmetry. Children with interaural aDOI differences >40 degrees were 6 times more likely to require special-needs and assisted educational programs for the hearing-impaired. The current study evaluated whether aDOI asymmetry is the result of interaural cochlear dimensions variability or secondary to differences in surgical technique.

Material and methods: *Study design* – retrospective cohort study. *Setting* – tertiary pediatric referral center. The study included prelingually deaf children who underwent bilateral simultaneous cochlear implantation and who had normal appearing inner ear structures. Cochlear size was assessed using the A-value method, a standardized linear measurement obtained from preoperative computed tomography imaging. The A-value was measured as the maximum linear distance between the center of the round window and the opposite lateral wall of the basal turn. Depth of insertion measurements were performed using intraoperative plain X-ray in the cochlear view. Correlations between cochlear size asymmetry and insertion asymmetry were assessed to determine the contribution of anatomical variation to electrode positioning.

Results: Average cochlear A values were 8.82 and 8.85 in the right and the left ears, respectively. There was moderate correlation ($r = 0.47$, $p = 0.038$) between the ears. The degree of aDOI asymmetry was not associated with interaural difference in cochlear dimensions, suggesting that aDOI asymmetry was in most cases the result of surgical technique and not secondary to anatomical variation.

Conclusions: Asymmetric aDOI is common and may be associated with functional outcomes. Meticulous surgical technique may reduce asymmetry.

Free paper 0258

The effect of the frequency to place mismatch on hearing outcome among cochlear implant recipients

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Introduction: Cochlear implantation (CI) is a standard treatment for severe to profound sensorineural hearing loss. Frequency-to-place mismatch, a disparity between the tonotopic organization of the cochlea and the frequency map of the cochlear implant, contributes in hearing outcomes among CI recipients. The variability in angular insertion depth (AID) resulting from differences in cochlear size and electrode array length leads to varying degrees of this mismatch. A significant mismatch between the tonotopic frequency map and the frequency map of a CI can have an impact on (initial) hearing outcomes in postlingual CI recipients. OTOPLAN®, a recent software by MED-EL, allows for modeling the cochlea and estimating electrode contact locations using postoperative X-ray imaging to support tonotopic fitting strategies. However, the correlation between this mismatch and a combination of subjective and objective hearing outcomes has not been fully explored.

Material and methods: This study includes 60 MED-EL cochlear implant recipients, divided into two groups: 27 children (3.5–18 years) and 33 adults (18–69 years). All participants have at least one year of CI experience. Postoperative X-ray images are being analyzed using OTOPLAN® software to determine the angular insertion depth and the degree of frequency-to-place mismatch for each electrode. Modified stenvers view was the best choice to visualize cochlear implant electrode (based on several trials that were performed with anteroposterior position with rotation of the patient's head 30 and 40 degrees were done). Hearing outcomes are being assessed through a battery of tests, including subjective measures like aided speech perception tests (Arabic PBKG and adult phonetically balanced lists) and objective measures such as Cortical Auditory Evoked Potentials (CAEP) and the Acoustic Change Complex (ACC).

Results and Conclusions: The detailed results will be thoroughly presented and discussed in the presentation after completing the study before the conference. However, this study would provide valuable insights into the clinical impact of frequency-to-place mismatch on hearing performance in both pediatric and adult CI users. By correlating the mismatch with both subjective and objective audiological measures, the findings are expected to inform the development of more precise, individualized CI programming.

Free paper 0461

The evolution of impedance telemetry in early versus late cochlear implant fitting with lateral and perimodiolar electrodes

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Backgroud: Impedance telemetry measures the resistance of each of the electrodes in the CI array. This could be due to fibrosis either reducing or changing the perilymph composition adjacent to the electrodes which leads to the observed elevated impedance.

Objectives: To evaluate the effect of early (next day) vs standard (4 weeks post CI) activation in addition to the effect of type of electrode array (lateral vs perimodiolar) on impedance telemetry.

Material and methods: 38 patients or 54 ears were recruited, there were 21 unilateral patients and 17 bilateral patients. Impedance telemetry was conducted intra-operatively, on the day of activation, 3, 6 and 12-months post activation.

Results: Effect of time of activation on common ground (CG) impedances showed that early activated patients show consistently lower impedances throughout all time points. Perimodiolar electrodes had lower CG impedances in early activated patients only.

Conclusions: There was an interaction between electrode array type and time of activation. Where perimodiolar electrodes showed significantly lower impedances than lateral wall electrodes only with early activation. Early activation might decrease fibrosis formation.

Free paper 0106

The Failure Index as marker of cochlear health in human CI users

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Cochlear implants (CIs) restore auditory input to the deafened ear by direct electrical stimulation of spiral ganglion neurons (SGNs). Consequently, CI outcomes critically depend on the number, integrity, and excitability of the SGN population. We recently introduced an electrically evoked

compound action potential (eCAP)–derived Failure Index (FI) as a quantitative marker of cochlear neural health in an animal model. The FI provides information about the presence, location, and extent of SGN lesions. Here, we translated the FI to clinical eCAP recordings obtained from CI users implanted with MED-EL devices. In this retrospective study, we analyzed patient data recorded between 2017 and 2024 at the German Hearing Center Hannover. The cohort comprised 199 post-lingually and 79 pre-lingually deafened ears. Across subjects, the FI averaged over all electrode contacts remained stable over the analyzed postoperative interval, spanning from the third month to the first year after implantation. The FI increased with age and was significantly elevated for etiologies known to be associated with greater SGN loss. Using three-dimensional electrode reconstructions derived from cone-beam computed tomography, we confirmed that the FI was independent of the electrode–modiolus distance over a range of 0.1–2.5 mm. Along individual electrode arrays, the FI exhibited distinct spatial patterns, with maxima most frequently observed at basal contacts, consistent with increased SGN degeneration at high-frequency cochlear regions. In a subset of post-lingually deafened ears, the FI correlated with speech perception outcomes in quiet and in noise ($n = 28$, $r^2 = 0.12–0.55$). Taken together, these findings identify the FI as a promising clinical metric for assessing neural health in CI-implanted ears and for detecting electrode contacts adjacent to regions of reduced SGN survival. The FI may thus provide a valuable tool to guide individualized speech-processor fitting and to optimize cochlear implant outcomes.

Free paper 0505

The French version of the Cochlear Implant Quality of Life (CIQOL) suite of 11 outcome measure instruments: Validation with adult cochlear implant users

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Introduction: The Cochlear Implant – Quality of Life (CIQoL) is a patient-reported outcome measure assessing quality of life (QoL) in adult cochlear implant (CI) users across six domains: *Communication*, *Emotion*, *Entertainment*, *Environment*, *Listening Effort*, and *Social*. Available in two versions, CIQoL-35 (35 items) and CIQoL-10 (10 items), it was recently translated and adapted from English to French. This study aims to evaluate the measurement properties of the French CIQoL.

Material and methods: Fifty adult CI users completed the CIQoL questionnaire. Domain scores and both CIQoL-10 and CIQoL-35 were analyzed. Principal Component Analysis (PCA) was performed to assess construct validity, while internal consistency was evaluated using Cronbach's alpha. Convergent validity was explored through correlation matrices.

Results: The *Social* domain received the highest score (mean: 78.8% ± 14.4%). Mean scores for CIQoL-10 and CIQoL-35 were 55.8% (±9.2%) and 62.8% (±11.5%), respectively. The CIQoL-35 showed excellent internal consistency (Cronbach's alpha = 0.937). The *Communication* domain had the highest consistency (0.892), while the Emotion domain had the lowest (0.694). No negative correlations were found between domains. PCA confirmed overall construct validity, though the Emotion domain demonstrated some divergence, suggesting it interacts differently from the other domains.

Conclusions: The French CIQoL provides a valuable tool for assessing CI-related QoL, helping healthcare professionals understand patients' experiences and tailor treatments to alleviate discomfort.

Free paper 0197

The HEARRING opinion study on hearing and structure preservation surgery

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Introduction: The application, practices, surgical techniques, materials, and tools in hearing and structure preservation surgery (HSP) and electric-acoustic stimulation (EAS) have undergone continuous evolution since their introduction 25 years ago. The last 5 years have witnessed further scientific insights and technological innovations since the previous opinion query on HSP by the HEARRING members.

Aim: A survey of HEARRING members assessed their current expert opinions on surgical techniques, materials, and practices in HSP CI surgery.

Material and methods: A previously published HSP questionnaire was adapted and expanded. The questionnaire was distributed to the HEARRING group of experienced CI surgeons and audiologists.

Results: Nineteen surgeons and thirteen audiologists completed the questionnaire. The percentage of agreement is displayed. Results are grouped into five categories of change from the previous query: (1) Remarkable evolution: a) the application of HSP surgery in severe-to-profound hearing loss: 70%; b) the use of preoperative cochlear size analysis with OTOPLAN™ software: 100%; c) electrode angular insertion depth of >540°: 100%. d) training – Workshops – Education on HSP and EAS: 95%. (2) Confirmation of opinions: no perilymph aspiration, slow insertion, flexible straight electrodes, round window insertion and corticosteroid treatment: 90–100%. (3) Raising interest: genetic testing in all CI candidates, the use of both pure tone average and speech reception for audiometric indication, and anatomy-based fitting: 60%. (4)

Emerging interests: stop smoking and upper respiratory infection control, scala tympani volume measurement, robotic-assisted insertion, and intra-operative electrophysiologic monitoring: 50%. (5) Declining interest: cochleostomy and extended round window approach.

Conclusions: In conclusion, this survey demonstrates significant changes in HSP CI surgery, with increased consensus among experienced HEARRING members, underscoring the need to apply all aspects of HSP rather than select a few actions. The Hearring Study Group attributes this evolution to growing evidence of improved hearing preservation outcomes. However, the areas of raising and emerging interests still require uniform protocols and supporting data for the methods.

Free paper 0452

The impact of bimodal stimulation with a cochlear implant and a hearing aid on auditory-speech development in children

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Objective: To compare auditory-speech development in 2–4-year-old children with a unilateral MED-EL SONNET 2 CI when the HA's automatic bimodal synchronization (Bimodal Link) was activated (ON) versus deactivated (OFF) during the first 6 months after speech-processor activation.

Material and methods: Prospective cohort at the ENT Department of the Republican Specialized Scientific and Practical Medical Center of Pediatrics. Forty-two children were enrolled and allocated to two groups: OFF ($n = 20$; Bimodal Link disabled in the SONNET 2 via Maestro) and ON (n = 22; automatic bimodal synchronization enabled). Outcomes at 3 and 6 months post-activation included: (1) Ling-6 Sound Test – maximum detection distance for /m, u, a, i, ʃ, s/ without visual cues; (2) Speech-in-Noise (10 monosyllabic words) at SNR +10 dB (speech ≈ 65 dB SPL; noise ≈ 55 dB SPL), reported as% correct; (3) LittlEARS (35 parental items); (4) IT-MAIS (10 items, 0–4 each; max 40).

Results: At 3 months, Ling-6 distance was ~1 m (OFF) vs ~2 m (ON); Speech-in-Noise: 50% (OFF) vs 70% (ON). LittlEARS increased similarly in both groups (+6 points). IT-MAIS rose from 9→18 (OFF) vs 9→25 (ON), a +7-point advantage with synchronization. At 6 months, Ling-6 distance reached 1.5 m (OFF) vs 2.5 m (ON); Speech-in-Noise: 60% (OFF) vs 85% (ON). LittlEARS remained comparable, while IT-MAIS again favored ON: 26 vs 35 (+9 points).

Conclusions: Enabling automatic bimodal synchronization (Bimodal Link) in unilateral CI users aged 2–4 years yields clinically meaningful early gains: longer Ling-6 detection distance, ~25% higher word recognition in noise, and higher IT-MAIS scores over 6 months post-activation.

Free paper 0120

The impact of cochlear implants on cognitive function and quality of life: A retrospective chart review

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Introdcution: Hearing loss has been identified as a significant factor contributing to cognitive impairment and dementia. Several studies have shown promising results indicating that cochlear implants (Cl) can significantly enhance cognition. Additionally, severe hearing loss has been associated with feelings of depression, anxiety, and stress, which can impair quality of life through social and communication challenges. This study aims to evaluate the impact of cochlear implantation on cognitive function and hearing handicap. Specifically, we assess whether cochlear implants lead to measurable cognitive improvements and reductions in hearing-related psychosocial issues.

Methods: A retrospective chart review was performed on adult patients who underwent CI between 2017 and 2025. Cognitive function was assessed using the Montreal Cognitive Assessment (MOCA), and hearing handicap was measured with the Hearing Handicap Inventory for Adults/Elderly (HHIA/E) at the following time points: preoperative, early postoperative (3–6 months), and late postoperative (9–12 months). Auditory function data, including the AzBio Sentence Test and Consonant–Nucleus–Consonant (CNC) Word Test, were collected at the same intervals. Patients were categorized into groups with asymmetric hearing loss, single-sided deafness, and bilateral hearing loss. Continuous data were analyzed using the related-samples Wilcoxon signed-rank test ($P < 0.05$).

Results: Data from 95 subjects were analyzed. Late postoperative MOCA scores showed a significant improvement compared to preoperative MOCA ($P = 0.049$) across subjects. HHIE/HHIA scores significantly improved from preoperative to early and late postoperative time points ($P < 0.001$). Higher preoperative MOCA scores correlated with better early postoperative AzBio sentence recognition ($\rho = 0.422$, $P < 0.001$) and improved CNC word recognition scores ($\rho = 0.283$, $P = 0.018$). The bilateral hearing loss group showed significant improvement in HHIE and HHIA scores from preoperative to early and late postoperative assessments ($P < 0.001$). AHL patients also improved in HHIE/HHIA scores at early or late postoperative intervals ($P = 0.027$). No trend was observed for SSD patients, possibly due to the small sample size.

Conclusions: This study supports that cochlear implantation not only improves hearing but also enhances cognitive function and reduces the psychosocial burden associated with profound hearing loss.

Free paper 0270

The impact of binaural hearing on children's speech perception, language development and verbal cognitions skills

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Purpose: More and more children with a bilateral severe to profound hearing loss are wearing two hearing devices: a cochlear implant + hearing aid or two cochlear implants. The objective of this study was to assess the role of bilateral/bimodal device use on auditory speech perception in complex listening situations and long-term verbal cognition in deaf children using cochlear implants (CI).

Material and methods: Two groups of deaf children with cochlear implants were compared (16 unilateral and 21 bilateral device users) on vocabulary, on speech perception at conversational level, in complex listening situations and on verbal cognition. It was a retrospective study on longitudinal data of deaf children with unilateral or bilateral devices: 37 children with normal learning potential of which 16 were unilateral device users and 21 were bilateral device users (9 with a bimodal fitting and 12 with bilateral CIs).

Results: The main outcome measures were the verbal cognition at 60 months. Further measures were open-set speech perception at 45 and 60 dB SPL, speech perception in noise, and receptive and expressive vocabulary. All measurements were made at 36 months post-implantation. The important factor associated with verbal cognition was the presence of binaural hearing (bimodal or bilateral). Bilateral input enhances complex listening skills and enables development of verbal cognition skills by learning in implicit, incidental (learning) situations.

Conclusions: Children with a bilateral severe to profound hearing loss who use two hearing devices from an early age have the opportunity to develop good speech perception skills in complex listening conditions. These abilities enable at least part of the children to develop nearly age-equivalent verbal-cognition skills.

Free paper 0224

The impact of frequency-based fitting in single-sided deaf or bimodally fitted CI users

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Introduction: Cochlear implantation is an established treatment option for patients with single-sided deafness. Numerous studies have demonstrated its positive effects. However, matching the cochlear implant input to the normal-hearing ear remains a challenge.

Objective: The aim of this study was to investigate whether frequency-based fitting can further improve speech understanding and listening experience compared to standard fitting methods.

Material and methods: This prospective study included 24 adult single sided deafness patients with unilateral cochlear implants. At baseline (t0), sinus tones were matched in frequency and loudness to the cochlear implant tones; the resulting values were used to adjust the electrode frequency allocations. Subsequently, speech tests, questionnaires, and sound comparisons were conducted. Participants used the frequency-based fitting setting for one month in a blinded cross-over design, without knowing whether it was the standard or the frequency-based fitting setting. After this period, all tests were repeated.

Results: Preliminary data indicate reduced listening effort at the same signal-to-noise ratio. Subjectively, many participants reported less fatigue while listening and improved recognition of musical instruments. Ratings of sound quality, however, varied individually.

Conclusions: Frequency-based cochlear implant fitting may facilitate better integration of electric and acoustic hearing and improve auditory outcomes in single-sided deafness patients.

Free paper 0710

The impact of genetic diagnosis on families of children with syndromic and nonsyndromic deafness: Evidence from a survey study

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Genetic testing is increasingly integrated into the diagnostic pathway of congenital hearing loss (CHL), providing etiological clarification, supporting personalized clinical management, enabling prevention of associated complications, and facilitating informed family counseling. While the psychological impact of genetic diagnosis has been widely studied in families with rare genetic disorders, it remains insufficiently explored in CHL, particularly with respect to differences

between syndromic and non-syndromic conditions and their implications for long term care. The primary aim of this study is to explore parental subjective experiences following a genetic diagnosis of CHL, adopting an otolaryngological–audiological clinical perspective. A secondary aim is to examine how emotional and cognitive dimensions relate to key clinical and rehabilitative variables within a long-term follow-up framework. We conducted a post-diagnosis survey study involving families of children with syndromic and non-syndromic CHL. A semi-qualitative analytical approach was used to investigate dimensions of emotional regulation, cognitive processing, and hope. These dimensions were explored in relation to clinical variables including severity of CHL, type of hearing devices (hearing aids or cochlear implants), auditory and linguistic outcomes, psychomotor development, timing of genetic diagnosis, and family alliance. By focusing on the parental experience of genetic diagnosis within the continuum of audiological and rehabilitative care, this study addresses a clinically relevant and underexplored aspect of CHL management. The proposed framework emphasizes the need to integrate genetic information with otolaryngological and audiological follow-up and supports structured interdisciplinary collaboration among genetics, otolaryngology, and audiology services. This perspective is particularly timely in light of the expanding role of genetic testing in neonatal screening programs and longitudinal diagnostic pathways. Finally, these insights are expected to be especially valuable for professionals who typically accompany patients and families over many years throughout the rehabilitative process with hearing aids or cochlear implant, enhancing communication, supporting adaptive coping, and contributing to continuity and optimization of long-term clinical and rehabilitative outcomes.

Free paper 0344

The impact of inter-implant interval on listening effort in sequential cochlear implant recipients

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Introduction: Traditionally, children with bilateral profound sensorineural hearing loss were treated with a single cochlear implant (CI). As candidacy criteria expanded, simultaneous bilateral cochlear implantation became the standard of care. Consequently, many individuals implanted in early childhood later underwent sequential implantation. While speech-perception outcomes after sequential implantation are well documented, its impact on listening effort (LE) is less studied. This study examined the effect of the inter-implant interval on LE and whether listening with two CIs reduces listening effort compared to using the dominant implant.

Material and methods: Twenty-nine participants aged 13–28 years who received their first implant before age three were divided into a short inter-implantation interval group (SIII, ≤5 years) and a long inter-implantation interval group (LIII, >5 years). LE was assessed using a sentence-completion-in-noise task with subjective effort ratings, dual-task paradigms combining word identification with manual or lexical secondary tasks, and the Vanderbilt Fatigue Scale (VFS). Dual-task costs were quantified using the Dual Task Effect (DTE) and interpreted within the interference model.

Results: In the sentence-completion task, both groups showed higher accuracy, and perceived effort was lower with two implants, with better results in the SIII group. In the manual dual-task, more positive DTE values for the secondary task were observed during listening with two implants as the inter-implant gap decreased. Both groups shifted from mutual interference to speech-priority trade-off strategies when moving from one to two implants, indicating more efficient attention allocation. In contrast, in the lexical dual-task, bilateral listening did not consistently reduce LE. Although primary-task DTE values became more positive with SIII, patterns of mutual interference continued with two implants. On the VFS, most participants reported fatigue levels within the normal range during everyday listening with two implants.

Conclusions: Listening with two implants reduced listening effort in sequential CI users, especially when the inter-implant interval was short. In dual-task paradigms, the manual secondary task was more sensitive to changes in LE than the lexical secondary task. The different measures captured distinct aspects of LE and fatigue, indicating that multiple complementary tools are required for comprehensive assessment and clinical evaluation.

Free paper 0670

The pillow technique for reducing postoperative pain after cochlear implantation

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Inroduction: In general, postoperative pain following CI treatment is classified as minor. Nevertheless, cases of CI explantation due to persistent pain symptoms have been reported. A review of larger study cohorts is pending. The causes of postoperative pain are divided into pain in the area of the implant and pain dependent on the head coil. Our study aims to evaluate the influence of a preoperative injection of a local anesthetic in the form of a cushion on the frequency of postoperative pain after cochlear implantation.

Material and methods: Starting in 2023, 10 milliliters of local anesthetic (lidocaine with epinephrine 1: 200,000) were injected preoperatively in a pillow-like manner directly between the periosteum and the cortex in the area of the implant pocket. 100 patients received a self-developed questionnaire to determine the frequency of pain. Their results were compared with the results of 550 patients who had implants between 2004 and 2023 without pillow injection. Different time points and degrees were recorded using a VAS (0–10).

Results: Immediately after surgery, pain occurred in 15.4% of cases following pillow-like injection at the implantation site. In contrast, this rate was 21.0% in the comparison group. Over time, the persistence rate decreased to 7.7% compared to 12.2%.

Conclusions: The type of preoperative injection of the local anesthetic has an impact on the frequency of postoperative pain.

Free paper 0228

The role of patient motivation in single-sided deafness: Patterns in treatment selection and cochlear implant outcomes

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Introduction: Single-sided deafness (SSD) treatment options include Contralateral Routing of Signal (CROS) or Bilateral Routing of Signal (BiCROS) systems, bone conduction devices, cochlear implants (CIs) and no intervention. Aligning treatment recommendations with patient motivations is fundamental for satisfaction and successful outcomes. At our institution, a structured telehealth consultation precedes formal testing and includes treatment motivation exploration and comprehensive review of all interventions.

Objectives: This study examined SSD treatment motivations and their association with pursuing cochlear implantation.

Material and methods: Adults who completed a pre-treatment SSD telehealth consultation over a four-year period were identified. Charts were retrospectively reviewed for demographics, SSD characteristics, treatment motivations, treatment choice, and CI outcomes.

Results: A total of 122 adults were evaluated. Mean age was 56.3 (±13.0) years, and 59.8% were male. Mean SSD duration was 10.8 (±15.8) years. The most common etiology was sudden sensorineural hearing loss. The top primary motivations were improving overall hearing (23.0%), restoring hearing to the deaf ear (22.1%), and improving hearing in noise (21.3%). Most patients (45.1%) opted for a hearing aid, CROS or BiCROS system; 38.5% chose CI; and 14.8% declined treatment. Only 57.4% of those who selected CI had the implant, primarily due to surgery avoidance (31.5%) and insurance limitations (10.5%). Motivation did not predict treatment choice or CI receipt. Among CI recipients ($n = 27$), those motivated by hearing restoration demonstrated poorer speech outcomes and datalogging.

Conclusions: Improving overall hearing and restoring hearing to the deaf ear were the most common motivations for seeking SSD treatment. Adult CI recipients had similar motivations to those who chose non-surgical options.

Free paper 0128

The stapes head coupler: A novel, low-profile solution for optimized vibroplasty outcomes

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Introduction: Vibroplasty using active middle ear implants, such as the Vibrant Soundbridge® (VSB), typically requires secure and space-efficient coupling to the ossicular chain. Existing coupling methods to the stapes head present limitations, particularly due to their vertical alignment and height, complicating procedures in anatomically restricted or previously operated middle ears In order to address these challenges, the novel Stapes Head (SH) Coupler was developed, featuring a significantly reduced functional height and enhanced flexibility for positioning. The objective of this retrospective study was to evaluate the surgical practicality, audiological effectiveness, and safety profile of the newly developed SH Coupler in patients undergoing VSB implantation.

Material and methods: A retrospective analysis was conducted on 12 patients (mean age: 43.1 years; range: 18–64) who underwent vibroplasty using the SH Coupler. The surgical placement of the Floating Mass Transducer (FMT) was performed by attaching it laterally onto the stapes head, with the orientation being directed either towards the promontory or the facial nerve. Audiological outcomes were assessed preoperatively and postoperatively by measuring auditory brainstem responses (ABR), sound field thresholds, vibrograms, and speech perception (Freiburg monosyllabic word test).

Results: All SH Coupler implantations achieved stable fixation of the FMT, as confirmed intraoperatively by ABR thresholds that were consistent with preoperative bone conduction thresholds (mean intraoperative ABR: 30.8 dB nHL). Postoperative audiometric evaluations demonstrated significant functional gains, with mean improvements in free-field thresholds of 35.1 dB. Speech recognition exhibited a significant enhancement, rising from 5.8% preoperatively to 58.8% postoperatively at 65 dB SPL. It is of particular significance that no deterioration in bone conduction thresholds was observed, thereby reinforcing the safety of the coupling technique.

Conclusions: The SH Coupler has been developed to provide a safe, effective and versatile coupling solution for vibroplasty, especially in anatomically challenging cases. The device's low-profile configuration has been demonstrated to enhance surgical flexibility and yield audiological outcomes that are comparable to, or in some cases superior to, those of conventional coupling methods. This finding supports the integration of the device into standard vibroplasty practice.

Free paper 0123

The values of imaging follow-up by using 0.55T low-field MRI in NF2-related schwannomatosis patients with auditory implantation

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Introduction: NF2-related schwannomatosis (NF2-SWN, previously called neurofibromatosis type 2) is characterized by bilateral vestibular schwannomas, causing hearing disability. Auditory rehabilitation surgeries for hearing improvement require lifelong MRI surveillance. However, metal artifacts and safety concerns limit routine MRI follow-up post-surgery. The safety and diagnostic performance of 0.55T MRI for those patients have not been elucidated.

Material and methods: This study evaluated the safety and efficacy of the Siemens MAGNETOM Free.Star 0.55T MRI in the follow-up of NF2-SWN patients post auditory implantation. This single-center observational study (Clinical trial registration number: ChiCTR2400085690) included 20 NF2-SWN patients who underwent 0.55T MRI scans at least 3 months post-surgery. The clarity of anatomical structure and overall image quality were assessed by two independent professional radiologists with a 5-point Likert scale. Secondary metrics included patient comfort and pain levels during scanning.

Results: The 0.55T MRI significantly provided good image quality for post-surgery MRI surveillance of NF2-SWN patients. Patients reported high comfort levels during the scan, with a mean Visual Analog Scale (VAS) pain score of 3.0 ± 1.5 (range: 0–5), with no severe pain or discomfort reported. Good (rating ≥4) image quality was achieved at 0.55T in T1-transversal for all patients in evaluating CPA structures both ipsilateral and contralateral to the implantation side. The T2-SPACE sequence was able to clearly visualize the contralateral CPA structures and inner ear structures in all patients with implants, while visualization of the ipsilateral structures was comparatively inferior, with 25% (5/20) of patients scoring below 3, making them unacceptable for clinical evaluation. T1-space images were significantly affected by metal artifacts, but they hold high diagnostic value for postoperative meningioma follow-up in such patients.

Conclusions: The Siemens MAGNETOM Free.Star 0.55T MRI demonstrates safety and efficacy in the follow-up of NF2-SWN patients post auditory implantation, providing high-quality images while reducing metal artifacts, thus enhancing patient comfort and safety. It is recommended to implement the 0.55T MRI in routine follow-up for NF2-SWN patients post auditory implantation to optimize follow-up strategies and improve the convenience for such patients.

Free paper 0190

Tinnitus and tolerance to loudness in adult cochlear implant users

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Objective: This study explored the interplay between tinnitus, hyperacusis, psychological factors (anxiety and depression), and auditory performance in adult cochlear implant (CI) users. The aim was to identify predictors of post-implantation tinnitus outcomes.

Material and methods: A nested case-control study was conducted on 50 adult CI users (63 ears), divided into a study group (SG) with persistent (20 ears) and absent (20ears) tinnitus post implantation and a control group (23 ears) with no history of tinnitus. Audiological variables included sound field pure-tone (SF-PTA) and speech perception in quiet and in noise. Measures for tinnitus distress and subjective symptoms to sound loudness included the Tinnitus Handicap Inventory (THI), Khalfa Hyperacusis Questionnaire (KQ), while psychological factors explored were the state and trait anxiety (STAI-Y 1-2), and depressive symptoms (Beck Depression Inventory-II (BDI-II). Cluster analysis was conducted to identify subgroups with distinct clinical profiles.

Results: In the SG, 35.3% of patients showed improvement in THI grade, 47.1% remained stable, and 17.6% worsened. Hyperacusis affected 64.7% of SG and was significantly associated with higher STAI-Y and BDI-II scores and SF-PTA. SF-PTA in the CI ear, was also positively correlated with tinnitus severity, loudness, and annoyance, as well as with psychological distress. THI and Kalfa scores were not correlated. Cluster analysis created three subgroups with differing profiles: one with worse-than-average SF-PTA and marked hyperacusis, but with mild tinnitus distress and minimal psychological symptoms; one with favourable auditory and psychological outcomes; and one with poor auditory performance, moderate tinnitus handicap, significant hyperacusis, and elevated emotional distress.

Conclusions: Persistent tinnitus and hyperacusis remain significant clinical challenges in a subset of CI users, particularly in cases characterized by auditory asymmetry and psychological comorbidities. Poor speech perception in noise may further exacerbate emotional distress. Cluster analysis highlights the heterogeneity of the CI population and supports the importance of a personalized, multidisciplinary rehabilitation approach, especially for individuals with complex symptom profiles requiring integrated psychological and audiological care. These findings reinforce the need for individualized rehabilitation strategies, including psychological screening and tailored CI programming, to improve long-term outcomes and overall quality of life.

Free paper 0033

To hear again: An auditory brainstem implant journey

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Neurofibromatosis type 2 (NF2) is a rare condition that frequently results in profound hearing loss due to bilateral vestibular schwannomas and the neurosurgical interventions required for their management. For many individuals, including myself, this trajectory involves multiple brain surgeries and the irreversible loss of natural hearing. The psychological impact of such loss is significant, encompassing grief, identity reconstruction, and the challenge of communication barriers. This presentation documents the lived experience of transitioning from silence to sound through two auditory brainstem implants (ABIs). While one ABI provides auditory input, the other has never produced auditory response, underscoring both the potential and limitations of this technology. With 12 electrodes delivering access to sound, rehabilitation required both technical adaptation and emotional resilience. The process of learning to interpret novel auditory signals illustrates the complexity of ABI rehabilitation, which extends beyond auditory perception to encompass connection, participation, and psychosocial adjustment. Beyond personal recovery, this journey has informed a sustained program of advocacy and education. I contribute to audiology and medical curriculums nationally in Australia and internationally, integrating lived experience into professional training and awarenessraising. These efforts aim to enhance clinician preparedness, foster empathy, and ensure that future practitioners understand both the technical possibilities and the human dimensions of ABI use. Advocacy also extends to systemic change, promoting accessible rehabilitation pathways, improved awareness of hearing loss, and recognition of the diverse outcomes associated with implantable technologies. This narrative underscores the transformative potential of auditory brainstem implants. While ABIs do not restore natural hearing, they provide a pathway back to sound, connection, and participation. The account highlights the intersection of rehabilitation and grief, and demonstrates how lived experience can inform education, advocacy, and systemic improvement in hearing health. By situating personal experience within broader professional and educational contexts, this presentation illustrates how individual journeys can drive collective progress in hearing health care.

Free paper 0439

Towards precision medicine in cochlear implantation: A multibrand study correlating postoperative radiological assessment, clinical data and functional outcomes

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Introduction: Hearing outcomes with cochlea implant (CI) is highly variable among the population. Several factors, including age of patients, duration of deafness, type of electrode variant, angular insertion depth of the electrode, and many others, affect the hearing outcome. We looked at age of patients, duration of deafness, electrode type (lateral wall vs peri-modiolar), electrode insertion angular depth as factors affecting hearing with CI when tested in quiet and noisy conditions.

Material and methods: Post-lingual adult subjects ($N = 93$ patients and 105 ears) were implanted with CI devices from Advanced Bionics, Cochlear®, MED-EL, and Oticon. Electrode variants implanted are Mid-scala, SlimJ from AB, Slim Modiolar, Contour Advance, Slim Straight from Cochlear®, FLEX24, FLEX28, and FLEXSOFT from MED-EL, EVO from Oticon. Post-operative CT scans were used to check for any electrode insertion misplacements like scalar deviation and tip fold-over.as well to measure the angular insertion depth. Patients were acoustically tested in both quiet and noisy environment for the effectiveness of CI.

Results: All pre-shaped electrodes on average covered an average angular insertion depth of approx. 360°. Medium length lateral wall electrodes (SlimJ, FLEX24, EVO, and Slim Straight) covered an average angular insertion depth of approximately 450°. Pre-curved electrodes showed 36.7% rate of scalar deviation compared to 11% with lateral wall electrode. Pre-curved electrodes showed 4.1% rate of tip fold-over compared to no tip fold-over with straight electrodes. In general, regardless of the CI brands implanted, there is a positive trend seen between electrode insertion depth and hearing outcomes in both quiet and noisy environment. No scala deviation showed slightly better hearing outcomes in quiet test condition and within MED-EL users but not in Cochlear® users. The data indicate that patient age at the time of CI and duration of deafness significantly influence CI performance in both quiet and noisy listening conditions.

Conclusions: Age and duration of deafness negatively affect hearing outcomes in CI. Electrode angular insertion depth seems to positively affect hearing outcome.

Free paper 0501

Transtympanic electrically evoked ABR (TTEABR) in grey-zone areas

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Introduction: Cochlear implantation in patients with borderline or complex anatomy remains challenging despite advances in imaging. Grey-zone scenarios such as narrow internal auditory canal, hypoplastic cochlear nerve, auditory neuropathy spectrum disorder (ANSD), post-tumour surgery, and post-traumatic deafness pose uncertainty regarding neural responsiveness. Transtympanic electrically evoked auditory brainstem response (TT-EABR) is a minimally invasive electrophysiological test that directly evaluates auditory pathway integrity and may aid preoperative decision making.

Material and methods: A retrospective review was conducted at a tertiary cochlear implant centre in South India between July 2019 and July 2023. Patients with congenitally profound hearing loss and narrow internal auditory canal or hypoplastic cochlear nerve (with or without cochleovestibular anomalies), ANSD unresponsive to conventional measures, profound hearing loss following temporal bone trauma, and post-bilateral vestibular schwannoma surgery were included. Candidates with normal cochlear anatomy, cochlear nerve aplasia, Michel aplasia, or rudimentary otocyst were excluded. TT-EABR was performed by elevating a tympanomeatal flap using extracochlear (round window or promontory) or intracochlear test electrodes when higher charge delivery was required. EABR responses were categorised as good, acceptable, or absent, and correlated with subsequent auditory rehabilitation decisions.

Results: Among 437 auditory implant cases, 66 involved abnormal cochlear anatomy and 39 underwent auditory brainstem implantation. Thirty-three patients underwent TT-EABR (31 extracochlear, 2 intracochlear). In ANSD, 3 of 4 patients demonstrated good responses and were planned for cochlear implantation. One post-vestibular schwannoma surgery patient showed good TT-EABR responses, favouring cochlear implantation. Intracochlear stimulation produced acceptable responses in two cases. Minor complications included tympanomeatal flap tears ($n = 5$) without persistent perforation and cerebrospinal fluid gusher ($n = 2$).

Conclusions: TT-EABR complements radiological evaluation and provides valuable functional information in grey-zone cochlear implant candidates. It aids in candidate selection, ear selection, and counselling, helping avoid ineffective implantation and optimising auditory rehabilitation outcomes in complex scenarios.

Free paper 0649

Ultra-high definition imaging of inner and middle ear structures by photon-counting computed tomography

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Introduction: Computed tomography of temporal bones has established place in the diagnostic algorithm for qualification and preoperative assessment of patients elected for cochlear or middle ear implantation. Due to complex structure within limited space, temporal bone demands very thin slice imaging. Newly developed photon-counting computed tomography (PC-CT), allowing for ultra-high resolution, seems an ideal tool for cross-sectional of temporal bone.

Objective: Assessment of the effectiveness of PC-CT in displaying sub-millimetric details of inner and middle ear.

Material and methods: Three radiologists (different levels of expertise) reviewed images of 100 temporal bones (exams performed using dedicated protocol on Alpha Photon-Counting CT) and assessed visualization of selected small anatomical structures: singular nerve canal, proximal part of vestibular aqueduct, stapedial muscle, both crura of stapes.

Results: The effectiveness for displaying each elected structure assessed independently by each radiologist was high (>95%). The inter-rater agreement assessed by Fleiss' kappa was high (0.81–1.00; Landis and Koch interpretation). The mean radiation dose of PC-CT temporal bone exams was lower at least by 40% comparing to standard CT temporal bones exams performed at the same centre.

Conclusions: Photon-counting computed tomography is highly effective in ultra-high resolution diagnostic imaging of inner and middle ear structures. It allows better visualisation of temporal bone at lower radiation dose.

Free paper 0242

Use of a split array electrode cochlear implant as a vestibulocochlear implant

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Introduction: In this presentation, we will talk about a case where we used a Split Electrode cochlear implant in a patient with profound bilateral sensorineural hearing loss and a severe bilateral vestibular dysfunction. Based on recent publications and oral presentation of electrical otolith stimulation and vestibular implant, we offered the patient the possibility to use a Split Electrode cochlear implant for cochlear ossification to improve hearing and locomotion disability. **Objective:** To offer useful auditory input and improve the locomotive impairment due to the vestibular dysfunction.

Material and methods: The patient is a 52-year-old female with a profound left SSHL since childhood and a left SSHL of six months of evolution after Timpanomatoidectomy for otitis media. Cochleovestibular tests were performed, which include: audiometry, ABR, otoacoustic emissions, caloric test, ENG, VEMPs and vHIT, CT scan. Inventory of discapacity questionary (DGI) was optained prior the surgery. We use a split double array electrode. Authorization of the Ethics committee and a signed iInformed consent was obtained from the patient. We decided to use a subtotal petrosectomy as an approach due to the following reasons: the history of previous infection in the mastoid and the previous surgeries, and to assure the proper placement of the electrode in the vestibule. We were able to make a deep insertion of all of the electrodes of the cochlear array and two electrodes of the vestibular array into the vestibular cavity. Electrical stimulation of the cochlear electrodes was performed with good response, electrical response was obtained on the electrode number 2 in the vestibular array. Vestibular evoked myogenic potentials were performed through electrode number 2 of the vestibular array.

Results: One month after implantation, mapping and programming were performed using the HDCIS strategy for both arrays, regardless, using a low MCL in electrode 2 of the vestibular array. The patient derveloped usefull hearing and improvment in gait an locomotive functions, and they are consistent and show improvement through time noted in subsecuent revisions.

Conclusions: Cochlear and vestibular stimulation can be achieved using a split array electrode, obtaining good results in the first months after implantation.

Free paper 0241

Use of the slim straight electrode in type III incomplete partition inner ear malformation

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Introduction: Incomplete partition type III (IP III) is a rare malformation of the inner ear that poses challenges during cochlear implantation due to inevitable cerebrospinal fluid (CSF) leaks and the potential misplacement of electrodes within the internal auditory canal (IAC). Although there is no consensus on electrode selection, the literature suggests that both straight and perimodiolar electrodes are viable options for proper insertion. The limited number of implantation series contributes to the ambiguity in electrode choice. In this study, we evaluated the insertion performance of three electrode types in a 3D model simulating the inner ear of an IP III patient.

Material and methods: A 3D model of the inner ear of a patient undergoing surgery for IP III was created. This model incorporated a canal wall up mastoidectomy and an enlarged round window approach. Electrode insertions were carried out using a straight electrode, a perimodiolar electrode, and a slim perimodiolar electrode. These were inserted through a sheath in the basal turn of the cochlea. The positions of the electrodes were assessed after each insertion, with each type being tested 20 times.

Results: The successful insertion rates were 95% for the slim perimodiolar electrode, 85% for the perimodiolar electrode, and 75% for the slim straight electrode. Statistical analysis revealed that the slim perimodiolar electrode was superior to the slim straight electrode in achieving successful insertions. We used the slim straight electrode on two patients with IP III and were able to position the electrode in the cochlea, achieving good stimulation results.

Conclusions: Surgery in patients with IP III is challenging. In the 3D model, we tested the perimodiolar, slim and slim straight electrodes and found that the slim straight electrode was superior to the slim electrode. We were also able to successfully implant the slim straight electrode in two IP III patients.

Free paper 0173

Using cortical auditory evoked potentials in active middle ear and bone conduction implant users: An objective method to optimize the fitting

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Objective: The study aimed to investigate whether cortical auditory evoked potential (CAEP) measures could be used to optimize active middle ear implant (aMEI) and bone conduction implant (BCI) fitting, with the goal of improving hearing outcomes in adults.

Material and methods: CAEPs were measured in response to LING sounds /OO/, /AH/, and /SH/ presented in sound field. If CAEP responses were recorded for all sounds, no map adjustments were performed. If a CAEP response was absent for one or more sounds, map parameters were optimized until a CAEP response could be induced. Functional outcomes were measured as pre- vs post-optimization adaptive speech-in-noise results. Subjective feedback was also collected.

Results: Of the fifteen participants, one was excluded from the study, three did not need optimization, nine were successfully optimized using CAEP measurements, and two could not be optimized. Comparison of CAEP morphology showed significant differences pre- vs post-optimization for middle- and high-frequency sounds (i.e., /AH/ and /SH/). Speech--in-noise testing revealed significant improvements pre- vs post-optimization, and participants were generally satisfied with the overall procedure.

Conclusions: These findings demonstrated that middle- and high-frequency tokens could be successfully optimized using CAEPs, resulting in significant improvements in hearing performance. Our results support the use of CAEPs for the optimization of aMEI and BCI adult users' fitting.

Free paper 0584

Utilisation of CT based virtual endoscopy as a diagnostic imaging tool for cochlear nerve deficiency

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Objectives: The presence of a functional cochlear nerve is a key issue in the preoperative evaluation of pediatric candidates for cochlear implants. MRI has been the gold standard tool for assessment of cochlear nerve pre-operatively. Correlations between cochlear nerve deficiency (CND) and bony landmarks of internal auditory canal are not yet well understood. The aim of this study was to assess the reliability of CT based virtual endoscopy (CTVE) of internal auditory canal as a pre-operative method for evaluation CND.

Material and methods: High resolution CT (HRCT) and MRI of a total of 250 cochlear implant candidates were retrospectively evaluated. DICOM data of HRCT were used for reconstruction of CTVE image of IAC, that were evaluated for anatomical bony landmarks. Tractus spiralis foraminosus was used as a bony landmark indicator for presence of normally developed cochlear nerve (CN). Sensitivity and specificity of such finding, for diagnosis of CND, was evaluated based on correlation with corresponding MRI images of the CN.

Results: From a total of 500 CTVE of IAC, diagnosis of unilateral and bilateral CND was made in 25 and 50 cases respectively. Diagnosis was confirmed in all of them, based on MR images of those cases. Five cases, whose CTVE reported normal CN, were diagnosed as CND based on MRI. Overall sensitivity and specificity ratios of CTVE, for diagnosis of CND, were 96.15% and 100% respectively.

Conclusions: CTVE can be used as a pre-operative imaging tool for evaluation of CN and detection of CND. Tractus spiralis foraminosus can be considered as a sensitive anatomical bony landmark for presence of normally developed CN.

Free paper 0581

Validation of OTOPLAN® software for cochlear duct length measurements: A comparison with conventional radiological morphometry in an Indian setting

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Introduction: Accurate measurement of Cochlear Duct Length (CDL) is essential for selecting an appropriate electrode array and achieving optimal Cochlear Implant (CI) outcomes. Traditional CDL measurement methods, including curved Multi-Planar Reconstruction (MPR) and calculation using Jolly's formula, are reliable but time-consuming and operator-dependent. OTOPLAN® is a software designed to simplify and standardize CDL estimation.

Objective: To validate CDL measurements obtained using OTOPLAN® software by comparing them with conventional radiological morphometry performed by an expert neuroradiologist.

Material and methods: This prospective cohort study included 42 MED-EL cochlear implant recipients (84 ears) who underwent preoperative high-resolution CT temporal bone imaging. CDL was measured using three methods: (1) Jolly's formula (CDL-CAL), (2) Curved MPR-based cochlear unfurling (CDL-MPR), and (3) OTOPLAN® measurement (CDL-OTO). Paired t-tests and Bland–Altman analyses were performed to compare the techniques.

Results: Mean CDL values were comparable across methods: CDL-OTO (33.002 ± 1.566 mm), CDL-CAL (32.904 ± 1.505 mm), and CDL-MPR (32.639 ± 1.812 mm). No statistically significant differences were observed between CDL-OTO

vs CDL-CAL ($p = 0.527$) or CDL-OTO vs CDL-MPR ($p = 0.078$). Subgroup analysis (sex, side, and age groups) showed no significant discrepancies. Bland–Altman plots demonstrated minimal bias and excellent agreement without proportional error.

Conclusions: CDL measurements obtained with OTOPLAN® align closely with conventional manual methods, confirming its accuracy and clinical reliability. The software provides rapid, standardized, and operator-independent CDL estimation, supporting its incorporation into routine CI preoperative planning. This study also contributes population-specific CDL data for the Indian demographic.

Free paper 0286

VSB as a viable treatment for complex hearing loss – 15 years experience of MUMC and RadboudUMC

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Introduction: The Vibrant Soundbridge (VSB) is an active middle-ear implant, providing amplification for moderate to profound sensorineural and mixed hearing loss. After recent broadening of reimbursement regulations in the Netherlands, the VSB can now be considered an alternative regular treatment, next to Bone Conduction Devices (BCD), when conventional hearing aids cannot be worn.

Material and methods: This study gives an overview of experiences with VSB in two tertiary outpatient clinics and audiological centers in the Netherlands, describing the clinical outcomes of a group of VSB patients ($N = 100$). An additional comparison with the results of patients with a powerful BCD ($n = 145$) will also be given.

Results: Analysis shows that the VSB provides good hearing performance for patients with bone conduction thresholds over 30 dB HL, even up to 65 dB HL. Multivariable regression analysis shows that, even though the included VSB-patients in general have a comparable or larger sensorineural hearing loss, their performance in speech intelligibility and functional gain is on average better than the results of the BCD-population. Although the spread in hearing performance is large in both groups.

Conclusions: From a purely functional perspective, a VSB provides a significantly better speech understanding in quiet, compared to BCDs on a group level. Future research should aim to broaden the application of VSB across a more diverse population to more accurately assess its impact on speech understanding, everyday auditory functioning, quality of life, and cost-effectiveness.

Free paper 0437

What stops audiologists using remote care tools to care for adults with cochlear implants?

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Introduction: Telemedicine has the potential to improve health equity, mitigate clinician shortages, reduce patient travel and associated costs, lower carbon emissions, decrease healthcare cost, increase patient engagement and adherence, and ultimately improve patient outcomes. Despite these well-recognised benefits, remote care adoption remains variable. Understanding clinician perspectives is essential to inform service development and optimise the integration of telemedicine into adult cochlear implant pathways.

Aim: To identify barriers that audiologists face in adopting telemedicine in adult cochlear implant care, and to determine what is needed to overcome these barriers.

Material and methods: A prospective mixed-methods anonymous online survey was conducted in 2024 among audiologists providing care to adults with cochlear implants across the United Kingdom.

Results: Thirty-one complete responses were received. The majority of respondents (87%, $n = 27$) reported having used remote care tools in clinical practice with adults with cochlear implants. However, 29% ($n = 9$) had never used these tools or used them only rarely, and no respondents reported daily use. All perceived benefits to remote care – mostly to both clinicians and patients. Training and workplace support were generally considered adequate, and reimbursement and data privacy were not identified as significant barriers. Sixty-eight percent of respondents reported experiencing frequent technical issues with remote care tools. Opinions were divided regarding the effectiveness of remote care compared with in-person appointments, but 81% felt that the gold standard of clinical care remains in-person care.

Conclusions: The primary barriers to telemedicine adoption in adult cochlear implant audiology were frequent technical issues and the perception that in-person care represents the gold standard. Technical barriers could largely be addressed through improvements to manufacturer tools, alongside better local technical support and integration into clinical systems. Since 2024, new cochlear implant remote care tools have been introduced and existing platforms further developed; a follow-up survey is underway. However, not all aspects of in-clinic care can yet be replicated remotely, and availability and functionality of remote care continue to vary by manufacturer, implant, and processor. As telemedicine becomes more seamless, accessible, and person-centred, clinician perceptions of optimal models of care may evolve, supporting wider adoption in adult cochlear implant services.

Free paper 0358

What the eye cannot see: Insights into structural preservation in cochlear implantation using an individualized imaging technique

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Introduction: Cochlear implantation (CI) outcomes may be influenced by the precise positioning of electrodes relative to cochlear structures. Advanced Bionics has developed CImago, a research software capable of reconstructing individual cochlear anatomy, including the basilar membrane and osseous spiral lamina, using active shape models derived from computed tomography (CT) scans. This study aimed to explore the relationship between CI electrode placement and clinical outcomes using individualized imaging.

Material and methods: A multi-centre, exploratory, longitudinal study was conducted across five centres in Spain, primarily through retrospective evaluation. Pre- and post-operative CT scans were obtained from all subjects to determine electrode position. Audiometric thresholds, speech intelligibility, impedance measurements, neural response imaging, programming levels, and electrophysiological data were collected throughout clinical follow-up. To date, 60 CI recipients have been enrolled since October 2023.

Results: Preliminary evaluation of 33 subjects implanted with HiFocus SlimJ electrodes revealed a mean insertion angle of 411° (range 287°–534°). The depth of insertion and the location of individual electrode contacts relative to the basilar membrane correlated with cochlear size, highlighting the variability of inner ear anatomy. The use of CImago enabled highly accurate reconstruction of cochlear and electrode geometry, supporting individualized pre-operative planning and post-operative verification of electrode placement.

Conclusions: These initial findings suggest that individualized imaging can provide insights into electrode-cochlear interactions not visible during surgery. Precise mapping of electrode position may inform strategies for structural preservation and optimization of CI programming. Continued follow-up and analysis are expected to elucidate correlations between electrode placement and audiological outcomes, potentially guiding improvements in clinical care.

Free paper 0451

Where do we go from "hear"? Factors impacting outcomes in CI rehabilitation: From language to cognition: The Saudi experience

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Introduction: Hearing loss is one of the most prevalent sensory impairment globally and the most common congenital abnormality in the Kingdom of Saudi Arabia (KSA), affecting 1–2% of school-aged children. The implementation of Newborn Hearing Screening (NHS) programs, advances in hearing technology, and evidence-based habilitation models, have transformed the developmental outcomes for children with hearing loss. Approximately 90% of infants with hearing loss are born to hearing parents driving the majority of families at King Fahad University Hospital (KFUH) to elect early cochlear implantation (CI) and to enroll in listening and spoken language (LSL) habilitation. Auditory-Verbal therapy (AVT) is the LSL program adopted by the hospital's cochlear implant program.

Material and methods: This study examines the longitudinal outcomes of KFUH Cochlear Implant program, established in 2009. Through an evaluation of over 400 cases, parental surveys, and literature, this research assesses the impact of NHS initiated in 2012 at KFUH and implemented nationally in 2016 on intervention timelines, clinical rationale for implementing AVT, AVT strategies and their effectiveness in parental commitment, proficiency, self-efficacy, and parental language input. Moreover, to associate these factors with auditory, speech-language, neurocognitive, academic, and social outcomes for children with CIs.

Results: Key findings highlight the pivotal role of early identification and intervention and proper access to sound, with the average age of CI decreasing to 1.6 years. Parental factors including active parental involvement, supported by targeted AVT coaching, emerged as a critical factor impacting self-efficacy and effective integration of strategies and language model used with the child influencing language skills and educational performance with 67% of children with CI achieving mainstream education placement, close to global benchmarks. Additionally, five key AVT strategies employed by 80% of parents demonstrated significant efficacy in daily habilitation practices.

Conclusions: This study underscores the pivotal role of early identification, timely intervention, and a collaborative partnership between AVT practitioners, parents, and children to achieve age-appropriate communication skills, academic success, and enhanced quality of life for CI recipients in Saudi Arabia.

Panels, Round Tables & Courses

Free paper 0212

CI in vestibular schwannoma patients managed with observation or gamma knife treatment

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Introduction: Vestibular schwannomas (VS) are commonly associated with progressive unilateral sensorineural hearing loss. Contemporary management strategies increasingly favor observation or stereotactic radiosurgery, such as Gamma Knife, particularly for small- to medium-sized tumors. As hearing deteriorates in these patients, cochlear implantation (CI) has emerged as a potential rehabilitation option, despite historical concerns regarding cochlear nerve integrity in retrocochlear disease.

Objective: To review current evidence on cochlear implantation outcomes in VS patients managed with observation or Gamma Knife radiosurgery, with emphasis on candidacy, timing, and audiological outcomes.

Material and methods: A narrative literature review was performed focusing on studies reporting CI outcomes in VS patients without microsurgical tumor resection. Outcomes of interest included speech perception, auditory benefit, and factors influencing postoperative performance.

Results: Published series and systematic reviews demonstrate that cochlear implantation can provide meaningful auditory benefit in selected VS patients managed conservatively or with radiosurgery. Open-set speech perception is reported in a majority of implanted patients, with outcomes often comparable to conventional CI candidates. Patients in the observation group tend to show particularly favorable results, likely reflecting preserved cochlear nerve function. Importantly, prior Gamma Knife radiosurgery does not appear to preclude CI benefit; multiple studies report satisfactory speech understanding and subjective hearing improvement following implantation. However, audiological outcomes remain variable, and predictors of success are not fully established. Tumor size, cochlear nerve integrity, duration of hearing loss, cochlear patency, and radiation-related changes may all influence performance.

Conclusions: Cochlear implantation represents a viable and effective hearing rehabilitation option for selected vestibular schwannoma patients managed with observation or Gamma Knife radiosurgery. These patients may achieve speech perception outcomes comparable to, or better than, those reported after microsurgical tumor removal. Careful patient selection, thorough preoperative assessment, and realistic counseling are essential. Cochlear implantation should be considered an integral part of the management pathway for hearing rehabilitation in conservatively treated VS patients.

Free paper 0687

Cochlear implantation in chronic otitis media and challenging cases

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Introduction: Cochlear implantation (CI) in the setting of chronic otitis media (COM), radical cavities, and other complex otologic conditions remains surgically demanding and clinically important. The presence of active or previously treated middle ear disease, subtotal petrosectomy (STP), obliteration techniques, and pediatric or medically fragile patients requires individualized strategies to ensure long-term safety and optimal auditory outcomes. Advances in surgical techniques and biomaterials have expanded indications and improved outcomes in these challenging scenarios.

Material and methods: This round table will present and discuss current evidence and surgical approaches in cochlear implantation for chronic ear disease and complex cases. The program of the round table will include:
Dr. Della Volpe (Naples, Italy) – *Challenging pediatric cochlear implantation cases*
Dr. Giulia Bertoli (Parma, Italy) – *Challenging adult cochlear implantation cases*
Dr. Giovanni Colombo (Legnano, Italy) – *Long-term results for fat graft obliteration in subtotal petrosectomy and cochlear implant surgery*
Dr. Matteo Di Bari (Legnano, Italy) – *Bioactive glass obliteration in subtotal petrosectomy and cochlear implant surgery*
Moderator: Dr. Matteo Di Bari
The discussion will integrate recent clinical data, surgical techniques, complication management strategies, and long-term follow-up results.

Results: Contemporary evidence supports subtotal petrosectomy with cavity obliteration as a reliable strategy in selected COM cases undergoing CI. Bioactive glass obliteration techniques demonstrate favorable infection control and stable long-term outcomes. In pediatric and revision cases, meticulous surgical planning and tailored approaches significantly reduce complication rates while preserving auditory performance.

Conclusions: Cochlear implantation in chronic otitis media and other challenging clinical scenarios can be performed safely and effectively when supported by appropriate surgical strategies and obliteration techniques. Multidisciplinary discussion and shared expertise remain essential to optimize patient selection, minimize complications, and improve long-term auditory outcomes.

Free paper 0706

Collaborative work between a CI team and the families of children with other comorbidities

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Collaborative work between the cochlear implant team and the families of children with hearing loss & cochlear implants is crucial. In the specific population of children with other associated comorbidities, this collaborative work must be accompanied by individualized action, centered on the family and its specific needs. Thus, it is possible to guarantee access to the best and most appropriate means and resources, in order to prioritize the homogeneous development of the child in all areas.

In this workshop, we will explain what the literature says about the care and requests necessary for this collaborative work, showing how important clear and transparent communication with the family is, as well as the inclusion of other professionals beyond those who commonly participate in the intervention with cochlear implants. In addition, the challenges and solutions found in some clinical case studies will also be presented and discussed.

Free paper 0517

Conductive humanitarian missions in optimizing cochlear implant candidacy: A structured model for global implementation

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Introduction: Humanitarian cochlear implant missions (HCIMs) play a critical role in expanding access to cochlear implantation in low-resource settings. However, CI candidacy determination in these contexts presents unique challenges, including inconsistent diagnostics, limited preoperative data, and lack of standardized workflows. The need for evidence-based, technology-supported candidacy pathways has become increasingly important, particularly as global demand for CI services grows.

Objective: To present a structured, technologyenabled framework for achieving accurate and efficient cochlear implant candidacy assessment within humanitarian missions, supporting the mission of CI2026 to advance global hearing healthcare and CI accessibility.

Material and methods: Drawing on operational experience from large-scale international CIMs, a three-phase candidacy model was developed. Components included: (1) Remote pre-screening using standardized digital data collection with local partners; (2) Multidisciplinary virtual triage integrating surgeons, audiologists, and speech-language pathologists; and (3) On-site "one-stop clinic" confirmation, combining imaging review, audiologic verification, communication assessment, and structured family counseling. Telemedicine, cloud-based tracking systems, and manufacturer-supported technical inputs were integrated to enhance accuracy and sustainability.

Results: The structured model streamlined case processing, reduced evaluation delays, and improved accuracy in identifying appropriate CI candidates. The "one-stop clinic" reduced evaluation time by up to 60% and minimized inter-team information loss. Teleaudiology and virtual counseling improved postoperative readiness and enhanced continuity of care – key elements for long-term success in resource-limited regions.

Conclusions: Conductive humanitarian missions, defined by structured clinical workflows, multidisciplinary collaboration, and strategic use of technology, significantly improve CI candidacy determination in underserved populations. This model supports global initiatives to expand equitable access to cochlear implantation and aligns with the CI 2026 focus on innovation, sustainability, and advanced practices in cochlear implant programs.

Free paper 0751

Detection of otoacoustic emissions in the 500 Hz band: Patients with partial deafness

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Introduction: Partial deafness is a kind of high – frequency hearing loss in which perception of high frequencies is attenuated while at low frequencies the perception is normal or only slightly limited.

Aim: The aim of the study was evaluation of otoacoustic emissions evoked by click (CEOAE) and by 500 Hz tone burst (TBOAE) in the diagnosis of patients with partial deafness.

Material and methods: The criteria for assigning patients to a specific group were medical history, otoscopic examination, impedance audiometry, and pure-tone audiometry. The presence of otoacoustic emission signals was assessed based on the measurement reproducibility parameter. The test specificity was determined for the total parameter and for the parameter in a half-octave band around 500 Hz. In the study, 21 subjects aged from 14 to 78 years with partial deafness were examined and divided into two groups: the "500" group – with normal hearing in the 125–500 Hz range (15 ears), and the "1000" group – with normal hearing in the 125–1000 Hz range (9 ears). The control group consisted of 26 individuals (52 ears) aged 22 to 72 years without otological problems

and with a normal hearing threshold. In all subjects, CEOAEs and 500 Hz TBOAEs were collected.

Results: We observed that in patients with partial deafness the credibility of the assessment of otoacoustic emissions using bandpass reproducibility parameter is higher than the total. 500 Hz TBOAEs were present in all patients despite hearing loss in neighboring frequencies. This effect was observed regardless of hearing loss starting frequencies.

Conclusions: Obtained results indicate that 500 Hz TBOAE is more valuable test than CEOAE for the study of cochlear function at low frequency. 500 Hz TBOAE can be used to partial deafness patients diagnosis where widely used CEOAEs are not usually present. Additionally, use of bandpass reproducibility parameter may increase the credulity of the test.

Free paper 0586

Environmental sounds, scenes, and soundscapes: Functional hearing beyond speech

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Perception of objects and events present in one's environment, other than speech and music, remains an underrecognized yet essential dimension of auditory function for individuals with hearing loss. In this session, a panel of experts will discuss how listeners with cochlear implants and other hearing-rehabilitation technologies navigate everyday environments by identifying and interpreting meaningful nonspeech sounds. The panelists will address emerging evidence on the relationship between environmental sound perception and traditional speech-perception metrics, highlighting convergences and dissociations. The session will also examine how implantable and acoustic devices shape access to critical environmental cues, influencing safety, independence, dynamic processing of spatial dimensions within perception-action loops and situational awareness. Presentations and group discussion will explore broader implications for cognitive processing, rehabilitation, psychological well-being, and overall daily functioning, emphasizing the need for more comprehensive auditory-function assessment. This session will outline current challenges, knowledge gaps, and future research priorities in environmental sound and auditory scene perception for individuals using modern hearing technologies.

Moderators: Michael S. Harris, MD (Medical College of Wisconsin) and Valeriy Shafiro, PhD (Rush University Medical Center).

Panelists: Damir Kovačić (University of Split), Dina Lelic (WS Audiology), Francesco Pavani (University of Trento), Joshua Sevier (Rush University Medical Center).

Free paper 0003

Healthcare and human rights

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The Universal Declaration of Human Rights (1948) defines that "everyone has the right to a standard of living adequate for the health and well-being of himself and of his family (…) medical care (…) social services (…) and the right to security in the event of (…) sickness (…)." Human rights should be an essential principle in the healthcare field. This review paper will demonstrate important human rights factors for us as professionals. The author conducted a review on human rights in general, and on human rights and healthcare. A review on human rights and hearing implants was also conducted. This paper will review the literature on human rights in general, and human rights in healthcare specifically. The review will consider the impact on hearing, as defined in the WHO World Report in Hearing (2021). Finally, the review will consider a document on a human rights based approach to healthcare, showing how these rights can be considered in our cochlear implant world. Human rights has an impact on healthcare. We as health professionals can consider these in our daily practise, providing each patient with the rights and dignity they deserve. We can also see the impact we could have on lobbying reimbursement and other parties to support human rights for all of our patients.

Free paper 0578

Hearing for All-Panel

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Hearing loss remains a major public health challenge in emerging nations, particularly India, where an estimated 63 million individuals live with significant hearing impairment and more than 50,000 children are born annually with severe to profound hearing loss. Globally, unaddressed hearing loss carries an economic burden approaching US$ 1 trillion annually, underscoring the urgency for scalable and sustainable intervention models.

This panel examines the framework of "Hearing for All" through early detection, timely implantation, structured rehabilitation, and long-term outcome monitoring. Emphasis is placed on Universal Newborn Hearing Screening (shifting benchmarks from 1–3–6 to 1–2–3 months), high-risk registries, and the critical window for language acquisition driven by neural plasticity.

Surgical preparedness – including advanced radiology, training models, and evolving cochlear implant technologies – is discussed alongside emerging innovations such as robotic

and totally implantable cochlear implants. Beyond technology, the talk highlights accessibility, affordability, and sustainability through government-supported schemes, philanthropic partnerships, and national and international collaborative bodies. The role of family-centered habilitation, tele-audiology, and multilingual rehabilitation models in mainstreaming children into society is emphasized.

Balancing advanced implant technology with cultural, ethical, and socioeconomic realities remains the central dilemma. The proposed "Hear a Million" initiative outlines actionable strategies spanning newborn screening, school programs, cochlear implantation (including bilateral implantation), bone conduction implants, and auditory brainstem implants.

Hearing for life is not merely a medical intervention – it is a social transformation.

Free paper 0233

HEARO procedure

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Introduction: The first aim is to describe the actual HEARO procedure that we have performed in 25 patients. Here, a robot arm-based drilles tunnels towards middle and also inner ear based on images acquired during surgery. Based on those images, a very accurate navigation system guides the drill that was programmed by the surgeon. Secondly, we also report improvement over the years, technological as well as surgical improvement that pave the wat towards true keyhole robot-assisted surgery and push towards autonomous CI surgery.

Material and methods: Pre-clinical evaluation of the full HEARO procedure, including the electrode insertion and scanning evaluation, was performed on ten formalin-flushed temporal bone specimen were used for the study. The HEARO procedure was then performed under IRB UZA (EAR²OS and ARCI 25 trial.gov) approval as a feasibility study in three patients and subsequently as an efficacy study ongoing for 25 patients with severe to profound sensorineural hearing loss, and in which the temporal bone anatomy allowed enough space between the facial nerve and the chorda tympani for safe passage of the drill. After the first 25 patients, we stopped opening the tympanomeatal flap for visual check of the insertion, and instead, we managed to perform insertions through the drilled tunnel. And this paved the way also to perform the actual insertion with yet another robotic device (OTODRIVE™) This way the insertion angle and also the insertion speed (0.1 mm) is standardized to the maximum and beyond human dexterity.

Results: Published results will be discussed.

Conclusions: Robotic assisted cochlear implantation is feasible in clinical setting. The procedure proves to realize the requested accuracy and precision to safely perform the procedure and form a sound platform for improving CI surgery. The improvements made so far are promising for standardizing the outcomes of ci surgery and pave the way towards standardizing preservation of residual hearing to be able to benefit electroacoustic stimulation in the same ear.

Free paper 0563

New frontiers for CI in patients with vestibular schwannoma, inner ear schwannoma, or endolymphatic sac tumour

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Patients with a vestibular schwannoma (VS) in the internal auditory canal and/or cerebellopontine angle, with an inner ear schwannoma (IES) or an endolymphatic sac tumour (ELST) experience hearing loss in most cases in the affected ear, either due to the disease or treatment. Cochlear implantation (CI) has emerged as a potential hearing rehabilitation option despite historical concerns regarding cochlear nerve integrity in retrocochlear disease, cochlear structural integrity and regarding the necessary radiological follow up.

Jeanette Hess-Erga (Bergen, Norway) will review the current evidence on cochlear implantation outcomes in VS patients managed with observation or "Gamma Knife" radiotherapy, with emphasis on candidacy, timing, and audiological outcomes demonstrating that this strategy represents a viable and effective hearing rehabilitation option for selected patients. These patients may achieve speech perception outcomes comparable to, or better than those reported after microsurgical tumour removal.

Jan Boucek (Prague, Czech Republic) will discuss different aspects of managing IES, presenting the experience of performing CI alongside resection. While this approach shows very promising results, the very low growth potential of IES under observation should be considered.

Stefan Plontke (Halle, Germany) will present the single-centre experience of 102 cases of CI after surgery for sporadic IES. In patients with the tumour limited to the cochlea and/or the vestibular labyrinth, hearing results with CI are good to above average, so that CI treatment has already become established in these cases. If the tumour extends into or through the modiolus involving the region of the spiral ganglion cells, hearing rehabilitation using CI is more complex. Possible solutions for these IES types are discussed.

Elisabetta Zanoletti (Padua, Italy) will present data on hearing rehabilitation of CI in very rare cases of endolymphatic sac tumours (ELST), a low-grade malignant tumor with local aggressiveness in the petrous bone. ELST exists in the

sporadic form and Von-Hippel-Lindau (VHL) disease associated. Since hearing declines quickly, with Ménière-like symptoms, CI becomes a viable option of hearing rehabilitation, provided that the cochlea is preserved. A case series is here reported with promising experience in the VHL-associated cases, which combine radical surgery with function rehabilitation with CI.

Free paper 0518

Outcomes of Cochlear Implant Humanitarian Missions across multiple countries

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Introduction: Cochlear implant (CI) humanitarian missions provide essential access to hearing rehabilitation for children in underserved regions. As part of the humanitarian efforts supported by the King Salman Humanitarian Aid and Relief Center, these missions address hearing loss in communities with limited resources and follow-up availability. This study summarizes outcomes from multicountry CI missions and highlights early device use among implanted children.

Material and methods: Data were collected from missions carried out in Turkey, Syria, Jordan, Kenya, Senegal, and Tunisia. Children received MEDEL cochlear implant systems using various electrode arrays and audio processors. Implantation was performed on either ear depending on clinical need. Age at implantation ranged across early childhood groups. Follow-up assessments focused on early device use, measured through average daily wearing hours at the first and second follow-up visits.

Results: Across all participating countries, children demonstrated strong engagement with their devices. Average daily wearing time increased from 7.37 hours at the first follow-up to 8.51 hours at the second follow-up, indicating consistent and improving use over time. Early outcomes were similar across regions despite differences in resources, patient ages, and device types. These results show that mission-based CI programs can deliver reliable early auditory access even in challenging environments.

Conclusions: The CI humanitarian missions supported by the King Salman Humanitarian Aid and Relief Center achieved positive early outcomes across diverse countries and clinical settings. Children adapted well to their devices and demonstrated meaningful early benefit regardless of implant type or region. These findings highlight the impact and scalability of structured humanitarian CI programs in expanding access to hearing care for underserved populations.

Free paper 0708

The involvement of the adult/senior CI users and their caregivers: What challenges do we face in holding adults accountable and involving them in the process of hearing rehabilitation?

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This roundtable will target a population that is growing in demand for hearing technology, namely cochlear implants. The objective is to identify the challenges faced by this population, which is quite heterogeneous, and which may condition or limit the use of cochlear implants.

In addition to the involvement and responsibility of the adult who receives a cochlear implant, this roundtable also aims to look very closely at communication partners, as they should also play an active role in the decision-making process and in the auditory rehabilitation journey of the adult/senior CI user. With the participation of experts with vast and diverse experience in the field of cochlear implantation, we want to contribute with the identification, reflection and discussion to the challenges and solutions found to better involve adults in this journey, aiming for a continuous improvement in quality of life and better auditory and communicative performance.

Free Paper 0755

The use of Connected Care to improve access to care

Helen Cullington

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Around one million people worldwide are now hearing with a cochlear implant, and referrals continue to rise. As this community expands, so too does the responsibility to rethink care delivery at scale. We need to take a more intentional, strategic and evidence-led approach. Do all cochlear implant recipients truly need the same care pathway? Is routine, in-person care always necessary to achieve excellent outcomes? Challenging long-standing assumptions about post-implant care is essential if we are to improve access, efficiency, and sustainability – without compromising quality. This round table brings together clinicians from Europe, South America, and Asia to explore how Connected Care is transforming cochlear implant services worldwide. Through shared experiences and practical insights, we will examine how remote and flexible care models can support personalised, timely follow-up – whenever and wherever patients need it – designed around the needs of both patients and clinics. Join the discussion to help define the future of cochlear implant care.

Free paper 0752

Traveling wave delay (velocity) in cochlear implantees: Preliminary results

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Introduction: Auditory performance among cochlear implant (CI) users exhibits significant variability. While normal hearing relies on the "traveling wave" process for frequency-specific stimulation, CIs stimulate the auditory nerve through a limited number of electrodes.

Objective: This study aims to investigate N1 latency differences based on electrode position via Neural Response Telemetry (NRT), examining whether latency variations between basal and apical electrodes align with the cochlea's tonotopic organization.

Material and methods: NRT measurements were evaluated in 16 postlingual CI users (mean age: 45.81 years) with at least one year of device experience. Electrode integrity was verified via impedance telemetry. N1 latency values were recorded for a comparative analysis between Electrode 1 (basal) and Electrode 22 (apical). Ethical approval was obtained from the University of Health Sciences, Gulhane Training and Research Hospital, Non-Interventional Scientific Research Ethics Committee (Approval No: 2025/250).

Results: N1 latencies were significantly longer at Electrode 22 compared to Electrode 1 (Wilcoxon signed-rank test, $Z = -2.633$; $p = 0.008$). The mean N1 latency was 316.4 ± 51.0 µs for Electrode 1 and 346.9 ± 64.0 µs for Electrode 22. Spearman rank correlation analyses demonstrated no statistically significant relationship between the ΔN1 latency (E1 vs E22) and clinical parameters, including Speech Reception Threshold (SRT: $\rho = -0.141$, $p = 0.602$), Speech Discrimination (SD: $\rho = 0.091$, $p = 0.739$), and CAP-II scores ($\rho = 0.050$, $p = 0.854$).

Conclusions: The significantly longer N1 latencies at the apical electrode suggest that the natural temporal delay from base to apex is preserved and measurable via NRT. However, the lack of correlation with SRT, SD, and CAP-II scores indicates that peripheral neural speed is not the primary determinant of speech perception. These preliminary results suggest that while electrophysiological variations reflect tonotopic organization, they do not directly predict behavioral clinical outcomes in postlingual recipients.

e-Posters

Free paper 0372

A comparison study between preformed and straight electrode arrays using intra-op fluoroscopy and ECochG with pre-and post op CT scan analysis with CImago

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Introduction/Objectives: Adavanced Bionics offers two different types of electrode array: the slimJ which is a slightly curved straight electrode and the high focus mid scala (HFMS) electrode, which is a preformed electrode array. This study investigated the differences between use of these two arrays in terms of placement within the scala tympani and anatomical variation.

Material and methods: For a group of 15 recipients of an Advanced Bionics cochlear implant, Intra-op fluoroscopy and ECochG measurements were carried out to help determine and control the position of the electrode array during insertion. Feedback to the surgeon was made available verbally in an attempt to minimize trauma and reach the targeted position for the electrode array. Pre and post OP CT scans were made to investigate the electrode array's final positioning. Post-op audiograms were administered to evaluate the degree to which residual hearing was preserved.

Results: The size and anatomy of cochleae varied widely in the study group, which is in keeping with what has been observed in other studies. These differences have caused very different placements accordingly. Generally, the HFMS array tended to take up a more medial position than the SlimJ array. Hearing preservation could be achieved with both electrode arrays, although to date the SlimJ appears to support slightly better hearing preservation. Analysis is ongoing for the latter implants in this study series.

Conclusions: Due to the anatomical variations of cochleae, the different properties of a preformed and straight electrode can beneficial. For straight SlimJ electrode electrodes, the maximum insertion depth is limited by the scala tympani height versus size of array height. A large cochlea easily accommodates the SlimJ electrode, while a compact cochlea may be much more suited for the preformed HFMS electrode array. The availability of a pre-op CT scan in combination with imaging software can be helpful in making a decision on which type of electrode array to select.

Free paper 0255

A concept for insertion force measurement during automated cochlear implant electrode insertion

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Introduction: Automating the electrode array (EA) insertion is gaining increasing attention in cochlear implant surgery due to its promise of gentler, less traumatic implantation, potentially resulting in improved hearing preservation and speech comprehension. However, as current automated insertion devices are merely linear drives that only allow control of the insertion speed and depth, no information about the insertion quality is provided to the surgeon. Information about insertion forces is lost, which surgeons are able to perceive to a certain extent during manual insertion. Therefore, we are introducing an extension to our hydraulically driven insertion tool, the Cochlea Hydrodrive (CHD), by integrating force-sensing capability for intraoperative measurements.

Material and methods: The CHD consists of a syringe whose plunger acts as a linear drive. The EA can be temporarily fixed in an electrode holder, which is connected to the syringe plunger. In this new version, a miniaturized 1D force sensor is added between the syringe plunger and the electrode holder to measure forces occurring along the direction of insertion. Since the force sensor, unlike the other components of the CHD, is not sterilizable, it is encapsulated in a sterile drape together with the associated cable. A strain relief prevents movements on the cable from being recorded as measurement artefacts by the force sensor.

Results: A first prototype of the force-sensitive CHD was built and is currently undergoing intensive preclinical evaluation showing, promising results: The specially developed miniature force sensor provides the necessary measurement accuracy. It can withstand high breaking loads; therefore, damage during intraoperative assembly that could falsify insertion force measurement, is not expected. The strain relief effectively prevents measurement artefacts caused by movements of the cable.

Conclusions: The integration of force-sensing capability into the CHD unlocks new possibilities for insertion monitoring, ranging from simple termination criteria, such as stopping the insertion when exceeding a certain force limit, to more complex control strategies, such as force-dependent adaptation of the insertion process. Pre-clinical evaluation will be continued and finalized in preparation of a first-in-man study of the updated CHD.

Free paper 0529

A monocenter, patient-blinded, randomized study to compare cochlear implant fixation techniques (COMFIT)

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Introduction: During the cochlear implantation procedure, the receiver/stimulator (R/S) part of the implant is fixated to prevent postoperative device migration, which could have an adverse effect on the position of the electrode array in the cochlea. We aim to compare the migration rates of two fixation techniques, the bony recess versus the subperiosteal tight pocket without bony sutures.

Material and methods: This single-blind randomized controlled trial will recruit a total of 112 primary cochlear implantation adult patients, eligible for implantation according to the current standard of practice. Randomization will be performed by an electronic data capture system Castor EDC, with participants block randomized to either bony recess or standard subperiosteal tight pocket in a 1: 1 ratio, stratified by age. The primary outcome is device migration rate (using pre- and postoperative ConeBeam CT scans; secondary outcomes include patient-experienced burden using the validated COMPASS questionnaire, electrode migration rate, electrode impedance values, speech perception scores, correlation between R/S migration, electrode array migration and patient complaints, assessment of complication rates, and validation of an implant position measurement method.

Results: Data were collected at baseline, day of surgery, 3 months and 12 months showing no difference in migration between different approaches in these preliminary results ($N = 50/112$). Postoperative imaging **material and methods:** (computing migration with CBCT) were comparable with the flexible measurement tape.

Conclusions: preliminary results showed validation of the patient-friendly, inexpensive and practical method using the flexible measurement tape to determine the exact location of the R/S device on the scalp. These were adequately validated by the gold standard postoperative CBCT data.

Free paper 0489

A novel radiological software prototype for automatically detecting the inner ear and classifying normal from malformed anatomy

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Introduction: To develop an effective radiological software prototype that could read Digital Imaging and Communications in Medicine (DICOM) files, crop the inner ear automatically based on head computed tomography (CT), and classify normal and inner ear malformation (IEM).

Material and methods: A retrospective analysis was conducted on 2053 patients from 3 hospitals. We extracted 1200 inner ear CTs for importing, cropping, and training, testing, and validating an artificial intelligence (AI) model. Automated cropping algorithms based on CTs were developed to precisely isolate the inner ear volume. Additionally, a simple graphical user interface (GUI) was implemented for user interaction. Using cropped CTs as input, a deep learning convolutional neural network (DL CNN) with 5-fold cross-validation was used to classify inner ear anatomy as normal or abnormal. Five specific IEM types (cochlear hypoplasia, ossification, incomplete partition types I and III, and common cavity) were included, with data equally distributed between classes. Both the cropping tool and the AI model were extensively validated.

Results: The newly developed DICOM viewer/software successfully achieved its objectives: reading CT files, automatically cropping inner ear volumes, and classifying them as normal or malformed. The cropping tool demonstrated an average accuracy of 92.25%. The DL CNN model achieved an area under the curve (AUC) of 0.86 (95% confidence interval: 0.81–0.91). Performance metrics for the AI model were: accuracy (0.812), precision (0.791), recall (0.8), and F1-score (0.766).

Conclusions: This study successfully developed and validated a fully automated workflow for classifying normal versus abnormal inner ear anatomy using a combination of advanced image processing and deep learning techniques. The tool exhibited good diagnostic accuracy, suggesting its potential application in risk stratification. However, it is crucial to emphasize the need for supervision by qualified medical professionals when utilizing this tool for clinical decision-making.

Free paper 0622

ABI in children. Audiological aspects. Our experience

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The ABI (auditory brainstem implant) is an auditory neuroprosthesis that stimulates the cochlear nucleus to provide sound perception and should be considered only when inner ear anatomy rules out other options (e.g., cochlear implant). Candidate selection must be rigorous and multidisciplinary (otologist, audiologist, neurologist/neuropediatrician, psychologist, speech and rehabilitation specialists), with subjective and objective audiological assessment (pure-tone audiometry, physiological tests such as ABR, OAE, eABR/ECAP, promontory/RW testing, and MRI/CT imaging) and cognitive/psychological evaluation. In children, earlier intervention improves outcomes and requires counseling and preparation for parents, therapists, and schools; realistic expectations and family support are crucial. Additional communication modalities (sign language and visual supports) are recommended, and close follow-up is required throughout the process. eABR and ECAP are used as guides for intraoperative mapping and later tuning.

In the presented series, 21 children showed positive but variable auditory development, with improvements in speech perception from detection to word identification and open-set recognition, though outcomes do not reach cochlear implant levels. Three children with severe coexisting developmental disabilities remained at detection/discrimination. Parents reported good adherence to ABI use and improved quality of life. Four children are receiving bimodal stimulation (CI + ABI).

Free paper 0603

Access to treatment for hearing loss in Chile: Do all people have the same opportunities? A scoping review

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Introduction: Contrary to many Latin American countries, Chile has made progress in strengthening its health care system; however, achieving equitable access to hearing care remains challenging. This scoping review explored and synthesized the literature on hearing care in Chile to identify key determinants and barriers contributing to disparities in access to hearing loss (HL) diagnosis and treatment.

Material and methods: The Joanna Briggs Institute guidance for scoping reviews was followed, and PCC mnemonic (Population, Concept, and Context) guided the development of the search strategy. Searches were conducted in MEDLINE via PubMed, Cochrane and Science Direct databases, limited to articles published from 2000 to June 2025, and supplemented by manual search. Two reviewers independently screened references, assessed eligibility, and extracted data; disagreements were resolved by a third reviewer. A basic content analysis was used to identify the local determinants and barriers. Results were narratively described and presented along visual summary tools.

Results: Of the 940 unique records identified for screening, the full texts of 135 publications were assessed and 50 were included in the review. The principal determinants of hearing care were identified as age, and type and degree of HL. Individuals with severe to profound bilateral sensorineural HL have access to appropriate treatment at any stage of their lives through publicly funded programs. However, youth and adults with mixed or conductive HL do not have a clear pathway to rehabilitation. Barriers to accessing hearing care services in Chile included lower education and income levels, unemployment, limited awareness of treatment options, insufficient family or social support, and residing in remote areas.

Conclusions: Despite public health advancements in providing HL treatment, gaps persist in certain populations. Reducing these disparities requires improving access to services, expanding hearing screening, and providing hearing technologies across all ages and for all types and degrees of HL.

Free paper 0704

Accessibility and communication in adult hearing rehabilitation: A lived-experience perspective

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Adult hearing rehabilitation is often designed around predictable pathways and single-sensory assumptions, yet many adults experience hearing loss in far more complex ways. Sudden hearing loss, rapid decline, and dual sensory loss create rehabilitation journeys that do not fit standard models of care. This presentation offers a lived-experience perspective on navigating auditory rehabilitation as a deafblind adult, highlighting the mismatch between rehabilitation theory and the realities faced by people with combined sensory loss.

The session examines how accessibility barriers are embedded in the everyday structures of audiology services. Booking systems that rely on phone calls, clinic layouts that depend on visual cues, patient-call systems that are inaccessible to those with low vision or no hearing, and non-existent use of speech-to-text technologies all shape whether rehabilitation is safe and equitable. These barriers are amplified when clinicians lack familiarity with the communication methods used by the communities they support. Despite working closely with D/deaf and hard of hearing adults, few audiologists have proficiency in Auslan, tactile sign, or basic visual communication strategies such as gestures, facial expression, or large-print resources. This gap limits the therapeutic relationship and restricts the patient's ability to participate fully in their own rehabilitation.

Drawing on feedback from the deafblind community, the presentation explores how rehabilitation processes can be redesigned to reflect the lived reality of dual sensory loss – particularly in an ageing population where both hearing and vision commonly decline. It argues for a model of rehabilitation that integrates multiple communication modalities, anticipates access needs from the outset, and positions the patient as an expert in their own communication. Practical strategies for improving clinic accessibility, strengthening clinician communication skills, and embedding inclusive practice into routine care will be shared.

By centring lived experience, this presentation highlights opportunities for clinicians, services, and communities to work together to create accessible, responsive, and personcentred rehabilitation pathways. It invites a re-imagining of adult hearing rehabilitation that recognises the diversity of sensory experience and ensures no one is excluded from the process of reconnecting with sound.

Free paper 0066

Accuracy evaluation of the next generation force-sensing tool for intraoperative insertion force measurement

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Introduction: Insertion forces are considered a valuable indicator for the risk of insertion trauma during cochlear implant surgery. Nevertheless, their measurement has not yet been integrated into standard clinical workflows. To address this gap our group developed the Forception Tool, which enables continuous insertion force measurements. Initial intraoperative evaluation demonstrated the practical applicability of this tool. Recent improvements include advancements in sensor technology and a more compact design. Therefore, we conducted a measurement accuracy evaluation of the updated tool.

Material and methods: For the next-generation Forception Tool, multiple controlled experimental trials were planned to quantify the measurement accuracy. First, static measurements were conducted to examine the drift characteristics of the sensor over a period of 10 minutes. This was followed by a test series of predefined rotational motions to validate the effectiveness of the algorithm removing gravity-related offsets from the force signal during handheld use. In a next step, three participants performed a total of 30 manual insertions in an artificial cochlear model. In these tests the measurements were compared with a gold standard reference sensor placed beneath the model. Additionally, five trials with exaggerated movements were recorded to assess the maximum measurement uncertainty.

Results: The static tests demonstrated high measurement accuracy with the drift remaining below 0.1 mN ± 0.1 mN. Rotational experiments showed that changes in tool orientation could be compensated down to a maximum force deviation of 1 mN. During manual insertions, the data obtained from the tool aligned well with those from the fixed external sensor. Although peak forces ranged up to 56 mN ± 20 mN, the average difference between tool and gold standard was only 0.34 mN ± 0.25 mN. Furthermore, even for exaggerated orientational changes the accuracy remained high with differences below 1 mN.

Conclusions: The results demonstrate that measurements with the updated Forception Tool are highly accurate and robust even when changes in orientation occur during manual use. High precision is essential to ensure high reliability when providing surgeons with intraoperative insertion force feedback. The established accuracy paves the way for the intraoperative use of this improved force-sensitive insertion tool.

Free paper 0249

Achieving a bloodless post-aural field minimal use of cautery

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Introduction: Creating a clear, blood-free surgical area during cochlear implant surgery is essential for achieving precise results, shortening operation time, and reducing unnecessary damage to surrounding tissues. Traditional methods relying on cautery pose significant risks, including thermal injuries to tissues and prolonged operation durations.

Objective: In this study, we introduce a novel non-cautery technique using infiltration-based hemostasis to effectively maintain a clean, bloodless field behind the ear.

Material and methods: We developed a straightforward, highly effective infiltration protocol applied to the postauricular area approximately 10 minutes before cochlear implant incision. This involves precise injection of a vasoconstrictor-containing solution into the surgical site, achieving hemostasis without mechanical or electrical cautery. In a series of cochlear implant surgeries, we systematically evaluated surgical field clarity, procedural efficiency, and tissue trauma markers.

Results: The infiltration-based technique consistently produced a clean, bloodless surgical field in all cases. Compared to traditional cautery methods, it offered key advantages: enhanced visibility of postauricular anatomical structures; reduced overall operation times due to fewer bleeding interruptions; minimal local tissue trauma, evidenced by decreased postoperative swelling and inflammation; and improved precision during critical implant placement.

Clinical significance: This technique marks a major advancement in cochlear implant surgery. By eliminating cautery, it avoids thermal injuries, improves visibility, and shortens operation time. The superior visualization directly enhances surgical accuracy during implantation, a phase requiring precise anatomical detail. Additionally, reduced tissue trauma promotes better patient recovery outcomes.

Conclusions: Our innovative infiltration-based hemostasis technique successfully eliminates cautery use in establishing a bloodless surgical field for cochlear implant surgeries. It enhances visibility, decreases operation duration, limits tissue trauma, and improves implant placement precision. We share our surgical protocol, methodological details, and comprehensive outcome data demonstrating its effectiveness and clinical benefits.

Free paper 0151

Active middle ear implant surgery under local anaesthesia

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Introduction: The Vibrant Soundbridge, manufactured by MED-EL, is an active middle ear implant that provides a direct-drive approach to hearing for individuals with moderate to severe hearing loss who don't benefit from conventional hearing aids. It converts sound signals into mechanical vibrations that stimulate the middle ear, offering more natural sound perception than hearing aids. Surgical insertion involves a postaural incision, cortical mastoidectomy, positioning of the implant body under a pericranial flap, and careful placement of the vibrating mass transducer onto the ossicular chain or round window. This surgery has traditionally been carried out under general anaesthesia.

Material and methods: Utilising surgical and anaesthetic experience from our cochlear implant programme, where an increasing proportion of patients choose local anaesthetic surgery, three patients have now been successfully and uneventfully implanted with Vibrant Soundbridge implants using local anaesthesia and dexmedetomidine sedation.

Results: Three cases will be presented, along with techniques for successful implantation which include surgical approach, operating room setup, anaesthetic perspective, and patient communication and consent. Patient experience and satisfaction will be presented, along with plans for responsible future service development, including routinely offering local anaesthesia with sedation, to improve accessibility to hearing implantation for patients who are not suitable for general anaesthesia, and for patients who prefer not to have general anaesthesia.

Conclusions: Middle ear implant surgery can be safely carried out under local anaesthesia and sedation, and is well tolerated with excellent clinical outcomes, high patient satisfaction and positive patient experience. Keys to success include motivated and well-prepared patients, surgical expertise in local anaesthetic auditory implantation, and anaesthetic experience in sedation techniques. Offering alternatives to general anaesthesia improves accessibility for hearing implant surgery, both for patient frailty (and unsuitability for general anaesthesia) and patient choice.

Free paper 0215

Adherence to auditory rehabilitation and predictors of success in adult cochlear implant users

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Introduction: Cochlear implantation is an effective intervention for adults with severe to profound sensorineural hearing loss; however, substantial variability in post-implant auditory and speech outcomes remains. Beyond surgical and technological factors, adherence to auditory rehabilitation plays a critical role in functional recovery and long-term performance. In adult cochlear implant users, rehabilitation adherence may be influenced by individual, social, and clinical factors.

Objective: This study aimed to identify factors predictors of successful to optimize rehabilitation after cochlear implant surgery.

Material and methods: An retrospective study was conducted including adult cochlear implant users followed at a cochlear implant reference center. Adherence to auditory rehabilitation was assessed through attendance at auditory and speech therapy sessions, consistency of device use, and engagement in structured auditory training. Auditory and speech outcomes were evaluated using standardized speech perception tests in quiet and noise at 12 months after cochlear implant activation. Multivariate statistical analyses were performed to assess the association between rehabilitation adherence and post-implant outcomes and to identify predictors of successful auditory performance.

Results: Adults with high adherence to auditory rehabilitation demonstrated significantly better speech perception scores compared to those with lower adherence. Regular therapy attendance and consistent daily device use were associated with faster improvement in auditory performance. Multivariate analysis identified adherence to rehabilitation, shorter duration of auditory deprivation, and younger age at implantation as significant predictors of successful outcomes, independent of baseline audiological measures.

Conclusions: Adherence to auditory rehabilitation is a key determinant of successful cochlear implant outcomes in adults. These findings emphasize the importance of individualized and structured rehabilitation programs, as well as early identification of patients at risk for poor adherence, in order to enhance auditory performance and overall clinical outcomes in adult cochlear implant users.

Free paper 0357

Adhesive CI processor attachment as an alternative for patients with special skin conditions

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Introduction: The magnetic attraction between the cochlea implant (CI) and the external processor ensures optimal alignment of sender and receiver coil. This enables consistent inductive transmission but requires a non-irritated skin of appropriate thickness. Skin health in the sensitive area between the cochlea implant and the processor thus plays a crucial role in long-term wearing comfort, functional reliability, and quality of life for CI patients. Skin dehiscence due to numerous previous interventions or due to age-related atrophy can cause problems when wearing the CI processor and might be further aggravated by the compression of the skin due to the magnetic attraction. Excessive thick skin flaps (even if only temporary) may lead to poor attachment of the processor above the implant. In these cases, an adhesive attachment of the processor above the implant represents a promising alternative to avoid limitations of the active CI use.

Objective: The aim of this study was to compare two different adhesive wearing options under laboratory conditions on porcine skin to test their functionality. The coupling between processor and implant as well as the maximum processor runtime are evaluated for each type of attachment.

Material and methods: Two different types of adhesive processor mounts are tested in comparison to the standard magnetic attachment: a magnet integrated into an adhesive foil as well as an ADHEAR adapter for which a special counterpart as inlay for the magnet recess of the MED-EL RONDO processor was developed. Porcine skin samples of different thicknesses corresponding to human skin were used for testing. Processor runtime is measured in different conditions using typical CI fitting maps and broadband noise in an anechoic chamber.

Results: First results regarding processor runtime and coupling quality show that adhesive coupling of the CI processor offers a good alternative for special medical cases where wearing a processor would otherwise be difficult or impossible.

Conclusions: To prevent further irritation in cases of skin dehiscence or the risk of losing the processor if the skin flaps are too thick, adhesive processor attachments may be a useful alternative.

Free paper 0149

Advanced surgical management of Ménière's disease: A case-informed perspective on healthy ageing and access to care

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Introduction: Hearing and vestibular disorders represent a major and growing public health challenge, with over 1.5 billion people globally living with hearing loss. Vestibular conditions such as Ménière's disease are associated with recurrent vertigo, hearing impairment, increased fall risk, cognitive decline, and loss of independence, particularly in older adults. The World Health Organization's Resolution WHA78.7 on integrated people-centred hearing care emphasises the need for lifecourse approaches that address both hearing and balance disorders within healthy ageing frameworks.

Aim: This abstract aims to illustrate how advanced otoneurosurgical intervention for refractory Ménière's disease can support functional recovery and healthy ageing when aligned with WHO-recommended integrated hearing care.

Material and methods: A case-informed narrative approach is used, integrating a patient experience with analysis of established surgical techniques for Ménière's disease reported in the literature, alongside international policy and health-systems evidence relevant to access and referral pathways.

Results: In an older adult with medically refractory Ménière's disease, advanced vestibular surgery resulted in marked reduction of vertigo, improved vestibular stability, and restoration of functional independence. Published evidence demonstrates that contemporary microsurgical approaches, including modified endolymphatic shunt and vestibular nerve procedures in selected patients, can achieve durable symptom control with acceptable risk profiles. Despite this, access to specialised vestibular surgery remains variable and is often delayed due to fragmented referral pathways, limited awareness of surgical options, and age-related bias.

Implications: Case-informed analysis highlights the importance of timely referral to specialist centres and integration of vestibular care within broader hearing health strategies. Aligning access to advanced surgical interventions with WHO healthy ageing principles may reduce fall-related morbidity, preserve independence, and mitigate downstream health and social care costs.

Conclusions: Advanced surgical management of Ménière's disease, when appropriately indicated, can play a meaningful role in supporting healthy ageing. Health systems should strengthen referral pathways and policy frameworks to ensure equitable access to specialised vestibular care for older adults.

Free paper 0678

Advancing cochlear implant follow-up through tele-remote programming: A multi-center Indian evaluation of accessibility, clinical outcomes, and user experience in India

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Introduction: Sustained post-implant care is essential for optimal cochlear implant (CI) outcomes; however, access to regular programming remains uneven in India due to a limited audiologist workforce and significant geographic and travel-related barriers. Tele-audiology solutions, particularly remote programming platforms, offer the potential to decentralize care while preserving clinical quality. With increasing smartphone penetration and reliable mobile data networks, app-based remote support systems may provide a scalable and patient-centered model for CI follow-up.

Objective: This multi-center Indian study assessed the clinical effectiveness, feasibility, and user acceptance of a smartphone-based remote programming system using Bluetooth connectivity and the AB Remote Support app in CI recipients.

Material and methods: Thirty CI users aged ≥13 years with at least six months of device experience were enrolled in a two-phase design. Phase 1 compared traditional in-person programming with in-clinic remote programming. Phase 2 evaluated remote programming conducted from non-clinical environments such as homes or workplaces. Outcome measures included speech perception scores, environmental parameters (ambient noise and internet connectivity), and structured feedback from participants and audiologists.

Results: Preliminary analysis of 16 participants demonstrated comparable speech perception outcomes between in-person (88.34%) and remote sessions (92.14%) ($p = 0.64$). Phonetically balanced word testing was successfully administered via monitored live voice with visual cues (92.36%) and audio-only conditions (78.14%). Ambient noise levels during remote sessions ranged from 44.1 to 59.2 dB, with mobile data speeds up to 250 Mbps, supporting stable connectivity. Participants reported travel distances of 17–467 km (1.1–8.5 hours) for conventional appointments. Remote programming substantially reduced travel burden, minimized missed visits, and was perceived as user-friendly with minimal technical assistance. Audiologists retained full programming control and reported enhanced workflow efficiency without compromising care quality.

Conclusions: Smartphone-enabled remote programming represents an effective and acceptable alternative to conventional CI follow-up. By reducing logistical barriers while maintaining clinical rigor, it offers a sustainable and scalable strategy

to strengthen post-implant care delivery in resource-constrained settings.

Free paper 0347

Aftercare and auditory therapy in the CI rehabilitation process

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The high number of cochlear implantations performed each year has clearly demonstrated that comprehensive aftercare, particularly structured auditory training, is an essential component of patient care. This auditory training program for adults developed by our team is intended to serve as the foundation for a clinical study designed to demonstrate that consistent and systematic hearing training leads to a significant improvement in patients' communication abilities as well as their overall quality of life.

Patients are informed about the importance and structure of the auditory training program during the preoperative phase and are prepared accordingly. Auditory training (10 units à 45 minutes) begins following the one-month postoperative follow-up appointment and is conducted at two-week intervals until the final hearing assessment, which takes place as part of the six-month follow-up. Standardized hearing evaluations are scheduled at one month, three months, and six months after implantation. The overall developmental and observation period for implanted patients extends over a total of 12 months and includes regular fitting and adjustment sessions to ensure optimal device performance. Each training session provides an opportunity to address technical questions, review device handling, and clarify any uncertainties that may arise during daily use.

The content of the training program is based on established milestones of auditory development. Patients follow a structured, step-by-step progression from syllable-level to word- and sentence-level perception. The training focuses on prosody, discrimination and differentiation of various sound qualities, and the development of directional hearing. These components form the basis for confident, effective, and natural communication in everyday situations. In addition, strategies and practical solutions for challenging listening and conversational environments are developed to reduce listening effort, stress, and cognitive load. This approach aims to minimize frustration and demotivation and to support long-term therapy adherence. Complementary music therapy is provided throughout the program to further enhance auditory perception and patient engagement.

Free paper 0536

Age- and sex-specific genetic risk factors in sensorineural hearing loss: Genome-wide evidence from large-scale biobank studies

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Introduction: Sensorineural hearing loss (SNHL) can be inherited or acquired, syndromic or non-syndromic. There are only a few age-stratified genome-wide association studies (GWASs) available despite the high prevalence of SNHL in the aging population.

Aim: To investigate the genetic components of SNHL by performing genome-wide meta-analyses using the data from the FinnGen and the Estonian Biobank.

Material and methods: GWAS approach was performed on cases with SNHL in the general population stratified to sex- and age-of-onset subgroups. The study-specific GWASs were combined through inverse variance-weighted genome-wide meta-analyses, encompassing a total of 531,059 individuals (N_{cases} = 35,960). Age-stratified meta-analyses included 28,198 individuals diagnosed at the age of 55 years or later, and 7,762 individuals diagnosed before the age of 55 years, with 495,099 controls. Sex-stratified meta-analyses included 313,501 females (N_{cases} = 17,761) and 217,558 males (N_{cases} = 18,199).

Results: In the meta-analysis focusing on the general population, we observed 32 loci associated with SNHL. Thirteen out of these have not been previously reported to be linked to hearing impairment. Age-group and sex-specific analyses suggested that several loci are associated with SNHL in those individuals diagnosed after the age of 55 years (N_{loci} = 20) and in females (N_{loci} = 15) compared with only a few associations observed in those diagnosed before the age of 55 years (N_{loci} = 3) and in males (N_{loci} = 4).

Conclusions: The present results provide additional insight into the genetic basis of SNHL by identifying a spectrum of effects on disease onset and sex. Downstream analyses of

the implicated pathways will help to elucidate the pathogenetic mechanisms.

Free paper 0523

AI-driven decision support system in audiological diagnostics: Automating ABR and PTA analysis

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Introduction: Hearing loss is a critical global health challenge, with the World Health Organization estimating that over 1.5 billion people currently live with hearing impairment. Projections suggest this will rise to 2.5 billion by 2050. Timely and accurate diagnosis is vital for effective rehabilitation. While methods like Auditory Brainstem Responses (ABR) and Pure-Tone Audiometry (PTA) are clinical standards, their interpretation is often time-consuming and highly dependent on the specialist's experience, leading to potential variability in care access and quality.

Material and methods: Within a project funded by the European Funds for a Modern Economy (FENG 2021–2027), two complementary artificial intelligence (AI)-based systems were developed. The first system utilizes advanced machine learning and deep learning techniques for the automated analysis of ABR recordings, trained on a large dataset from the Center of Hearing and Speech in Kajetany. The second system evaluates pure-tone audiometry results using a combination of expert-defined clinical decision rules and AI-driven algorithms. Both systems were validated against independent datasets and compared with expert audiological assessments.

Results: Preliminary findings indicate that the AI system for ABR analysis achieves detection accuracy comparable to experienced audiologists while significantly reducing the time required for signal interpretation. The audiometry-based support system successfully identifies the presence, type, and degree of hearing loss. Furthermore, it provides evidence-based recommendations for further management, such as hearing aid fitting or surgical referral. In both applications, AI-supported analysis accelerates clinical workflows and enhances decision-making efficiency.

Conclusions: The integration of AI-based tools into audiology promotes standardization, objectivity, and efficiency in both objective and subjective hearing assessments. These systems reduce inter-observer variability and provide valuable support for less experienced clinicians, potentially expanding high-quality diagnostics to underserved regions. While final clinical responsibility remains with the professional, these decision-support tools have the potential to significantly improve the accessibility and timeliness of hearing healthcare globally.

Free paper 0643

Air along the enlarged vestibular aqueduct after cochlear implantation in incomplete partition type II: The reverse-pathway sign

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Introduction: Incomplete partition type II (IP-II), also known as classic Mondini malformation, is associated with an enlarged vestibular aqueduct and carries well-recognized surgical risks during cochlear implantation, including perilymphatic gusher and electrode insertion resistance. Despite these intraoperative findings, the postoperative radiological correlates of endolymphatic pressure transmission through the vestibular aqueduct remain poorly characterized. This report describes a novel computed tomography (CT) finding of air tracking along the enlarged vestibular aqueduct following cochlear implantation in two patients with IP-II, and discusses its pathophysiological plausibility through a pressure transmission model.

Material and methods: Clinical review of intraoperative findings and postoperative CT imaging in two patients with progressive sensorineural hearing loss and radiological diagnosis of incomplete partition type II who underwent cochlear implantation.

Results: Both patients were implanted with the MED-EL FORM 24 electrode array. Intraoperatively, perilymphatic oozing and resistance to electrode advancement were observed in both cases. Postoperative CT demonstrated pneumolabyrinth with air in the vestibule and continuous extension throughout the entire course of the enlarged vestibular aqueduct on the implanted side. In Case 2, this finding was absent on the contralateral side, where electrode insertion had been uneventful, providing an internal radiological control supporting the mechanistic interpretation.

Conclusions: The proposed "reverse-pathway sign" – defined as postoperative air tracking along the endolymphatic pathway from the cochlear implant entry point through the vestibule and into the enlarged vestibular aqueduct – may represent an inverse radiological verification of a functional endolymphatic/vestibular aqueduct communication associated with pressure transmission in IP-II. This CT finding offers a direct imaging correlate for a pathophysiological mechanism that has traditionally been inferred from indirect intraoperative signs, and may contribute to the preoperative counselling and surgical planning of patients with this malformation.

Free paper 0418

Analysis of access and polarisation impedance components in MED-EL cochlear implants in the postoperative period

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Introduction: Electrode impedance measurements are routinely used in cochlear implants to monitor device functionality and the electrode–tissue interface. In MED-EL systems, total impedance reflects both cochlear fluid conductivity and electrode surface phenomena. Biophysically, impedance can be separated into access impedance and polarisation impedance, which may provide improved insight into postoperative cochlear changes such as healing and fibrosis.

Objective: The main objective of this thesis is to analyse changes in the electrical impedance components of cochlear implant electrodes (access impedance and polarisation impedance) in MED-EL cochlear implants during the postoperative period, and to evaluate their potential as indicators of the condition of the electrode-tissue interface.

Material and methods: The study included 18 adult MED-EL cochlear implant users (mean age: 52 years; 12 females, 6 males), including 12 right-ear and 6 left-ear implantations. The implanted devices were SONATA ($n = 11$) and SYNCHRONY 2 ($n = 7$). Electrode impedance components were measured using MED-EL research software at four time points: intraoperatively, and 3 days, 1 month, and 5 months postoperatively, enabling assessment of postoperative impedance changes over time.

Results: Both impedance components changed over time following implantation. Access impedance increased shortly after surgery and then stabilised, whereas polarisation impedance showed a larger and more sustained increase during the early postoperative period, with values plateauing by 5 months. Higher impedance values were observed in basal electrodes compared to apical electrodes.

Conclusions: The different temporal patterns of access and polarisation impedance suggest that they reflect distinct biophysical processes at the electrode–tissue interface. Polarisation impedance appears to be more sensitive to postoperative cochlear changes, such as healing and tissue response, and may therefore provide additional clinically relevant information beyond total impedance measurements.

Free paper 0549

Analysis of cochlear duct length based on computed tomography images of temporal bones in patients of the Institute of Physiology and Pathology of Hearing in Warsaw/Kajetany, Poland

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Introduction: The literature includes studies on cochlear measurements in the general population from several countries. However, an analysis of these publications indicates that it is difficult to determine whether cochlear dimensions depend on ethnic factors due to methodological differences. Furthermore, there are no published results regarding the Polish population.

Objective: The aim of this study was to analyze cochlear length in the Polish population and establish normative values that take sex-related differences into account.

Material and methods: The study included 1,056 cochleae with normal anatomy, obtained from 528 patients at the Institute of Physiology and Pathology of Hearing in Kajetany. The group comprised 517 female ears and 539 male ears. An experienced radiologist performed measurements using computed tomography images of the temporal bones with the aid of OTOPLAN software.

Results: The mean cochlear length in the total population was 35.51 mm (SD = 1.75; range 27.1–41.2 mm). Although the distribution was approximately normal, statistical testing revealed significant deviations ($p < 0.001$). Female cochleae were significantly shorter than male cochleae ($M = 34.96$ mm; SD = 1.61 vs $M = 36.00$ mm; SD = 1.73; $p < 0.001$). The sex-specific tercile boundaries were as follows: for females, ≤34.4 mm (short), 34.5–35.4 mm (average) and ≥35.5 mm (long); and for males, ≤35.4 mm, 35.5–36.7 mm and ≥36.8 mm.

Conclusions: This study provides the first normative data on cochlear length in the Polish population. These results can serve as a reference for comparative international comparisons and support clinical decision-making in cochlear implant electrode selection and surgical planning.

Free paper 0395

Anatomic based cochlear implantation with the FLEX34 electrode: Maximizing cochlear coverage and speech understanding

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Objective: This study aimed to assess the feasibility, precision, and clinical relevance of anatomy-based planning and postoperative validation of FLEX34 electrode insertions using high-resolution imaging, with a focus on cochlear coverage and insertion accuracy.

Material and methods: Between November 2023 and December 2025, 36 adult patients underwent cochlear implantation with the FLEX34 electrode. All insertions were performed via the round window. Preoperative imaging-based planning included manual cochlear duct length (CDL) measurements using OTOPLAN software and virtual electrode insertion depth planning. Imaging modalities comprised flat panel volume CT until 2024 and photon-counting CT thereafter. Postoperative imaging was performed using the same modality to localize electrode contacts. Quantitative analyses compared planned versus actual contact positions, cochlear angles, and achieved cochlear coverage. Measured contact positions were integrated into anatomy-based fitting strategies.

Results: The cohort had a median age of 66.2 years (range 28.1–80.4). Imaging-based planning demonstrated CDL at the Organ of Corti (CDLOC) of 38.1 mm, planned apical contact positions of 656.95° simulating the FLEX34 electrode and postoperative cochlear coverage of 699.7°. Postoperative audiometric outcomes showed favourable speech discrimination results. No major insertion-related complications were observed, supporting the atraumatic nature of the technique.

Conclusions: Anatomy-based planning combined with high-resolution postoperative imaging enables precise and reproducible deep insertion of the FLEX34 electrode, resulting in consistently high cochlear coverage. In appropriately selected anatomies, the FLEX34 represents a reliable and clinically feasible standard option rather than a special-case solution. Its routine use may contribute to optimized cochlear engagement and improved functional outcomes.

Free paper 0689

Anatomical aspects of the double myofascial flap for cochlear implant extrusions

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Introduction: The acquisition of cochlear implants in developing countries presents a challenge in daily practice. This situation is exacerbated when the patient experiences a skin complication known as device extrusion. In many cases, the implant must be removed, and the patient remains hearing impaired due to the difficulty in obtaining a replacement implant. Anatomical knowledge of the skull and its fascia and aponeuroses provide the surgeon with an invaluable resource for attempting to cover the exposed and contaminated implant, thus avoiding its removal. Among the available musculoaponeurotic tissues the temporoparietal fascia, the fascia of the temporalis muscle, the temporalis muscle itself, and the pericranium are found. Some or all of these can be used to attempt to reconstruct the skin defect.

Material and methods: Five human heads preserved in 10% formalin were used for structural identification and photography. A double myofascial flap was also performed using the temporoparietal fascia and temporalis muscle with its aponeuroses in three patients with extrusion of the cochlear implant. This study was conducted jointly by the Instituto Superior of Otolaryngology and the University of Salvador, Buenos Aires, Argentina.

Results: Skin wound closure was achieved in all three patients with complete preservation of the cochlear implant, combined with meticulous irrigation using chlorhexidine, povidone-iodine, saline solution, and bleach. For this procedure, a hemicoronal incision was made on the same side as the extrusion. The temporoparietal fascia, dependent on the galea aponeurotica, was detached from the subcutaneous tissue. Subsequently, the temporalis fascia was dissected from the temporalis muscle, and the muscle was rotated to cover the device. The incision was successfully closed in layers. On the other hand, at the Department of Human Anatomy of the University of Salvador, five formalin-preserved heads were obtained, and various dissections of the aponeuroses were performed for photographic documentation.

Conclusions: In developing countries, obtaining a cochlear implant is a significant challenge in itself. Similarly, obtaining a replacement device is a much more complex task. The surgical technique, as well as the anatomical basis, are presented in this article to demonstrate an effective technique for preserving extruded cochlear implants.

Free paper 0557

Anatomy-based fitting using OTOPLAN-software for preoperative predictions of electrode insertion angles

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Objectives: Preoperative planning of cochlear implant (CI) electrode insertion depth has become increasingly important in context of anatomy-based and tonotopy-oriented fitting strategies. OTOPLAN® enables three-dimensional cochlear reconstruction and contact-specific prediction of insertion angles based on preoperative CT imaging. However, the accuracy of these predictions at the individual contact level and their robustness against influential observations remain insufficiently validated.

Objective: The objective of this study was to quantify the agreement between preoperatively predicted and postoperatively measured electrode insertion angles to evaluate the stability of the results using influence diagnostics.

Material and methods: In this retrospective cohort study, adult CI recipients implanted with a MED-EL FLEX 28 electrode were included if high-quality pre- and postoperative CT datasets were available. For each patient and electrode contact, preoperative insertion angles predicted by OTOPLAN® were compared with postoperatively reconstructed angles. Agreement was assessed using contact-level error metrics, Bland–Altman analysis, and linear mixed-effects modeling with random intercepts for patient identity. Cook's distance was used to identify influential observations, and a sensitivity analysis was performed by refitting the model after exclusion of these observations.

Results: Across the cohort, preoperative OTOPLAN® predictions showed close correspondence with postoperatively measured insertion angles at contact level. The overall bias between predicted and measured angles was small, with moderate dispersion reflected in the limits of agreement. Error distributions were largely symmetric, patient-level mean absolute errors were low for the majority of subjects. Mixed-effects model demonstrated only weak systematic dependence of prediction error on contact position along the electrode array. Cook's distance identified a small number of influential contact-level observations, predominantly clustered within individual patients. Sensitivity analyses showed that exclusion of these observations did not materially change fixed-effect estimates, model fit, or global error metrics, indicating high robustness of the primary findings.

Conclusions: OTOPLAN® provides accurate and robust preoperative predictions of electrode insertion angles for FLEX28 cochlear implant electrodes. Deviations between predicted and achieved insertion angles are generally small and not driven by a limited subset of influential observations. These findings support the clinical reliability of OTOPLAN-based planning as a foundation for anatomy-based electrode selection and tonotopy-oriented CI fitting strategies.

Free paper 0630

Angular insertion depth of CI electrode influences hearing outcomes

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Introduction: Cochlear implant (CI) concerns provided electrical stimulation inside the cochlea activating neruonal elements. CI outcomes depend on several factors including patient, surgical and device related.

Objective: Does electrode angular insertion depth influences hearing outcomes with CI?

Material and methods: Literature review collecting articles published on electrode insertion depth and hearing outcomes with CI following PRIMA technique.

Results: 29 published articles reporting on electrode insertion depth and hearing outcomes with CI. Out of 29 articles, 21 articles reported postive relation between insertion depth and hearing outcomes. Insertion depth >540° significantly provides higher hearing outcomes compared to insertion depth <540°.

Conclusions: Electrode insertion depth certainly plays a bigger role influencing hearing outcomes with CI.

Free paper 0400

App-based self-assessment of OLSA in cochlear implant recipients: Reliability and agreement with soundbooth standard of care

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Aim: The Matrix Sentence Test (MST) is a widely accepted clinical tool for assessing speech perception; however, its dependence on calibrated sound booths restricts testing frequency and limits ecological validity. To address these constraints and enable remote assessment, the MST was implemented within the Cochlear™ Mobile Research App (MRA), allowing cochlear implant (CI) recipients to self-administer the test on personal smartphones via direct Bluetooth audio streaming. The mobile MRAMST incorporates calibrated stimulus delivery, automated scoring, and secure data transmission. The present study aimed to evaluate whether MRAMST testing provides test-retest reliability and performance outcomes comparable to standard of care (SOC) audiologist administered assessments conducted in a controlled sound booth.

Material and methods: A repeated-measures design was used with 10 experienced adult CI recipients from a single study site at Hannover Medical School (MHH). In a

counterbalanced protocol, participants completed unilateral MST testing under two conditions: (1) the closed set mobile MRAMST (German OLSA version, full choice set) and (2) the SOC condition (audiologist led, open-set sound field OLSA). Speech reception thresholds (SRTs) were derived using identical adaptive procedures across both conditions.

Results: Initial findings indicate that MRA-based MST testing exhibited strong test–retest reliability ($r = 0.76$, $p < 0.05$). This was comparable to SOC reliability ($r = 0.86$, $p < 0.01$) and broadly consistent with published booth-based OLSA data. MRA and SOC SRT scores were strongly associated ($r = 0.92$, $p < 0.001$) and showed close agreement, with SOC scores being on average 3.26 dB SNR higher than MRA (95% CI: 2.63–3.89 dB SNR). Participants also reported high usability and low test-burden, supporting the feasibility of routine, unsupervised at home assessments.

Conclusions: These results demonstrate that a self-administered, smartphonebased MST delivered via direct streaming to CI sound processors can yield reliable speechinnoise measurements comparable to traditional clinical methods. This approach provides a scalable pathway toward more flexible, patientcentred auditory monitoring.

Free paper 0268

Application of the CROS system in cochlear implant users

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Introduction: Unilateral cochlear implantation in individuals with bilateral deafness typically provides substantial auditory benefits; however, users often continue to experience difficulties, particularly in complex acoustic environments. The use of a contralateral routing of signal (CROS) system, which transmits sound from the non-implanted side to the side with the speech processor, may help reduce these limitations and improve auditory performance in challenging listening conditions. The aim of this study was to evaluate the benefits of CROS system use in cochlear implant users.

Material and methods: The study group consisted of 15 cochlear implant users with severe-to-profound hearing loss in the contralateral ear. The mean age at the time of assessment was 66.2 years (SD = 10.6). All participants had used their cochlear implant for more than 9 months. To assess binaural benefits – including summation, squelch, and head shadow effects – speech-in-noise audiometry was conducted under three listening conditions with the CROS system switched on and off.

Results: The results demonstrated significant improvements in speech discrimination with the CROS system activated compared to the CROS-off condition in selected listening scenarios.

Conclusions: The CROS system may offer auditory benefits to cochlear implant recipients for whom bilateral implantation is not feasible. It is essential to appropriately inform potential users about the listening conditions in which the CROS system provides benefits.

Free paper 0009

Assessing dynamic instability in bilateral vestibulopathy patients during daily living tasks using inertial measurement units

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Monitoring the functional status of patients with bilateral vestibulopathy (BV) or unilateral vestibulopathy (UV) in an ecological environment remains a challenge, as current tests are performed in specialized laboratories and do not reflect patients' limitations and symptoms. This study aimed to evaluate the overall movement pattern of patients using inertial measurement units (IMU) in a semi-standardized environment that replicated daily-life situations.

Nineteen BV patients, 20 UV patients, and 20 healthy subjects were recruited to perform 15 ecologically valid tasks. Intensity, smoothness, and stabilization parameters were calculated from IMU data. The analysis included the selection of relevant tasks, based on task time and perceived difficulty, before performing a principal component analysis on all parameters calculated.

The variables that contributed most to the variance of the dataset were then examined to assess their ability to discriminate between groups. Tasks involving limited compensatory sensory inputs (put on pants, walking on uneven ground, on inclined plane, in the dark, on a wood beam, or with head turns) with IMUs placed on the feet proved to be the most discriminating. BV and UV patients exhibited reduced movement intensity compared to healthy subjects, that can reflect different compensatory stabilisation strategies.

This study demonstrated the feasibility of objective functional status assessment using IMUs and provided a basis for the development of rapid clinical protocols to assess outcomes for rehabilitation therapies.

Free paper 0715

Assessing music-related quality of life in Hebrew-speaking cochlear implant users: Clinical implications of the MuRQoL-He

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Introduction: Clinical outcome evaluation in cochlear implant (CI) users primarily focuses on speech perception measures. However, music listening constitutes a distinct auditory domain that contributes to emotional well-being, social engagement, and overall listening satisfaction. Despite its clinical relevance, music-related quality of life is not routinely assessed in standard follow-up protocols. The Hebrew adaptation of the Music-Related Quality of Life questionnaire (MuRQoL-He) provides a culturally and linguistically appropriate patient-reported outcome measure for Hebrew-speaking adults.

Objective: To outline the clinical rationale for assessing music-related quality of life in CI users and to describe the potential role of the MuRQoL-He in audiological evaluation and rehabilitation planning.

Material and methods: The MuRQoL was translated and culturally adapted into Hebrew in accordance with established cross-cultural adaptation guidelines. A psychometric evaluation of adult CI users demonstrated satisfactory internal consistency and construct validity. In parallel, clinical application scenarios were examined to explore how structured assessment of music-related experiences may inform counseling and individualized rehabilitation strategies.

Results: The MuRQoL-He enables systematic identification of inter-individual variability in music engagement, emotional response to music, and perceived listening challenges. These dimensions are not routinely captured by conventional speech perception testing. Incorporating music-related patient-reported outcomes into follow-up discussions may support alignment of expectations, guide music-focused auditory training, and enhance shared clinical decision-making.

Conclusions: Assessment of music-related quality of life represents a complementary dimension of outcome evaluation in cochlear implantation. The MuRQoL-He offers a structured and clinically feasible approach to integrating musical experiences into rehabilitation discourse.

Clinical Implication: Systematic evaluation of music-related quality of life may refine outcome monitoring and broaden the scope of patient-centered cochlear implant care.

Free paper 0144

Assessing quality of life in Arabic-speaking children with cochlear implants

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The outcome of cochlear implantation is typically assessed by measuring hearing thresholds in the aided condition and by evaluating functional hearing for communication using speech tests.

In addition to objective measures, postoperative performance can be assessed using subjective self-rating questionnaires. Assessing quality of life helps recognize the effects of healthcare intervention on patients' lives. Although assessing the quality of life of children with cochlear implants is highly recommended, only the KINDL-R, the Pediatric Quality of Life Inventory, and the Glasgow Children's Benefit Inventory questionnaires have been translated into Arabic.

However, all of these questionnaires are generic health questionnaires, and the effect of cochlear implantation on quality of life may be underestimated. This highlights the need for an Arabic version of a specific-disease quality of life measure that focuses on hearing. A specific-disease quality of life questionnaire, named the Speech, Spatial, and Qualities of Hearing Scale for Parents (SSQ-P), has been translated into Arabic by the researchers of this study. The parents completed the SSQ-P questionnaire after giving them a "pre-scale observation period," which is a period of days/weeks in which the parent observes specified aspects of the child's performance in everyday listening situations. The findings of this study and the efficacy of the Arabic version of the SSQ-P in assessing hearing function in everyday listening situations among Arabic-speaking cochlear implant children in Saudi Arabia will be discussed.

Free paper 0365

Assessing real-world listening experiences in adult CI users using an ecological momentary assessment mobile app

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Introduction: Real-world listening for cochlear implant (CI) recipients is shaped by rapidly changing acoustic environments, social context, and individual factors that are not fully captured in controlled clinical assessments. Our Ecological Momentary Assessment (EMA) framework

uniquely integrates self-reports, contextual information, device logs, speech outcomes (speech in noise (CVC/ Digit Triplet Test) and concurrent audio recordings within a single tool (Mobile Research App), providing a synchronized snapshot of system behaviour in real-world listening situations. Using this multimodal EMA approach, this study characterized daily listening experiences, identified environments associated with increased difficulty, and examined predictors of listening satisfaction among experienced adult CI users.

Material and methods: Participants completed scheduled daily EMA surveys as well as event triggered surveys in daily and self-perceived challenging situations over an eight-week home monitoring period. Each EMA entry captured: listening satisfaction, perceived environment, subjective sound quality, loudness, listening effort and a concurrent audio recording along with device logs. Statistical analyses included descriptive summaries, ANOVA, linear regression, correlation analyses, and predictive modelling using generalized linear models and neural networks.

Results: In total, 2,972 EMA surveys were collected from 48 CI recipients, accompanied by 56 hours of audio recordings. Listening satisfaction was acceptable in 94% of daily contexts but lower in challenging situations (82%), with noise reported as the most common difficulty, followed by loudness, echo, wind, and competing talkers. These self-reported challenges were supported by concurrent device logs and audio characteristics, which confirmed elevated noise levels and acoustically complex conditions in these situations. Predictive modelling of perceived satisfaction showed that demographic, device programming, behavioural and audio features individually explained limited variance, however, a combined multimodal neural network achieved the best performance, indicating complex interactions among predictors.

Conclusions: EMA provided detailed, ecologically valid insights into real-world listening experiences of CI users. Pronounced variability even in similar or low-noise situations highlights the need for improved characterization of acoustic environments, as well as more effective personalization of sound processing strategies. The success of integrated multimodal modelling underscores the multifactorial nature of real-world listening satisfaction and highlights the value of EMA data for future CI feature development, personalization frameworks, and context-aware sound processing.

Free paper 0353

Assessing the impact of stimulation parameters on voltage matrices and vestibular co-stimulation in cochlear implant users

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Introduction: Cochlear implants (CIs) can stimulate not only auditory but also vestibular neural structures can be co-stimulated, eliciting cervical and ocular vestibular evoked myogenic potentials (e-cVEMP, e-oVEMP).

Objective: This study aimed to investigate differences in voltage distributions and field spread between CI users with and without detectable e-VEMP responses, and to examine how voltage matrices depend on stimulation parameters such as charge and pulse width.

Material and methods: Seventeen CI users (18 ears; MED-EL SYNCHRONY) underwent e-VEMP recordings after stimulation at different electrodes. Voltage matrices were corrected for either the e-VEMP threshold or the upper comfortable level. Individual electrode voltage profiles were analyzed. In a separate group of four CI users, the dependency of voltage matrices on stimulation amplitude (1.9–23 qu) and pulse width (fixed at 50.83 μs) was systematically assessed using eIFT mode, with a focus on the effects of stimulation parameters and the calculation of correction factors.

Results: Changes in stimulus charge led to substantial alterations in the voltage matrix. Electrode-specific but not universal correction factors could be determined. This enabled the estimation of the electrical field under various stimulation conditions. For e-oVEMP, significant differences in voltage distribution were observed at specific intracochlear electrodes between groups with and without detectable responses, while e-cVEMP voltages showed minimal group differences. Individual analyses revealed irregular voltage patterns, suggesting anatomical variability such as differences in cochlear bone density and electrode positioning.

Conclusions: The study highlights the significance of individualized analysis in interpreting CI-induced vestibular activation. The implementation of electrode-specific correction factors makes it feasible to estimate electrical field distribution at arbitrary stimulation levels, even without access to eIFT measurements, supporting more flexible and accurate scientific investigations into CI-field effects and their clinical relevance.

Free paper 0659

Assessment of binaural performance in digisonic cochlear implant users

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Introduction: Understanding speech in noisy environments and accurately localizing sounds remain major challenges for cochlear implant (CI) users. Bilateral implantation provides access to binaural cues that may enhance auditory performance and spatial hearing. The Digisonic device is a unique system designed to support bilateral cochlear implantation, allowing the patient to stimulate both ears using a single receiver–stimulator and one sound processor. The aim of this study is to investigate the potential binaural advantages in adult patients using the binaural Digisonic device.

Material and methods: A group of binaural Digisonic CI users underwent a comprehensive audiological assessment, including standardized speech-in-noise testing and subjective

evaluation of listening effort and spatial hearing using the SSQ12 questionnaire. Their results were compared with those of unilateral CI users. All tests were conducted in a sound field under both bilateral and unilateral listening conditions.

Results: Preliminary findings suggest improved speech understanding in noise and better sound localization among binaural Digisonic device users, reflecting the benefits of binaural summation and spatial release from masking. The degree of improvement varies across subjects and appears to be related to individual auditory experience.

Conclusions: Preliminary data support the functional benefits of the binaural Digisonic device for speech perception in noise and sound localization. Further analyses are needed to define the specific contribution of binaural processing mechanisms and their clinical implications for this type of cochlear implant system.

Free paper 0065

Assessment of cochlear health and chronic stimulation using a dexamethasone-eluting electrode in a minipig model

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Introduction: The cochlear implant field lacks a simple, reliable biomarker for cochlear health, akin to blood pressure in cardiovascular medicine. Recent advances in dexamethasone-eluting electrodes – associated with reduced impedances and improved outcomes – prompt investigation into whether impedance can serve as such a biomarker.

Objective: This study aimed to establish a long-term minipig cochlear implantation model to evaluate chronic electrical stimulation and cochlear health up to six months.

Material and methods: CI632 perimodiolar arrays (Cochlear Ltd, Sydney) were implanted via an extended round window approach, with receiver/stimulator placement on minipigs' skull. Electrode position was confirmed postoperatively using Trans Impedance Matrix and cone beam CT. Animals underwent daily two-hour electrical stimulation in fabric slings. Assessments included: (1) Electrophysiological measurements via sound processor and coil; (2) Cone beam CT and auditory brainstem responses; (3) Post-mortem cochlear analysis using micro-CT; (4) Thin Sheet Laser Imaging Microscopy (TSLIM) with immunohistochemical staining for: hair cells and neurons, inflammatory markers, and fibrotic tissue.

Results: Minipigs were successfully implanted, with two cohorts ($n = 10$ and $n = 12$) stimulated and monitored for six and four months respectively. Electrophysiological assessments included: (i) Simple and complex impedance measures; (ii) AutoNRT; (iii) Auditory brainstem responses.

Post-mortem immunohistological imaging enabled correlation of electrophysiological data with cochlear health indicators, comparing dexamethasone-eluting electrodes to controls.

Conclusions: This pioneering minipig model enables comprehensive evaluation of cochlear health under chronic stimulation. Findings support impedance as a surrogate marker for intracochlear fibrosis and highlight the therapeutic benefits of dexamethasone-eluting electrodes in preserving cochlear integrity.

Free paper 0147

Assessment of cochlear implant function and patient performance using remote care

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Cochlear implant (CI) care is traditionally delivered at large academic centres located in urban settings. Patients who live at a distance often face challenges related to travel time, cost, and logistical burden when accessing in-person care. Additionally, many CI centres are reducing the frequency of routine follow-up visits to improve clinic efficiency, which may further limit access to in-person assessments. Although previous studies have demonstrated that remote CI programming is comparable to in-person programming, relatively little research has examined the remote assessment of CI performance. With the recent availability of MED-EL Remote Care, new tools are available to monitor patient performance and device function outside the clinic. This study evaluated the feasibility and effectiveness of MED-EL Remote Care, its potential impact on time and cost savings for patients and clinicians, and the relationship between in-clinic and remote assessments.

Twelve MED-EL cochlear implant recipients participated in this study. All participants had a minimum of two weeks of CI experience and used a compatible RONDO or SONNET sound processor. Participants attended a baseline in-person assessment that included speech perception testing using CNC words, AzBio sentences in quiet and in noise, and an aided soundfield audiogram. During the same visit, participants completed baseline remote assessments using MED-EL Remote Check. Remote Check measures included the 2-Tone audibility test, a 3-Digits test assessing hearing in noise, and the 6-Sounds (Ling) test assessing sound discrimination.

Follow-up assessments were completed remotely. Participants performed technical checks of sound processor function and telemetry using the HearCare App. Participants also completed Remote Check assessments from home at least once during the six-month study period and answered surveys evaluating ease of use, satisfaction, and likelihood of future use following both baseline and remote testing. Most participants reported that Remote Care was easy to use and were able to independently complete all HearCare and Remote Check sub-assessments. No clinically significant issues related to implant or sound processor function were identified. Preliminary findings support the feasibility of remote CI assessments using

MED-EL Remote Care, with relationships between remote and in-clinic speech perception measures to be described.

Free paper 0621

Assessment of electrode–neural interface in cochlear implanted children with inner ear malformations

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Introduction: Cochlear implantation outcomes in children with inner ear malformations demonstrated variability in auditory performance. Structural abnormalities may influence electrode placement, neural survival, and the electrode–neural interface (ENI), thereby affecting speech perception outcomes.

Objective: To evaluate the characteristics of the electrode–neural interface in cochlear implanted children with EVA and IP-II and to compare objective electrophysiological measures and clinical outcomes with those of children with normal cochlear anatomy.

Material and methods: This prospective observational study included pediatric cochlear implant recipients diagnosed radiologically with EVA and/or IP-II. Electrophysiological assessments were conducted using impedance telemetry and electrically evoked compound action potentials (ECAPs). Measures of stimulation levels (T- and C-levels), dynamic range, and electrode activation patterns were analyzed. Speech perception performance in quite and in noise. Outcomes were compared with an age- and device-matched control group with normal inner ear anatomy.

Results: Children with EVA and IP-II demonstrated stable electrode impedances and measurable ECAP responses across the majority of electrodes. However, greater inter-electrode variability in ECAP thresholds and broader dynamic ranges were observed compared to controls. Despite these differences, speech perception scores were comparable.

Conclusions: The electrode–neural interface in children with EVA and IP-II is generally functional and supports effective cochlear implant stimulation. This information facilitates informed decision making for health care professionals and families.

Free paper 0307

Assessment of quality of life in patients with far-advanced otosclerosis (FAO) after cochlear implantation

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Introduction: Otosclerosis is a disease of unidentified origin, and as a result, there are many methods of treating it. Cochlear implantation is a highly effective treatment method, as demonstrated by the results of studies of implanted patients with far-advancedotosclerosis (FAO). It has a significant impact on the patients' quality of life.

Material and methods: Ten patients (seven women and three men) with far-advanced otosclerosis (FAO) and profound hearing loss underwent cochlear implant surgery using a MED-EL device. The study group was selected based on a retrospective review of patient data from the Institute of Physiology and Pathology of Hearing in Kajetany. Inclusion criteria comprised adults over 18 years of age with advanced otosclerosis who had previously undergone stapedotomy or stapedectomy in the ear qualified for cochlear implantation. The Assessment of Quality of Life (AQoL-8D) questionnaire was used to assess health-related quality of life in the study participants.

Results: Preoperatively, all patients underwent free-field speech audiometry using hearing aids and none achieved scores above 25% in quiet. Twelve months after cochlear implantation, speech discrimination scores in quiet ranged from 15% to 95%, reaching the maximum measurable values. Mean air and bone conduction thresholds in the implanted and non-implanted ear were recorded before the procedure and at 12 months post. Patients completed the AQoL-8D questionnaire twice, before and 12 months after implantation. Significant improvements in quality of life were observed, particularly in the psychosocial domain, in the categories of *Mental Health* and *Relationships*.

Conclusions: The results of cochlear implantation followed by auditory rehabilitation in patients with advanced otosclerosis were satisfactory and indicate an improvement in health-related quality of life. Including health-related quality of life assessment using the AQoL-8D questionnaire in diagnostic procedures may provide a more comprehensive evaluation of patients' health status.

Free paper 0246

Assessment of the usefulness and comprehensibility of postoperative materials for parents regarding pharmacotherapy after surgical ENT procedures: An anonymous questionnaire study with eye-tracking analysis

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Introduction: Proper preparation, dosing, and storage of medications following pediatric otorhinolaryngological procedures are essential for ensuring safe recovery. Educational materials (e.g., guides), particularly those incorporating visual elements (e.g., pictograms and tables), may facilitate caregivers' adherence to postoperative recommendations. To assess the usefulness and comprehensibility of a guide presenting fundamental principles of medication use after tonsillectomy, adenotonsillectomy and/or ear drainage, using an anonymous questionnaire survey supported by eye-tracking analysis.

Material and methods: An anonymous questionnaire survey was conducted among respondents ($N = 39$), including an evaluation of educational materials using a 5-point Likert scale (1–5) and an assessment of pictogram comprehensibility (1–5). Internal consistency of the pictogram scale was examined using Cronbach's alpha. Additionally, an eye-tracking study was performed in 15 respondents, incorporating general parameters of visual activity, including the number of samples, fixations, and saccades. The study was approved by the Bioethics Committee.

Results: Respondents rated the materials as highly useful and comprehensible. The statement regarding the completeness of information achieved a mean score of 4.68 ± 0.62. Elements supporting content reception were rated very highly, including text formatting (4.86 ± 0.35), dosing tables (4.81 ± 0.40), and pictograms (4.67 ± 0.62). The overall evaluation of pictograms was excellent (mean 4.80 ± 0.30), and the scale demonstrated high reliability (Cronbach's alpha = 0.914). In the eye-tracking study, the mean number of samples was 103,664 ± 22,450, the number of fixations was 57,241 ± 20,534, and the number of saccades was 6,650 ± 1,537, indicating substantial visual engagement while reviewing the guide content, as well as individual variability in perception and information-processing strategies.

Conclusions: The analyzed material was assessed as clear and highly useful. The findings indicate that pictograms and tables provide significant support in understanding postoperative recommendations. Eye-tracking data confirm active processing of the content by users, supporting the rationale for incorporating clear visual elements in patient and caregiver education.

Free paper 0013

Association between cochlear height and postoperative ECAP thresholds in pediatric cochlear implantation

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Purpose: This study investigates the association between cochlear anatomy and postoperative Evoked Compound Action Potentials (ECAP) in pediatric cochlear implant recipients.

Material and methods: This retrospective cohort chart review included children who underwent CI procedures at our institution between 2017 and 2023. Preoperative cochlear anatomical metrics were recorded, and postoperative ECAP measurements were recorded.

Results: A total of 45 pediatric ears with cochlear implants were included. Males comprised approximately 57.8% of the participants. The mean age at the time of implantation was 2.4 ± 0.9 years. The mean *A* value was 8.5 ± 0.4 mm, *B* value was 6.3 ± 0.4 mm, and *H* value was 3.6 ± 0.4 mm. The mean cochlear duct length was 33.2 ± 2.0 mm, and cochlear coverage was 76.0 ± 5.7%. A significant moderate negative correlation was demonstrated between H value and ECAP threshold of the middle turn electrodes ($r = -0.513$, $p = 0.012$). In univariate model, each increase of *H* value per unit was associated with a significant decrease in the middle ECAP thresholds of approximately 5.79 ($\beta = -5.79$, 95% CI: −10.20 to −1.39, $p = 0.012$). This significance was not observed in the multivariate model.

Conclusions: Cochlear anatomical variability, particularly cochlear height (*H* value), moderately correlates with ECAP thresholds in the middle turn electrodes. These findings suggest possible influence of such variability on neural responsiveness. More studies with larger samples are still required to confirm such results.

Free paper 0396

ATHOS: At THe Origin of Sounds: Neural entrainment to continuous speech before and after pediatric cochlear implantation

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Language acquisition depends on both biological factors, including the integrity of the central nervous system and peripheral sensory pathways, and experience-driven interactions with the environment through the senses, particularly audition and vision. In congenitally deaf individuals, early auditory deprivation profoundly affects language development. Technological advances have provided effective compensation, with cochlear implants (CIs) being the most advanced and widely used intervention. Research in pediatric and adult CI users shows substantial benefits for speech perception and language outcomes, and earlier implantation is associated with better development of the auditory cortex and linguistic outcomes.

A key question remains: How does the infant brain develop to encode and synchronize with auditory and audiovisual features of natural speech after CI? Studying this in infants is challenging due to the difficulty of acquiring data. Thus, objective and noninvasive neural measures are required. With support from Cochlear Ltd, we are conducting a multicenter longitudinal study investigating neural speech processing in CI infants using electroencephalography (EEG). Seven pediatric hospitals and research centers across Italy participate, and we aim to map the developmental trajectory of neural responses to continuous, naturalistic speech during the first year of CI use. Each session (15 minutes) includes two conditions: auditory-only (listening to audiobooks) and audiovisual (watching a speaker narrating stories). EEG is recorded at four time points: a few weeks before surgery (T0), shortly after CI activation (T1), three months post-activation (T3), and one year post-activation (T5).

Preliminary results from six infants (aged 9–22 months) who completed T0 and T1, with three also completing T3, are reported. All had congenital bilateral profound deafness and prior hearing-aid experience. Neural synchronization to the speech envelope was assessed using Temporal Response Functions (TRFs). TRF responses were weak at T0 and at T1, reflecting early adaptation to electrical sound, and increased modestly at T3, suggesting emerging neural tracking. These preliminary findings support EEG-based neural entrainment as an objective biomarker of early auditory development in CI infants, with implications for optimizing intervention timing, rehabilitation, and follow-ups.

Free paper 0589

Audiologic and genetic characteristics of cochlear implant recipients with biallelic DFNB1 mutations from a single clinical center

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Introduction: Mutations at the DFNB1 locus (*GJB2* and *GJB6* genes) are the most common cause of autosomal recessive non-syndromic hearing loss and represent a frequent indication for cochlear implantation. However, detailed genotype–phenotype data focused specifically on cochlear implant recipients within large, genetically homogeneous cohorts remain limited. The aim of this study was to characterize the genetic background and early clinical presentation of patients with DFNB1-related hearing loss treated with cochlear implants.

Material and methods: From a total cohort of 1614 patients with biallelic pathogenic or likely pathogenic DFNB1 variants, we selected individuals with available audiometric data ($n = 1338$). Among them, 608 patients who underwent cochlear implantation were included in the final analysis. Genetic variants were classified according to their predicted functional effect as truncating or non-truncating. Clinical data included age at diagnosis of deafness and audiologic findings prior to implantation.

Results: Among the 608 cochlear implant recipients, deafness was diagnosed within the first year of life in 494 patients (81.3%). A total of 33 unique DFNB1 genotypes were identified. Biallelic truncating variants accounted for 97% of cases ($n = 590$), while compound heterozygous truncating/non-truncating genotypes represented 2.5% ($n = 15$), and biallelic non-truncating variants 0.5% ($n = 3$). The most frequent genotype was the c.35delG homozygous variant, identified in 465 patients (76.5%). Other recurrent genotypes included c.35delG/c.313_326del in 44 patients (7.2%), c.35delG/c.-23+1G>A in 26 patients (4.3%), c.35delG/c.167delT in 20 patients (3.3%), and c.35delG/del(*GJB6*-D13S1830) in 10 patients (1.6%). Each of the remaining genotypes was observed in fewer than 1% of patients.

Conclusions: Cochlear implant users with DFNB1-related hearing loss represent a genetically distinct subgroup dominated by biallelic truncating *GJB2* variants and characterized by very early onset of profound hearing loss. The predominance of severe genotypes, particularly c.35delG

homozygosity, underscores the strong association between DFNB1 genotype and early candidacy for cochlear implantation. These findings support the role of early genetic diagnosis in optimizing timing and planning of cochlear implant-based rehabilitation.

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Free paper 0457

Audiological and functional outcomes following split electrode cochlear implantation for cochlear-vestibular rehabilitation: A case report

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Introduction: This study explores the functional restoration of both auditory and vestibular systems using an existing commercial device. We present the use of a double array electrode (Split Electrode) as a cochleo-vestibular implant in a patient suffering from bilateral profound hearing loss combined with severe vestibular insufficiency. The primary aim was to restore useful hearing while improving balance and functional mobility compromised by vestibular dysfunction.

Material and methods: The case involves a 52-year-old female with profound left hearing loss acquired in childhood and acquired profound right hearing loss with incapacitating vestibular dysfunction secondary to iatrogenic suppurative otitis media and prior tympanomastoidectomy. Comprehensive evaluation included audiometry, auditory evoked potentials, caloric testing, cervical VEMPs, video head impulse test vHIT, and surgical planning using the OTOPLAN system. A MED-EL Split Electrode implant was selected. A subtotal petrosectomy approach was performed to manage prior infection and ensure accurate placement of both cochlear and vestibular electrode arrays. Intraoperative monitoring included ECAPs and eVEMPs.

Results: Surgery was completed without complications, Intraoperative eC-VEMP recordings demonstrated stable and reproducible vestibular responses from the vestibular electrode array. Device activation was performed one month postoperatively. Electrodes 06-12 were activated for cochlear stimulation, while Electrode 02 was configured for constant vestibular stimulation using a HDCIS strategy with bandwidth reduced to 0 Hz to prevent sound-induced vestibular interference. A vestibular baseline was established at 2.09 qu, just below the nystagmus threshold of 2.22 qu. Combined stimulation resulted in improved postural stability, with normal performance on Romberg and Fukuda stepping tests. The patient achieved a Dynamic Gait Index (DGI) score of 24/24, indicating safe ambulation, and reported restored autonomy with no falls.

Conclusions: The adaptation of a commercial split electrode implant via subtotal petrosectomy represents a feasible approach for simultaneous auditory and vestibular rehabilitation in complex cases. Targeted vestibular stimulation provided effective gait stabilization without compromising auditory performance, leading to substantial functional improvement and enhanced quality of life.

Free paper 0236

Audiological and subjective comparison of unilateral and bilateral active bone conduction implants in a child with microtia and atresia

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Introduction: Bilateral hearing loss presents major challenges, particularly in speech understanding in noisy environments and sound localization, especially in cases of asymmetrical hearing loss. Conductive hearing loss can be managed through various treatments, including active bone conduction implants. This case study aims to evaluate the auditory benefits and sound localization accuracy of sequential bilateral active bone conduction implants compared to unilateral implantation in a patient with congenital bilateral conductive hearing loss due to outer ear malformations.

Material and methods: A 15-year-old patient with bilateral congenital malformations of the outer ears and associated conductive hearing loss underwent sequential bilateral implantation with Bonebridge active bone conduction devices. Audiological assessments included free-field hearing thresholds, speech recognition tests in quiet and noise, and sound localization accuracy. These tests were conducted under three conditions: unaided, unilateral (right-side implant), and bilateral (both implants). Additionally, the patient completed the Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire to assess subjective hearing-related limitations in daily life.

Results: The bilateral implantation led to significant improvements in hearing thresholds and speech discrimination in both quiet and noisy environments compared to unilateral implantation and unaided conditions. The patient reported fewer difficulties in everyday hearing situations with bilateral devices, as reflected in the APHAB scores. Sound localization accuracy was notably better with bilateral implants than with unilateral use.

Conclusions: Unilateral Bonebridge implantation in this patient did not provide complete auditory benefits. Bilateral sequential implantation significantly enhanced speech understanding in noise and sound localization, highlighting the importance of bilateral bone conduction implants in managing congenital bilateral conductive hearing loss.

Free paper 0701

Audiological monitoring of patients after chemotherapy and radiotherapy

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Introduction: Advances in cancer treatment, especially with platinum-based chemotherapy and radiotherapy, have significantly improved patient survival rates. It is important that such patients maintain a high quality of life. However, these therapies carry the risk of serious side effects, including ototoxicity that can cause permanent hearing loss, for which one of the treatment methods is cochlear implantation.

Aim: This article reviews the literature on the impact of cancer treatment on the hearing system and evaluates current methods for the prevention, diagnosis, and management of ototoxicity. We develop standard recommendations for audiologically monitoring cancer patients.

Material and methods: This study reviews the scientific literature on the clinical experience of oncology patients of various ages who received chemotherapy and/or radiotherapy and experienced hearing impairment.

Results: Treatment with cytostatic drugs (particularly cisplatin), as well as radiotherapy to the head and neck, are both linked to a high risk of developing bilateral, high-frequency, permanent, and progressive hearing loss. Risk factors include the total drug dose, the patient's age, comorbidities, and previous ototoxic treatment.

Conclusions: It is advisable to establish a thorough hearing monitoring protocol before, during, and after cancer treatment. Important considerations are screening assessments, regular audiometry, and the use of hearing protection devices. A multidisciplinary approach to the management of cancer patients is also important. It is essential for oncologists and other specialists treating the cancer patient to be alert to potential hearing changes. It is important for them to promptly refer cancer patients with suspected hearing loss for an audiological examination. A promising development is therapy based on genetic markers. These approaches can minimise side effects and enhance the quality of life for cancer patients.

Free paper 0262

Audiological outcome after ultra early activation of a cochlear implant followed by early rehabilitation in bilateral deafness

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This prospective, single-center, open-label study investigated the audiological outcomes of ultra early cochlear implant (CI) activation combined with immediate rehabilitation in adults with bilateral sensorineural hearing loss, compared to the standard activation protocol, where activation occurs 3–4 weeks post-surgery. Conducted at the University Clinic of St. Pölten the trial explored whether earlier activation improves hearing recovery, speech understanding, compliance, and quality of life, while also reducing the number of hospital visits. Forty participants (20 per group) were randomized to either the ultra early activation group (activation and therapy during the same hospital stay) or the regular activation group (standard timeline). The investigational devices include the MED-EL "SYNCHRONY 2" and Cochlear "Nucleus" implants, both CE-marked and clinically established. Primary outcomes include improvements in hearing thresholds (via pure tone audiometry) and speech discrimination scores (via speech audiometry) at 3, 6, and 12 months post-implantation. Secondary outcomes involve patient compliance with rehabilitation, changes in quality of life, and reduced hospital attendance. Audiological and imaging tests such as CT, MRI, DVT imaging, and repeated audiometry are used pre- and post-operatively to monitor performance and electrode positioning. Early rehabilitation includes music therapy and auditory training starting within days after surgery. The study aimed to demonstrate that early CI activation can accelerate auditory rehabilitation, improve patient satisfaction, and streamline postoperative care without increasing risk.

Free paper 0264

Audiological outcomes of the new bone-conduction hearing system OSIA OSI300 in adults and children

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Introduction: The Osia OSI300 (Cochlear) is an active bone-conduction implant, indicated for individuals aged 12 years and older with conductive or mixed hearing loss. It was commercially approved for clinical use in key markets in 2024. The system features nextgeneration magnet and transducer design that enables MRI scanning without surgical magnet removal. The aim of this study was to evaluate the audiological and patientreported outcomes of hearing rehabilitation with the Osia OSI300 system in adults and children.

Material and methods: Thirty patients (16 females, 14 males; mean age 50 years, range 12–76) with conductive ($n = 7$) or mixed ($n = 23$) hearing loss received the Osia OSI300 implant. Preoperative assessment included pure-tone audiometry, speech audiometry (Demenko and Pruszewicz Monosyllabic Word Test) and speech-in-noise testing (Polish Matrix Sentence Test). Free-field measurements were then performed on the day of implant activation and at a 1-month follow-up. Subjective benefit was assessed using the Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire, completed before surgery and 1 month after activation.

Results: Patients presented with a preoperative mean air-conduction threshold of 66.8 dB HL (SD = 13.5) across 500–4000 Hz. Following OSIA implantation, threshold improved significantly ($F(2,54) = 142$; $p < 0.001$), reaching 27.9 dB HL (SD = 6.98) on the activation day and 27.2 dB HL (SD = 8.41) at 1-month follow up. Speech discrimination increased markedly ($F(2,50) = 701$; $p < 0.001$) from 4.5% preoperatively (SD = 13.8) to 89.3% (SD = 8.17) after activation and 92.7% (SD = 5.33) at follow-up. Speech perception in noise also improved significantly ($F(2,44) = 130$; $p < 0.001$), with scores rising from +5.43 dB SNR preoperatively to –0.67 dB SNR after activation and –1.34 dB SNR at follow-up. Subjective outcomes reflected these improvements, with APHAB global scores decreasing from 56.4 (SD = 20) preoperatively to 41.6 (SD = 17.3) at follow-up ($W = 225$; $p < 0.001$).

Conclusions: The Osia OSI300 bone-conduction implant provided substantial improvements in hearing thresholds and speech discrimination, with benefits evident immediately after activation and maintained at 1 month. Moreover, patients reported reduced hearing difficulties. These findings support Osia OSI 300 as an effective option for audiological rehabilitation in individuals with conductive or mixed hearing loss.

Free paper 0074

Audiological outcomes of the Sentio system in a young paediatric population

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Introduction: Bone Conduction Hearing Devices (BCHDs) are commonly used for patients with conductive or mixed hearing loss. They have also proven useful for individuals with Single-Sided Deafness (SSD) as an alternative to the Contralateral Routing of Signal (CROS) hearing aid. Recently, a new model, the transcutaneous Sentio system, has been developed, and its audiological outcomes are currently under investigation in the paediatric population. The Sentio system comprises the Sentio Ti implant, reported as the smallest transcutaneous implant to date, and the Sentio Mini sound processor, the smallest and lightest sound processor available to date.

Objective: The overall aim of this multi-centre study is to evaluate safety and performance of the Sentio system in children aged 3 to 11 years. This presentation will cover results of audiological outcome from the cohort of children implanted at Great Ormond Street Hospital, London, UK.

Material and methods: Children in ages from 3 to 11 years that are candidates for BCHD are prospectively recruited to this 12-month follow-up study to assess safety and performance of the Sentio system. Audiological assessments include aided and unaided hearing thresholds as well as speech recognition testing in both quiet and noisy environments. Data will be analysed to evaluate improvements in auditory perception and functional hearing performance. Questionnaires are used to assess listening fatigue (pre- vs. post-surgery), quality of life, as well as functionality and satisfaction with the device.

Results: This far, six participants of ages 5–9 years have been recruited at our centre, of which four have undergone implantation (one bilateral) and subsequent fitting of the Sentio 1 Mini sound processor. Preliminary data suggest greatly improved hearing thresholds for all patients. The fitting session was perceived as easy and straightforward. Patients and parents have expressed an improvement in hearing and are happy with the device.

Conclusions: The Sentio system holds promise for effective hearing rehabilitation in children with conductive or mixed hearing loss, or single-sided deafness. Initial results indicate good performance with significantly improved hearing thresholds when compared to the unaided condition. This study contributes to the evidence supporting the benefits of the Sentio system for young paediatric populations.

Free paper 0469

Audiometric outcomes after cochlear implantation in single-sided deafness

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Introduction: Cochlear implantation (CI) is an established treatment option for patients with single-sided deafness (SSD); however, speech perception outcomes show substantial interindividual variability. The aim of this study was to investigate the relationship between preoperative hearing status and postoperative outcomes following CI in SSD.

Material and methods: This retrospective analysis was based on cleaned clinical routine data. Baseline measures included the last available preoperative pure-tone audiogram prior to implantation and the corresponding preoperative speech test results. If no preoperative audiogram was available, date and pure-tone-average (PTA) from the earliest available audiometric assessment were used as a fallback. Postoperative outcomes comprised Freiburg monosyllabic word scores obtained under CI use from longitudinal follow-up records. The primary endpoint was defined as the last temporally assignable postoperative measurement. Primary outcomes were the postoperative monosyllabic score and the gain relative to preoperative

performance (Δ monosyllables). Additionally, responder definitions (≥50% postoperative performance; ≥20 percentage-point gain) and exploratory interaction effects were analyzed.

Results: 78 patients with an assignable baseline and minimum one postoperative monosyllabic score were included (mean age 54.5 ± 14.6 years; ipsilateral PTA 83.1 ± 8.1 dB HL; contralateral PTA 16.1 ± 7.9 dB HL). Preoperative monosyllabic scores were nearly all at floor level. The mean final postoperative monosyllabic score was 48.8 ± 28.6%, with a mean gain of 47.9 ± 28.8 percentage points. Multivariate linear regression models explained only a small proportion of outcome variance; due to complete-case requirements, the primary model included 66 patients. The only significant term was a manufacturer effect (MED-EL vs reference Advanced Bionics), associated with lower monosyllabic scores, while the overall model test was not significant. Responder analyses did not identify robust baseline predictors; in particular, the preoperative monosyllabic variable showed numerical instability due to lack of variance.

Conclusions: In this SSD cohort, CI resulted in a pronounced average improvement in monosyllabic speech perception, whereas routinely available preoperative audiometric markers showed limited ability to explain interindividual outcome variability. Future analyses integrating patient-reported outcome measures on subjective hearing performance, listening effort, and quality of life may help to better capture treatment benefit and improve outcome prediction beyond objective speech test results alone.

Free paper 0556

Auditory and cognitive mechanisms underlying speech--in-noise performance in sequential and simultaneous bilateral cochlear implant users: Preliminary study

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Introduction: Sequential and simultaneous bilateral cochlear implantation are increasingly adopted, improving acces to binaural cues and speech perception. Yet, speech-in-noise outcomes remain inconsistent, highlighting the role of central cognitive and neurophysiological mechanisms beyond peripheral input. QuickSIN and the Turkish Matrix test provide standardized speech-in-noise measures, Stroop performance reflects cognitive control and mismatch negativity (MMN) indexes cortical auditory discrimination. Combining these tools may clarify how auditory and cognitive domains interact in pediatric CI users, offering insights for individualized rehabilitation strategies.

Material and methods: Thirty children (ages 10–18) with severe-to-profound sensorineural hearing loss using cochlear implants and fifteen age-matched normal-hearing peers were included. CI users comprised 15 sequential and 15 simultaneous bilateral recipients. Speech-in-noise perception was measured wtih the Turkish Matrix test and QuickSIN, cognitive control with the Stroop task and auditory discrimination with MMN. All testing was conducted in a sound-treated room; CI users were evaluated in their everyday best aided bilateral condition, while normal-hearing participants were tested under standard listening conditions.

Results: Cochlear implant users demonstrated significantly poorer speech-in-noise than normal-hearing peers on both the Turkish Matrix and QuickSIN tests (<0.05). Within the CI group, simultaneous ($p < 0.05$). Stroop performance revealed lnger reaction times in CI users, while MMN recordings showed reduced amplitudes. Correlation analyses indicated a modarate positive assosication between QuickSIN scores and MMN amplitudes ($r = 0.534$) and a weak positive correlation between Stroop performance and MMN amplitudes ($r = 0.357$).

Conclusions: Findings indicate that speech-in noise performance in pediatric cochlear implant users is closely linked to cognitive control and auditory discrimiation. Sequential and simultaneous bilateral implantation show subtle differences, yet both highlight the importance of integrating behavioral and neurophysiological mesasures. These results support a multidimensional approach to assesment and rehabilitation, emphasizing that speech perception outcomes are shaped not only by peripheral hearing bur also by central cognitive mechanisms.

Free paper 0085

Auditory brainstem implantation in adults: Our experience

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Objective: To present the experience in adult auditory brainstem implantation.

Material and methods: The data of 3 patients with deafness who underwent auditory brainstem implantation on the base of the NRMCO in 2024 were evaluated. Type of pathology, previous surgeries, intraoperative findings, complacations and audiological outcome were evaluated. The follow-up period was 7 months.

Results: In all cases etiological factor was trauma, that caused near total cochlear ossification. In one case ineffective cochlear implantation was performed before. All patients underwent successful placement of an auditory brainstem implant using a retrosigmoid craniotomy approach. There were no side reaction from ABI implants in these cases intraoperatively. However, in early postoperative period in one case muscle contruction was revealed from 4 electrodes, also patient faced on with IX bilateral paralysis. The audiological results in this case was moderate. In the 2nd case no significant complications were observed except for enlargement of ventricles on the 20th day postop. Ventriculoperitoneal shunting was performed with normaliztion of situation. No complications in 3rd case. The audiological results in the patient was good with speech recognition score 60%.

Conclusions: An ABI has proven to be a safe procedure without serious complications. ABI can provide useful hearing in patients when CI is impossible. It The entire ABI process is handled by a multidisciplinary team with extensive experience in cerebellopontine angle tumour surgery and cochlear implantation in adults and children.

Free paper 0467

Auditory deprivation affects visual onset and offset responses in a secondary visual area of congenitally deaf cats

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Congenitally deaf cats (CDCs) elicit altered cortical responses of the auditory cortex. Yusuf et al. (2016, 2017, 2021) demonstrated that neural responses in primary auditory cortex A1 and posterior auditory field (PAF) of congenitally deaf cats exhibited reduced induced cortical power and weakened functional coupling between both areas. Additionally, studies conducted by Land et al. (2016 and 2018) showed a moderate visual cross-modal plasticity in the dorsal zone of the congenitally deaf cats, while the majority of neurons remained responsive to cochlear implant stimulation. In this study, we compared the response dynamics in the dorsal zone and antero/postero-medial lateral suprasylvian sulcus (A/PMLS) between congenitally deaf ($n = 6$) and normal hearing ($n = 4$) cats. Electrical stimulation was applied through a cochlear implant with randomised 9 intensities ranging from -2 below to 6 dB above eABR (electrical auditory brainstem response) threshold, and visual stimulation was full-field flashes. The evoked local field potentials (LFPs) were recorded simultaneously in the DZ and visual area A/PMLS at 44 penetrations of 16-channel multielectrode arrays in controls and 70 in CDCs, resulting in 704 recording sites in controls and 1120 in CDCs. Local field potentials were subsequently processed by custom-made MATLAB scripts using the Fieldtrip toolbox. Bipolar LFPs and time-frequency representations (TFRs) of each layer of both areas of interest were calculated. Furthermore, the unbalanced ANOVAN test and cluster-based permutation statistics were applied to analyse the statistical differences of both groups. The results showed a reduced dynamic range of CI-evoked activity and lower cortical power of alpha and beta frequency bands in congenitally deaf cats. Additionally, CDCs demonstrated significantly enhanced onset and reduced offset responses, specifically the reduced power in the alpha band. This study suggests that congenital deafness alters oscillatory and temporal response dynamics not only in the auditory cortex but also in the extrastriate visual area.

Free paper 0060

Auditory Nerve Test System (ANTS) in grey zone candidates patients with auditory nerve aplasia/ hypoplasia: Alexandria experience

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Auditory nerve testing system (ANTS) is a method that utilizes an atraumatic intracochlear test electrode and electric auditory brainstem response (E-ABR) to physiologically assess the functionality of the auditory nerve. ANTS can be used with cases with suspected aplasia or hypoplasia of the auditory nerve, as imaging alone is not always enough to ensure the existence of a functional nerve. If we determine that the nerve is still functional, a cochlear implant is recommended, which has better outcomes than auditory brainstem implant patients. In the cases where no auditory nerve response is found, an auditory brainstem implant may be a better option for that patient. In Alexandria, we used ANTS with 14 cases with hypoplastic auditory nerves as been confirmed by imaging. The patients had no auditory response with conventional hearing aids. Twelve patients were implanted unilaterally, and only one had bilateral implantation. Promontory testing was negative in 11 patients. The intracochlear test electrode (developed by MED-EL) is atraumatically inserted through the round window, and electrical stimulation is generated by the MAX software interface to elicit E-ABR. The intracochlear electrode testing yielded reproducible E-ABR waves. The test was repeated after insertion of the cochlear implant electrode and gave nearly the same results. The patients have a good perception of sound. This demonstrates that the intracochlear test electrode may be a suitable method of testing the integrity of the auditory nerve by recording eABR signals. It is a more accurate assessment of the physiological function of the auditory nerve than other methods, such as promontory stimulation. This can allow successful cochlear implantation and will grant many patients with auditory nerve hypoplasia who were previously considered not candidates of cochlear implantation a chance of hearing.

Free paper 0591

Auditory outcomes after early cochlear implantation in children with DFNB1-related hearing loss

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Introduction: Nearly 60% of children with profound prelingual hearing loss (HL) have a genetic cause of their disease, most commonly biallelic recessive pathogenic variants within the DFNB1 locus (*GJB2/GJB6* genes). However, the

relationship between HL etiology and cochlear implantation (CI) outcomes remains insufficiently explored.

Objective: This study aimed to evaluate auditory development following CI in a homogeneous group of children with DFNB1-related HL.

Material and methods: The study included 196 children with profound prelingual HL who underwent cochlear implantation before 24 months of age and had completed DFNB1 genetic testing. Auditory development was assessed using the LittlEARS Auditory Questionnaire at CI activation and at 5 and 9 months post-implantation. Among the enrolled patients, 149 children were diagnosed with DFNB1-related HL.

Results: Children with DFNB1 pathogenic variants demonstrated favorable auditory outcomes after CI, with mean LittlEARS scores of 6.85 at activation, 22.24 at 5 months, and 28 at 9 months post-CI. Superior auditory development was observed in children implanted before 12 months of age. Interestingly, children without residual hearing prior to implantation showed a higher rate of early auditory development compared to those with measurable responses in hearing aids across a wide frequency range. Nevertheless, both groups achieved comparable auditory performance 9 months after CI activation.

Conclusions: These findings confirm the effectiveness of cochlear implantation in children with DFNB1-related HL and highlight the critical role of very early implantation in optimizing auditory outcomes. The results support CI as the most effective therapeutic approach in this genetically defined group and emphasize the importance of early diagnosis and timely intervention.

Free paper 0318

Benefits of bone conduction implants (BAHA, Osia and Bonebridge)

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Introduction: Bone conduction implants are a therapeutic option for the rehabilitation of conductive and mixed hearing loss, as well as single-sided deafness. These devices ensure cochlear stimulation via bone conduction, bypassing the affected structures of the external and middle ear. Among the options currently available, BAHA, Bonebridge, and Osia stand out, having demonstrated consistent and significant audiological benefits in their users. The aim of this study was to evaluate the audiological benefit of bone conduction implants in a clinical sample.

Material and methods: A study was conducted with 45 patients, 21 male and 24 female, with a mean age of 48 years. Two patients underwent bilateral implantation, resulting in a total of 47 implants analyzed. Regarding device type, 25 implants corresponded to the Osia system, 12 to BAHA and 10 to BoneBridge. Concerning laterality, 25 implants were placed on the left side and 22 on the right side. The audiological evaluation included the determination of the pure-tone average (500, 1000, 2000, 4000 Hz) without the implant and the pure-tone average with the implant, allowing calculation of the mean tonal gain. Speech discrimination percentage was also assessed with and without the implant at an intensity of 50 dB. Outcome evaluation was performed in free field conditions in a sound-treated room.

Results: The mean pure-tone average without the implant was 63 dB. After implantation, the mean pure-tone average with the implant was reduced to 28.5 dB. The mean tonal gain observed was approximately 34.5 dB. Regarding speech perception, mean speech discrimination with the implant was 96%, compared to 42% without the implant, corresponding to a mean speech gain of 54%. These results demonstrate a significant hearing improvement with bone conduction implants rehabilitation.

Conclusions: Bone conduction implants demonstrated a relevant audiological benefit, reflected in a significant reduction in mean tonal and speech loss. These findings confirm the effectiveness of bone conduction systems as auditory rehabilitation options, reinforcing their role in improving hearing loss and its impact on patients' quality of life.

Free paper 0495

Bibliometric mapping of research on cochlear implantation and electrically evoked compound action potential

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Objective: This study aimed to map the scientific landscape of research focusing on Electrically Evoked Compound Action Potential (ECAP) in the context of cochlear implantation, and to identify publication trends, influential sources, leading institutions, and prominent research themes over time.

Material and methods: A bibliometric analysis was conducted using the Web of Science Core Collection database. An advanced search of the Web of Science Core Collection was conducted on 27 January 2026 using the search terms ("Electrically Evoked Compound Action Potential" OR ECAP) AND ("Cochlear Implant*"). Document types other than article and review article were excluded. Following the screening process, 500 publications were included from an initial total of 525 records. All bibliographic data were exported in tab-delimited format and analyzed using VOSviewer software (version 1.6.20) to assess author, institutional, source, and country contributions, as well as citation relationships and keyword co-occurrence networks.

Results: A total of 500 publications were analyzed. The journals with the most publications were *Ear and Hearing, Hearing Research, and Otology & Neurotology*. The most productive institutions included the Hannover Medical School, the University of Iowa, and Utrecht University. In terms of country distribution, the United States emerged as the leading country in publication output. Keyword analysis revealed that

the most frequently occurring terms were "cochlear implant," "electrically evoked compound action potential," "auditory nerve," "neural response telemetry," and "speech recognition," indicating a strong research emphasis on objective electrophysiological measures and their relationship with auditory and speech outcomes. Bibliometric analysis revealed that Carolyn J. Brown was the most influential author, with the highest number of publications and citations in ECAP-related cochlear implant research.

Conclusions: This bibliometric analysis demonstrates the growing significance of electrically evoked compound action potential (ECAP) in cochlear implant research and underscores its central role in studies focusing on objective auditory assessment and outcome-related measures.

Free paper 0686

Bilateral active bone conduction implants: A systematic review highlighting current evidence and knowledge gaps

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Introduction: Active bone conduction implants (ABCI) represent an established hearing rehabilitation option for patients with conductive or mixed hearing loss and selected cases of single-sided deafness who are not candidates for conventional hearing aids or middle ear surgery. While unilateral implantation is well documented, bilateral implantation is increasingly performed to restore binaural hearing. However, the clinical benefits and safety of bilateral ABCI remain insufficiently defined. This systematic review aimed to evaluate audiological outcomes, patient-reported benefits, and complications associated with bilateral ABCI implantation, and to identify current gaps in the available evidence.

Material and methods: A systematic review was conducted in accordance with PRISMA 2020 guidelines. PubMed, Embase, Scopus, and the Cochrane Library were searched for studies reporting bilateral (simultaneous or sequential) implantation of active bone conduction devices with extractable audiological or subjective outcomes. Data extracted included pure-tone audiometry, speech perception in quiet and noise, patient-reported outcome measures, follow-up duration, and complications. Risk of bias was assessed using ROBINS-I and Joanna Briggs Institute checklists. Due to substantial clinical and methodological heterogeneity, meta-analysis was not feasible and a narrative synthesis was performed.

Results: Seventeen studies including 112 patients met the inclusion criteria. The mean age at implantation was 27.6 years, and most patients underwent simultaneous bilateral implantation. The predominant indication was congenital bilateral aural atresia or microtia. Ten studies evaluated the Bonebridge system and seven the Osia system. Bilateral implantation consistently provided superior audiological outcomes compared with unilateral fitting, particularly for speech perception in noise, with reported signal-to-noise ratio improvements of approximately 3–5 dB. Functional gain ranged from 35 to 47 dB HL, and postoperative word recognition scores were high across studies. Patient-reported outcomes indicated improvements in spatial hearing, listening comfort, and overall hearing-related quality of life. Complications were uncommon and generally minor.

Conclusions: Bilateral active bone conduction implantation appears to be a safe and effective strategy, offering consistent functional and subjective benefits. Nevertheless, current evidence is limited by small sample sizes, observational study designs, and heterogeneous outcome measures. Prospective studies with standardized protocols are needed to better define the true binaural advantage and long-term outcomes of bilateral ABCI implantation.

Free paper 0595

Bilateral Bonebridge implantation in Guion and Almeida mandibular-facial dysostosis

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Introduction: Guion-Almeida type mandibulofacial dysostosis (MFDM) is a rare genetic disorder characterized by a combination of congenital anomalies associated with abnormalities in the development of the first and second pharyngeal arches. Phenotypically, MFDM manifests as hypoplasia of the zygomatic bone and mandible, microcephaly, facial dysmorphia, psychomotor developmental delay, intellectual disability, ear malformations, and associated conductive or mixed hearing loss.

Material and methods: This retrospective case study describes a patient with MFDM (Guion-Almeida type), presenting with bilateral mixed hearing loss, as well as bilateral complex malformations of the middle and inner ears and the right outer ear. The study also outlines methods for treating hearing loss with bilateral Bonebridge (BB) bone conduction implants.

Case report: An 11-month-old patient was referred to the World Hearing Center due to abnormal results from a newborn hearing screening test, which were confirmed by an ABR test. Physical examination revealed facial dysmorphia, auricular deformity, external auditory canal stenosis and right-sided congenital paresis of the facial nerve. Initially, the boy was fitted with bone conduction hearing aids on a headband. Tonal audiometry revealed severe mixed hearing loss in the right ear and moderate hearing loss in the left ear. Bone conduction threshold did not exceed 40 dB bilaterally. A CT scan of the temporal bones revealed a complex defect involving stenosis of the right external auditory canal, a complex middle

ear and ossicular defect, and an inner ear defect. At age 12, a Bonebridge 602 bone conduction hearing implant was placed in the right ear and seven months later in the left ear.

Results: In the free-field threshold audiometry test in BB implant in the left ear, the average hearing threshold was 39 dB and 33 dB in the right ear for frequencies of 0.25–6 kHz (the bilateral ear passively masked). In the free-field speech audiometry test with the BB implant on the left side, the patient achieved 80% speech intelligibility.

Conclusions: The presence of complex ear defects and conductive or mixed hearing loss due to defects of the first and second branchial arches may indicate the need for bone conduction implants.

Free paper 0303

Bilateral cochlear implantation as a treatment for partial deafness following chemotherapy for medulloblastoma: A case report

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Introduction: Medulloblastoma is a malignant pediatric brain tumor. Its treatment consists of surgical removal of the tumor followed by radiotherapy and chemotherapy. Among the drugs used in chemotherapy is cisplatin, which is characterized by strong ototoxic properties. The hearing loss typically associated with cisplatin administration is high-frequency sensorineural hearing loss.

Case study: An eleven-year-old girl was admitted to the Institute of Physiology and Pathology of Hearing for cochlear implant candidacy evaluation. Medical history revealed that the child had undergone chemotherapy for medulloblastoma, including treatment with cisplatin. The girl subsequently underwent cochlear implantation surgery in the left ear and, three years later, in the right ear. The child demonstrates very promising speech perception outcomes with the cochlear implant.

Conclusions: Cochlear implantation is a valuable and effective rehabilitative option for children who develop significant sensorineural hearing loss following cisplatin-based chemotherapy for medulloblastoma. Pediatric survivors can achieve meaningful speech perception and improved communication with timely, bilateral implantation, which should be integrated into multidisciplinary survivorship care to optimize long-term developmental outcomes.

Free paper 0409

Bilateral cochlear implantation in a child with Galloway–Mowat syndrome: A case report

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Introduction: Galloway–Mowat syndrome (GAMOS) is an exceptionally rare, autosomal recessive genetic disorder characterized by microcephaly, early-onset steroid-resistant nephrotic syndrome, and structural brain abnormalities. Profound sensorineural hearing loss may occur, yet data on auditory rehabilitation in this population are virtually nonexistent. To our knowledge, this is the first reported case of bilateral cochlear implantation in a child with GAMOS, and the first description of early auditory outcomes following such intervention.

Case study: We present a male child with genetically confirmed GAMOS, presenting with profound bilateral deafness, cerebellar hypoplasia, hypotonia, epilepsy, and visual impairment likely related to optic nerve dysgenesis. Bilateral cochlear implantation was performed in two stages at the ages of 2 and 3 years. Despite dysplastic cochlear anatomy and partial bony overgrowth in the round window region, surgical access was achieved without major difficulty. Soft electrodes were deliberately selected to accommodate the malformed cochlea and minimize intracochlear trauma.

Results: No perioperative or postoperative complications were observed. At six months following the second implantation, auditory outcomes were encouraging. The child demonstrated consistent sound perception and began using auditory input functionally to support interaction and communication with his environment.

Conclusions: This case suggests that cochlear implantation can be a safe and effective option for auditory rehabilitation in children with GAMOS, even in the presence of cochlear dysplasia and complex neurological comorbidities. Careful surgical planning, adequate exposure of the round window region, and the use of flexible electrode arrays appear to be key factors in achieving favorable early outcomes.

Free paper 0364

Binaural cue characterization in bilateral cochlear implants

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Introduction: Bilateral cochlear implantation is a crucial intervention for individuals with severe-to-profound hearing loss. While cochlear implants (CIs) enable effective speech understanding in quiet, their performance in noise environments and sound localization is more variable. In bilateral CI users, independent processing between implants distorts interaural time (ITDs) and level differences (ILDs), critical for spatial hearing. This simulation study systematically examines binaural cue distortions at key stages of the CI processing pathway, with the goal of informing strategies to mitigate existing limitations.

Material and methods: Sound spatialization relies on measured Head-Related Transfer Functions. Binaural cues are extracted after microphone processing, envelope extraction, loudness growth function (LGF), and mapping stages. ITDs and ILDs are assessed per frequency band and then aggregated using mean absolute error-based metrics. Additionally, we evaluate the impact of (1) interaural linked channel selection and (2) increased maxima (from 8 to 12 to 16) on cue preservation and speech intelligibility in noise using the normalized covariance metric.

Results: Non linear compressions emerge as the dominant source of level distortions, introducing errors of 6.9–10.4 dB. Envelope extraction shows a comparatively small effect on timing cues, with errors of 38–42 μs. Linked channel selection reduces ILD distortions under strong head-shadow conditions (from 1.8 to 0.2 dB), but introduced large ITD distortions (around 248–390 μs) due to frame based synchronization. Increasing the number of maxima from 8 to 12 provides modest improvements (up to 0.9 dB and 44 μs), while increasing further to 16 adds only minor benefits (0.4 dB and 11 μs). However, none of these adjustments mitigate compression related distortions, which remain a major challenge for accurate ILD encoding. Speech intelligibility improves with linked channel selection on the side with poorer signal-to-noise ratio, particularly with spatially separated speech and noise.

Conclusions: These findings underscore persistent challenges in preserving binaural cues in current CI strategies. Linking channel selection alone is insufficient; targeted solutions addressing the degradation introduced by non-linear compressions and temporal distortions are needed for improved spatial hearing.

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Free paper 0034

Binaural localization development and the effect of SmartSound iQ with SCAN in children with cochlear implants

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Introduction: Binaural hearing is crucial for spatial auditory perception, including sound localization. Cochlear implants (CIs) are commonly used in children with congenital deafness to support binaural auditory development, but the extent to which they facilitate effective localization remains unclear.

Objective: This study evaluates the impact of CIs on binaural functional auditory development and sound localization in children with congenital deafness, considering factors such as age at implantation, hearing experience, and CI laterality.

Material and methods: Thirty-eight CI-assisted children (aged 4–9 years) underwent directional hearing assessments using the "Erfassung des Richtungshörens bei Kindern (ERKI)" device. Localization accuracy was analyzed across various noise stimuli, and correlations with audiometric parameters and CI history were examined.

Results: Localization accuracy improved with age and CI experience. Bilateral CI users outperformed unilateral users, particularly with pulse pink noise stimuli. The use of SmartSound iQ with SCAN technology enhanced localization, especially in younger children.

Conclusions: CIs support binaural functional auditory development in children with congenital deafness, with localization skills improving over time. Bilateral implantation and early intervention may further enhance outcomes, warranting continued research.

Free paper 0610

Biologic therapies for chronic rhinosinusitis with nasal polyps with coexisting asthma: A Systematic review of randomized controlled trials

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Introduction: Asthma and chronic rhinosinusitis with nasal polyps (CRSwNP) frequently coexist and share common type 2 inflammatory mechanisms. This comorbid phenotype is associated with more severe asthma, increased nasal symptom burden, and poorer response to conventional therapies. Although biologic therapies targeting type 2 pathways have demonstrated efficacy in asthma and in CRSwNP separately, most randomized trials enrolled heterogeneous populations

and provided limited predefined subgroup analyses of patients with both conditions, leaving uncertainty regarding the magnitude and consistency of benefit in this comorbid population.

Objective: The aim of the study was to evaluate the efficacy of biologic therapies in patients with asthma and comorbid chronic rhinosinusitis with nasal polyps.

Material and methods: In this systematic review of randomized controlled trials (RCTs), we searched PubMed, Scopus, ScienceDirect, and Embase from January 1, 2015 to October 28, 2025, for studies assessing the efficacy of biologic therapies in adults with asthma and comorbid CRSwNP (or nasal polyps). The review was conducted in accordance with PRISMA guidelines. We included original RCTs as well as post-hoc analyses of RCTs, because they reported outcomes specifically for the comorbid population, as these analyses offered complementary data not available in primary publications. Eligible participants were adults with asthma and coexisting CRSwNP treated with biologics. Relevant trials were manually retrieved and reviewed by two independent reviewers. Rayyan sofware was used for screening. This study was registered in PROSPERO.

Results: The initial search identified 3,109 records. After removal of 2,780 duplicates, 329 studies were screened at the title and abstract level. Thirty-five articles underwent full-text assessment, and 28 studies met the predefined inclusion criteria, comprising original RCTs and post-hoc analyses reporting outcomes in the comorbid population. The In the review, changes were analyzed in the following outcomes: VAS score, SNOT-22 score, NPS, FEV1, AAER, CAE, and asthma control.

Conclusions: Among the studies and agents analyzed – dupilumab, tezepelumab, mepolizumab, benralizumab, depemokimab, and omalizumab – clinical benefit was observed in patients with asthma and/or nasal polyps; however, at the time of this analysis, it is too early to draw a definitive conclusion.

Free paper 0237

Bone conduction implants in single-sided deafness: Assessing hearing outcomes and patient benefit

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Introduction: Single-sided deafness (SSD) significantly affects speech understanding in noisy environments and spatial hearing, reducing overall quality of life. Traditional hearing solutions such as contralateral routing of sound (CROS) hearing aids or cochlear implants may not be suitable for some patients due to anatomical constraints or intolerance. Bone conduction implants offer an alternative rehabilitation approach by transmitting sound from the non-hearing side to the functioning cochlea. This study evaluates the audiological and subjective benefits of active transcutaneous bone conduction implants in SSD patients.

Material and methods: A prospective study was conducted at a tertiary referral center, including 35 participants aged 13 to 51 years (mean: 33.5 years) diagnosed with SSD. The leading causes of SSD were congenital deafness and mumps-related deafness. All participants were deemed unsuitable for CROS hearing aids or cochlear implants due to anatomical limitations or intolerance. Each patient underwent surgical implantation of a bone conduction device on the deaf side, allowing sound transmission to the functioning ear. Speech recognition in noise was assessed using the Polish Sentence Matrix Test. Patient satisfaction and quality of life were evaluated before and after implantation using the Abbreviated Profile of Hearing Aid Benefit (APHAB) questionnaire.

Results: Patients demonstrated a significant improvement in speech recognition in noisy environments. The mean Polish Sentence Matrix Test scores improved from +0.5 dB SNR at the initial assessment to –3.6 dB SNR six months after activation. The APHAB questionnaire results indicated enhanced communication abilities, with a mean benefit score of 21.5 points. The surgical procedures were well tolerated and no major complications were reported.

Conclusions: Bone conduction implants provide an effective and safe rehabilitation option for SSD patients, significantly enhancing speech understanding in noisy environments and overall quality of life. Early intervention with this technology may improve hearing outcomes in individuals with SSD who are not candidates for traditional hearing solutions. Further research is needed to assess long-term benefits and refine patient selection criteria.

Free paper 0561

Bone conduction versus middle ear implant treatment concept in patients with asymmetrical mixed hearing loss

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Introduction: Bone conduction devices (BCDs) and middle ear implants (MEIs) are established treatments for persistent mixed hearing loss (MHL). While both can yield more and less comparable audiological outcomes within their indication ranges, differences may arise in cases of asymmetrical MHL. In such cases, better bone conduction thresholds in the contralateral ear may lead to cross-hearing with BCDs. MEIs, offering side-specific stimulation, are expected to avoid this issue. This retrospective study aims to clinically assess spatial hearing and sound localization in patients with talk-over risk.

Material: Patients with BCDs or MEIs and at least a 10 dB difference in bone conduction thresholds at two or more frequencies on the implanted side were included. Spatial hearing was evaluated in S_0N_0, S_1N_C, and S_0N_i conditions, both aided and unaided. Localization ability was also assessed.

Results: Preliminary data from the BCD group (N = 10) show improved signal-to-noise ratios of 2 dB (S_0N_0) and 6 dB (S_0N_C). However, no improvement – and slight deterioration – was observed in the S_0N_i (squelch) condition. No benefit in localization was found with BCD use. Data from the MEI group are still being collected and will be presented.

Conclusions: Initial findings suggest limitations in spatial hearing and localization with BCDs. The comparison will become more insightful once MEI data are available.

Free paper 0547

Bonebridge implantation in a child with congenital cholesteatoma: A case study

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Introduction: Congenital cholesteatoma is a relatively rare condition accounting for about 2% to 5% of all cholesteatomas. Congenital cholesteatomas pose a significant challenge to treat. Failure to detect cholesteatoma early can lead to progressive and severe damage to middle ear structures, resulting in hearing loss. If conventional hearing aids are not a viable option, a bone conduction implant may be considered. One of the most successful is the Bonebridge implant, designed for adults and children with conductive or mixed hearing loss. The aim of this study was to analyze the surgical implications, efficacy, and safety of the Bonebridge implant in our patient.

Case report: We report the case of a 10-year-old girl with a diagnosis of congenital cholesteatoma and progressive hearing loss. She had undergone multiple surgical procedures, with no lasting results. To improve hearing, she underwent a comprehensive diagnostic evaluation for an implantable bone conduction device, and she was found to be eligible for a Bonebridge implant. To verify the improvement in hearing, pure-tone audiometry, speech audiometry, and the Polish Matrix Sentence Test were performed before implantation, during processor activation, and at the follow-up visit 3 months later. Follow-up was planned at 3 and 6 months to monitor for recurrence of cholesteatoma, with cavity checks every 4 weeks.

Conclusions: After Bonebridge implantation, the patient demonstrated significant improvement in hearing thresholds and speech recognition. Implantation was uncomplicated and regular follow-ups were scheduled to monitor for recurrent cholesteatoma.

Free paper 0401

Can a floating mass transducer function as a middle ear microphone? Speech intelligibility results

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Introduction: The Floating Mass Transducer (FMT) is the electromagnetic actuator of the active middle ear implant Vibrant Soundbridge (MED-EL, Austria), consisting of a magnet and coils. Based on electromagnetic induction, mechanical vibrations are generated and transmitted to the ossicular chain. When applied in reverse, this principle is comparable to the operation principle of dynamic microphones. This enables the recording of acoustic signals through the FMT.

Objective: This study investigates the feasibility of using the FMT as an implantable middle ear microphone and evaluates the speech intelligibility of recordings obtained with the FMT operated in microphone mode. The findings aim to assess the potential of this approach for future applications such as fully implantable hearing devices.

Material and methods: The FMTs used in this study were adapted for the use as a microphone. Stimuli from a German speech test were presented via a loudspeaker at 65 dB SPL and 80 dB SPL and recorded through the FMT. To determine the intelligibility, the recorded speech tests were presented to normal-hearing subjects and CI users via a calibrated audiometer.

Results: Preliminary measurements were obtained with ten normal-hearing test subjects, and the results indicated that speech signals recorded at 65 dB SPL with the FMT were generally well comprehensible. The collection of data from CI users has only recently been initiated and is still in progress.

Conclusions: These initial findings from the speech intelligibility tests confirm the FMTs potential for promising applications as a middle ear microphone. This could represent an important step towards the development of fully implantable CIs that overcome the limitations associated with external processors, potentially offering improved convenience and hearing experiences for users.

Free paper 0322

Can Bonebridge BCI 602 be safely implanted in young children? A CT morphometric study

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Bone conduction hearing implants have become increasingly valuable in managing various forms of hearing loss, particularly conductive hearing loss, mixed hearing loss, and single-sided deafness (SSD). Among the most innovative of these devices is the Bonebridge BCI 602, a second-generation

active transcutaneous bone conduction implant developed to overcome several anatomical limitations associated with earlier models. It features a reduced implant thickness making it more suitable for younger patients and individuals with narrower mastoid anatomy. Successful implantation of the BCI 602 relies heavily on anatomical compatibility – particularly sufficient bone thickness and volume in the mastoid region. Critical factors influencing suitability include the size and pneumatization of the mastoid bone, proximity of the sigmoid sinus and dura mater, and spatial relationships with adjacent anatomical structures like the external auditory canal and middle cranial fossa. Insufficient bone may necessitate the use of surgical lifts or limit device selection altogether. Therefore, careful preoperative imaging analysis is essential for safe and effective device placement. While large-scale anatomical assessments have been conducted in European cohorts, there is limited evidence regarding anatomical suitability for the BCI 602 among Middle Eastern populations. Skull morphology, cranial bone thickness, and pneumatization patterns can vary significantly by ethnicity and geography. This is especially relevant for Saudi Arabia, where no published normative data currently exist regarding mastoid bone characteristics in relation to implantable hearing devices. This study aims to retrospectively evaluate high-resolution temporal bone CT scans of Saudi individuals to determine anatomical conditions necessary for Bonebridge BCI 602.

Free paper 0031

Can constant "baseline" electrical stimulation improve function in patients implanted with vestibulo-cochlear implants?

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Purpose: Prototypes of vestibular implants are under development to rehabilitate patients with bilateral vestibulopathy (BV), mimicking the physiology of the vestibular system. An alternative and simplified approach consists in delivering only constant electrical stimulation to restore a "baseline" activity in the vestibular system. This study aimed to quantify the benefits of such a "baseline" stimulation (BS) delivered to semicircular canal afferents during prolonged periods of activation.

Material and methods: Two female patients with BV received a modified cochlear implant providing 3 extra-cochlear electrodes implanted in the semicircular canals. The patients' speech processor was programmed to deliver a BS to the posterior semicircular canal for a period of 2.5 months. Objective and subjective measurements (gait analyses, questionnaires) were acquired throughout the stimulation period and afterward over 6 sessions. DHI scores and number of steps for the tandem walk task were also analysed.

Results: For patient-1, DHI scores improved from 52 to 30 throughout the BS, reflecting clinically relevant changes. After BS deactivation, DHI score increased to 48, representing a decline of functional status. The number of steps in the tandem walk task increased from 2 to 10 steps. Results for patient-2 do not present any changes during the BS.

Conclusions: Results in at least one patient demonstrate that vestibular deficits were reduced during the BS, complemented by positive patient feedback: "*the implant allows me to walk in a straight line*". Objective and subjective gains disappeared when BS was deactivated. While this stimulation shows promise, its effectiveness may vary among patients, highlighting the need for devices that employ stimulation methods closer to human physiology.

Free paper 0624

Case series: Cochlear implantation in complex anatomy

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Cochlear implantation (CI) in children with congenital inner ear and craniofacial anomalies poses unique surgical and rehabilitative challenges. Anatomical variations such as those seen in Goldenhar syndrome, Incomplete Partition Type II deformity, and Arnold–Chiari malformation require preoperative planning and intraoperative modifications to ensure optimal outcomes. We present a case series of four patients with complex congenital anomalies who underwent cochlear implantation.

Material and methods: This case series included four pediatric patients with profound sensorineural hearing loss who underwent unilateral cochlear implantation at a tertiary care center. Preoperative assessment included audiological evaluation, HRCT, and MRI. Intraoperative findings, surgical challenges, electrode insertion details, and postoperative auditory outcomes were analyzed.

Results: One child with Waardenburg syndrome underwent cochlear implantation via posterior tympanotomty with careful identification of aberrant anatomy. Neural response telemetry confirmed appropriate electrode function, and the child demonstrated progressive auditory gains postoperatively. Two patients exhibited Incomplete Partition Type II (IP-II) deformity characterized by cystic cochlear apex and enlarged vestibule. Both cases posed a risk of intraoperative cerebrospinal fluid (CSF) gusher. Perilymph ooze was encountered in one patient and successfully managed with soft tissue packing around the electrode array. Full electrode insertion was achieved in both cases, with satisfactory impedance levels and steady auditory-verbal progress during follow-up. The fourth patient had Arnold–Chiari malformation with associated ventriculomegaly and developmental delay. Preoperative neurosurgical clearance was sought. Surgical anatomy was favourable, and electrode insertion

was uneventful. Postoperative mapping revealed consistent auditory responses, and the patient showed meaningful environmental sound awareness and speech perception. Across all cases, there were no major postoperative complications such as meningitis, device extrusion, or facial nerve palsy. All patients demonstrated good Categories of Auditory Performance (CAP) scores over the follow-up period, although the degree of speech and language acquisition varied according to associated syndromic and neurological factors.

Conclusions: Cochlear implantation in children with complex congenital anomalies – including Waardenburg syndrome, IP II deformity, and Arnold–Chiari malformation – is feasible and safe with comprehensive radiological evaluation, and tailored surgical strategies. Anticipation of anatomical variations and potential CSF leak is critical. Despite syndromic and neurological comorbidities, meaningful auditory rehabilitation can be achieved.

Free paper 0274

Case study of eleven patients with unilateral deafness (SSD) after cochlear implant surgery

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Introduction: Single-Sided Deafness (SSD) is a clinical condition defined by the presence of normal hearing in one ear and severe to profound sensorineural hearing loss in the contralateral ear. The growing recognition of SSD as a significant challenge has driven the search for effective interventions worldwide, with several countries, including Brazil, already incorporating indications for devices for SSD in their clinical protocols.

Objective: The objective of the study was to evaluate the outcomes of adults with SSD using a cochlear implant.

Case study: This is a case study approved by the Ethics Committee of the Clementino Fraga Filho University Hospital (UFRJ). Eleven patients with single-sided deafness who were cochlear implant users were studied. The SSQ and Tinnitus Handicap Inventory (THI) questionnaires were applied before surgery, and at 1 and 3 months after activation, the Hearing in Noise Test (HINT – fixed and adaptive) was administered, and usage time was analyzed through data logging.

Results: In the SSQ questionnaire, an improvement was observed in all adults evaluated after 3 months in all questions, with improvement mainly in questions related to spatial hearing. Of the 11 patients, only 1 did not have a complaint of severe tinnitus, and in all there was considerable improvement in tinnitus after 3 months of CI use, with an average HINT score before surgery of 76 points and 21 after 3 months. The assessment of speech perception in the presence of competing noise was conducted using the HINT test, adapted for Brazilian Portuguese, in a free field, in the presence of fixed and adaptive competing noise. Significant improvement was observed with CI use, especially in the noise situation on the good ear. Regarding the analysis of CI datalogging, patients used it for an average of 8.2 hours per day, reporting great improvement in tinnitus, localization, and discrimination in noisy situations.

Conclusions: cochlear implantation is effective in reducing deterioration in patients with SSD and disabling tinnitus, leading to a reduction in tinnitus and restoration of binaural hearing abilities, especially in cases of recent deafness.

Free paper 0585

Case study of two pediatric patients with bilateral cochlear nerve hypoplasia and cochlear hypoplasia (Type I and IV) and results after bilateral cochlear implant surgery

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Objective: To present two pediatric cases of bilateral cochlear nerve severe hypoplasia associated with cochlear hypoplasia (Types I and IV) that achieved favorable outcomes following bilateral cochlear implant (CI) surgery.

Material and methods: Retrospective analysis of medical charts, imaging studies, audiologic hearing aids fitting evaluations, intraoperative findings and literature review.

Results: *Patient 1* is a female with no identifiable risk factors for hearing loss, failed newborn hearing screening. Congenital profound hearing loss was confirmed at ABR at 7 months and hearing aids were initiated. Computed tomography and magnetic resonance imaging demonstrated bilateral cochlear hypoplasia type I with severe cochlear nerve hypoplasia (CNH). MED-EL OTOPLAN analysis suggested FLEX24 or Medium electrode. She had positive aided responses and she underwent simultaneous bilateral cochlear implantation at 1 year and 4 months with FLEX24 electrode without complications. Neural Response Telemetry (NRT) showed robust responses, and intraoperative radiography confirmed appropriate electrode positioning. Device activation one month later demonstrated good responses, and she has remained a consistent implant user. *Patient 2* female and without risk factors, failed newborn screening and was diagnosed with congenital profound hearing loss with ABR at 4 months. Hearing aids were fitted at 7 months. Imaging revealed bilateral cochlear hypoplasia type IV and severe CNH. Aided audiologic evaluation

demonstrated functional auditory responses that supported the indication for cochlear implantation. Bilateral surgery was performed at 1 year and 10 months. A left-sided gusher occurred but was successfully controlled with a muscle graft. No other complications. NRT responses were excellent and X-ray confirmed adequate positioning bilateral. Activation is scheduled in two weeks from the day of this abstract submission.

Conclusions: Cochlear nerve hypoplasia should not be considered an absolute contraindication for CI. Preoperative evaluation should include detailed speech and auditory assessment with and without amplification, since insufficient access to appropriately fitted hearing aids often contributes to language deficits. Even minimal hearing experience can favor activation of auditory pathways. The positive aided responses observed in both patients reinforce that functional auditory findings must complement radiologic data when determining candidacy. A multidisciplinary approach integrating imaging, electrophysiologic and behavioral audiology remains essential for prognosis and surgical planning.

Free paper 0360

Challenges in audiological assessment and speech therapy in the pre-cochlear implant child

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Introduction: Audiological assessment and speech-language therapy intervention in children who are candidates for cochlear implantation are complex and interdependent processes, fundamental for appropriate candidate selection, prognosis definition, and therapeutic planning. Specific aspects of child development – such as neurological immaturity, limited attention and communication skills, and the high prevalence of comorbidities – pose significant challenges to obtaining reliable results. At the same time, speech-language therapy in the pre-implant period aims to promote communicative skills and to prepare the child and family for future auditory stimulation.

Material and methods: A narrative review of the scientific literature published between 2000 and 2024 was conducted using the PubMed, Scopus, and Google Scholar databases. Studies related to pediatric audiological assessment, severe to profound sensorineural hearing loss, cochlear implant candidates, pre-implant protocols, and early speech-language therapy intervention were included. The analysis focused on assessment methods used, reported clinical difficulties, and proposed therapeutic and evaluative strategies.

Results: The results show that the main challenges in pre-implant audiological assessment include inconsistency in behavioral responses – especially in very young children – difficulty in accurately estimating auditory thresholds, and the integrated interpretation of objective tests such as auditory brainstem responses and otoacoustic emissions. Factors such as global developmental delay, autism spectrum disorders, and cognitive impairments compromise the validity of results. In speech-language therapy, key challenges include the absence of effective auditory feedback, the promotion of prelinguistic skills, and the need for family-centered interventions. The literature emphasizes the importance of flexible protocols, repeated assessments, and interdisciplinary teamwork.

Conclusions: Audiological assessment and speech-language therapy in the pre–cochlear implant child require an individualized, specialized, and multidisciplinary approach. The careful combination of objective and behavioral methods, together with early, family-centered speech-language therapy intervention, is essential for informed clinical decision-making and for optimizing post–cochlear implant outcomes.

Free paper 0119

Changes in the situation of cochlear implantation in China after the centralized procurement of cochlear implants

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In 2024, cochlear implants devices are officially included in the scope of centralized procurement of cochlear implants organized by the Chinese state. This produces direct and profound effects on the domestic cochlear implant market and clinical implantation practices. From the perspective of price and accessibility, centralized procurement, through the "volume-for-price" model, reduced the average price of selected devices by more than 80%, lowering the original equipment cost of 100,000–250,000 yuan per unit. This adjustment effectively lowered the payment threshold, accelerating the release of medical demand among hearing-impaired populations previously constrained by financial barriers. Consequently, implantation rates have increased substantially, particularly among adults and elderly, as well as patients with bilateral hearing loss, single-sided deafness, or asymmetric deafness. Yet this rapid expansion has been accompanied by relatively low overall satisfaction among recipients, largely attributable to limited patient engagement in preoperative decision-making and excessively high expectations of outcomes. It is therefore predicted that cochlear implantation in China will continue to grow rapidly; however, to ensure both quantitative and qualitative improvements, it is essential to strengthen scientific and comprehensive preoperative evaluation and counseling, standardize postoperative rehabilitation, and implement full life-cycle management for recipients.

Free paper 0244

Children's Tinnitus Questionnaire (CTQ)

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Introduction: Tinnitus in children is hearing phantom sounds (ringing, buzzing, etc.) without an external source, often overlooked as they may think it's normal or can't express it. The largest study so far (43,064 children) showed that tinnitus in children affects just 3.1% of normally hearing children, although it is significantly more frequent (9%) in children with hearing loss.

If a child, accompanied by guardians, reports experiencing tinnitus, it indicates that it is clinically significant and requires further diagnostics. Tinnitus is usually subjective, and questionnaires are used to assess the severity of tinnitus.

Objective: The aim of this work is to present the process of creating the Children's Tinnitus Questionnaire (CTQ).

Material and methods: The development of the tool consisted of several stages. After a pilot study involving 12 children suffering from tinnitus, a validation study was conducted with 192 children aged 11 to 14 years with tinnitus. The children underwent audiometric testing, completed the Visual Analog Scale (VAS), and filled out the β-version of the questionnaire.

Results: As a result of the validation process, a new 11-item questionnaire concerning tinnitus in children was created. It includes items related to the impact of tinnitus on functional, cognitive, emotional, and social spheres. The validity of the new tool was established by finding significant correlations between it and the VAS loudness ($r = 0.42$), VAS annoyance ($r = 0.67$), and VAS coping ($r = -0.41$). Validity was also confirmed by measuring differences in CTQ scores among four groups of children with graded frequencies of tinnitus. Internal consistency, assessed using Cronbach's alpha, was high ($\alpha = 0.82$)

Conclusions: The Children's Tinnitus Questionnaire is the first fully validated multi-item instrument designed specifically for children. The tool has the potential to become a valuable new instrument for use in clinical practice and research; it might be useful for assessing the impact of tinnitus on those children who find that the condition creates problems in their everyday life.

Free paper 0279

CI teens and young adults: Where are they today? Outcomes and future challenges

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Introduction: With the widespread implementation of early cochlear implantation, a significant number of recipients is now transitioning from adolescence to young adulthood. While early intervention has fundamentally improved spoken language development, this generation faces unique challenges as they move toward independence. Understanding their current academic, social, and personal experiences is essential for professionals to provide support that aligns with the demands of this life stage.

Material and methods: This presentation synthesizes recent international literature regarding long-term outcomes in CI users, integrated with clinical insights and observations from professional practice in CI rehabilitation. By combining evidence-based findings with clinical experience, a comprehensive overview is provided of the challenges and successes encountered by adolescents and young adults in their daily lives.

Results: Evidence indicates that a majority of young CI users successfully integrate into mainstream education, often matching the academic levels of hearing peers. However, this success often masks underlying challenges. Research and clinical practice show that many continue to experience high levels of listening fatigue and deficits in executive functions which can hinder higher-level academic success. Furthermore, adolescence is often marked by a strong desire for peer conformity. Many CI teens struggle and do not wish to be perceived as different from their hearing peers, which can impact how they manage their hearing loss in social settings. As they transition into higher education or the workplace, new challenges emerge. Throughout their childhood, most have benefited from a highly involved support network of parents, teachers, and therapists. While this provided a solid foundation, it also means that the environment often managed their needs for them. When this support system diminishes during young adulthood, a significant gap in self-advocacy skills often becomes apparent. Young adults find it difficult to independently communicate their requirements in new, demanding environments.

Conclusions: Rehabilitation for teens and young adults must evolve beyond traditional auditory training toward a holistic, patient-centered approach. This includes providing targeted support for executive functions, and fostering self-advocacy. Empowering young adults to take full ownership of their hearing technology and communication strategies is paramount for successful participation in a complex social landscape.

Free paper 0263

Clinical evaluation of the new bone-conduction implant Sentio: Outcomes in hearing rehabilitation

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Introduction: Sentio (Oticon Medical) is an active bone-conduction implant approved for clinical use in Europe and the United States in 2024. Among currently available bone-conduction implants, Sentio is the smallest system, offering a minimally invasive and cosmetically discreet option. The device is indicated for patients aged ≥12 years with conductive or mixed hearing loss who cannot use conventional hearing aids.

Objective: The aim of this study was to evaluate the clinical outcomes of hearing rehabilitation with the Sentio implant.

Material and methods: The study included 26 patients, 16 women and 10 men, aged 13 to 64 years ($M = 42$; SD = 17.3) with conductive ($n = 9$) or mixed hearing loss ($n = 17$). Patients were implanted with the Sentio system. Preoperative assessment involved pure-tone audiometry and speech audiometry (Demenko and Pruszewicz word lists). Speech perception in noise was evaluated preoperatively using the Polish Matrix Sentence Test. Free-field measurements were then conducted on the day of device activation and at a 1-month follow-up visit. Moreover, APHAB questionnaire was used preoperatively and one month post-activation.

Results: Mean preoperative air-conduction threshold across 500–4000 Hz was 55.3 dB HL (SD = 13.3). After Sentio activation, hearing threshold improved significantly ($F(2,50) = 135$; $p < 0.001$) to 25.1 dB HL (SD = 2.89) immediately after activation and remaining stable at 24.2 dB HL (SD = 5.57) at 1 month. Speech discrimination increased ($F(2,44) = 337$; $p < 0.001$) from a preoperative mean of 11.3% (SD = 18.7) to 88.8% (SD = 11.2) after activation and further to 94.2% (SD = 5.14) at first follow-up. Moreover, speech perception in noise improved markedly ($F(2,36) = 31.9$, $p < 0.001$) from +2.12 dB SNR preoperatively to –1.92 dB SNR after activation and –2.75 dB SNR at follow-up. APHAB results showed a significant improvement in perceived hearing difficulties, with global scores decreasing from 52.9 to 32.6 ($W = 159$, $p < 0.001$).

Conclusions: The Sentio bone-conduction implant led to marked improvements in hearing performance and a meaningful reduction in self-reported hearing difficulties, supporting its reliability and clinical effectiveness for auditory rehabilitation in patients with conductive and mixed hearing loss.

Free paper 0425

Clinical impedance measurements of cochlear implant electrode arrays: A literature review

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Introduction: Electrode impedance is a key parameter influencing cochlear implant (CI) performance and is routinely measured using impedance telemetry. Telemetry delivers brief electrical current pulses to a selected electrode contact and records the resulting voltage. Impedance is calculated as the voltage-to-current ratio according to Ohm's law. Clinically, impedance telemetry supports device integrity assessment: low values may indicate a short circuit, whereas high values may suggest an open circuit. Importantly, electrode impedance changes over time and depends on multiple factors, including cochlear biophysical conditions, surgical technique, electrode design, and stimulation mode. Impedance profiles may differ between pediatric and adult CI users. Understanding impedance dynamics is essential for optimizing fitting parameters and monitoring cochlear status.

Objective: To review the literature on clinical electrode impedance measurements in CI systems and identify factors influencing impedance changes over time.

Material and methods: A literature search was performed in PubMed and Google Scholar. Studies including pediatric and adult populations after cochlear implantation were eligible.

Results: The reviewed studies indicate that impedance telemetry is performed in clinical practice and provides information on electrode function and cochlear condition. In the first weeks after implantation, impedance typically peaks, attributed to tissue formation around the electrode array. After CI activation and initiation of electrical stimulation, impedance gradually decreases and stabilizes. Further changes may occur beyond 9–12 months but are less pronounced. Sudden impedance increases may reflect inflammatory processes and can prompt intervention. Several reports show higher early postoperative impedance in children than in adults, likely due to a stronger immune response; however, values become comparable after several months. Recent research highlights intraoperative steroid use to mitigate inflammation, resulting in lower impedance and suggesting an association with long-term impedance reduction.

Conclusions: Clinical impedance measurements are fundamental for CI fitting and follow-up, providing insight into electrode function and electrode–tissue/electrolyte interactions in the cochlea. Ongoing studies investigating impedance

components may improve understanding of post-implantation cochlear processes and support more effective stimulation parameter optimization and outcomes.

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Free paper 0562

Clinical pitfalls and management strategies in complex cochlear implantation: A case-based series

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Introduction: While cochlear implantation (CI) is highly successful in standard indications, complex clinical scenarios continue to challenge perioperative decision-making and postoperative outcomes. We report a series of six illustrative cases highlighting practical pitfalls and management strategies in challenging CI presentations.

Material and methods: A retrospective review of six instructive CI cases from a tertiary referral practice was performed. Clinical history, imaging, intraoperative electrophysiological measures, and postoperative courses were analyzed. Cases focused on geriatric rehabilitation, post-meningitic ossification, delayed facial nerve palsy, electrode malposition, elective explantation due to imaging requirements, and MRI-related magnet complications.

Results: (1) Geriatric CI: A 69-year-old male with 24 years of auditory deprivation achieved significant rehabilitative success after 10 months of consistent device use. (2) Post-meningitic CI and Delayed Palsy: In a 63-year-old patient with post-meningitic bilateral hearing loss, delayed incomplete facial nerve palsy developed three weeks postoperatively. Complete recovery was achieved within one month following combined valacyclovir and prednisone (1 mg/kg/day) therapy. (3) Electrode Malposition: A case was identified where intraoperative telemetry (NRT/impedance) was reassuring despite radiological evidence of malposition, emphasizing the limitations of objective testing. (4) Elective Explantation: The management of a patient with epilepsy requiring recurrent MRI who requested device removal was analyzed regarding patient autonomy and clinical necessity. (5) Postoperative Facial Nerve Palsy: A separate case of postoperative-onset facial paralysis was evaluated, focusing on early intervention protocols. (6) Magnet Displacement: A case of magnet dislodgement from its silicone housing during MRI was examined, highlighting technical challenges and the subsequent revision process even with MRI-compatible devices.

Conclusions: Challenging CI scenarios require individualized candidacy assessment, realistic expectation management, and a verification strategy that does not rely solely on intraoperative telemetry. Early recognition of electrode malposition, prompt management of facial nerve palsy, and awareness of MRI-related complications are essential to mitigate morbidity and optimize functional outcomes.

Free paper 0611

Clinical role of transtympanic promontory testing in cochlear implant candidates with long-term auditory deprivation

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Introduction: In cochlear implant (CI) candidates with long-term auditory deprivation, transtympanic promontory stimulation is commonly used to assess auditory nerve excitability and guide clinical decision-making. Although patients with prolonged deprivation are traditionally considered to have limited expectations for speech perception, many still experience meaningful auditory benefit after implantation. This study aimed to evaluate the relationship between positive promontory stimulation and speech perception outcomes in this challenging population.

Material and methods: We conducted a retrospective observational study of CI candidates with severe-to-profound hearing loss who underwent transtympanic promontory stimulation prior to implantation. Speech discrimination score (SDS,%) was assessed preoperatively and at 3 and 6 months after device activation. The primary endpoint was SDS at 6 months. Poor outcome was defined a priori as SDS <20%. Longitudinal changes in SDS and overall functional benefit were analyzed.

Results: Among promontory-positive implanted patients with available 6-month data (n = 16), speech outcomes were variable, with poor outcome observed in 25% of cases. Most patients demonstrated progressive improvement in SDS from the preoperative condition to 3 and 6 months. Importantly, even patients with limited speech perception showed measurable gains compared with their preoperative performance. Clinical review suggested that early-onset hearing loss and long auditory deprivation were more frequent among poorer performers, whereas postlingual or progressive hearing loss was associated with higher speech scores. Despite heterogeneous speech outcomes, the majority of patients experienced functional improvement and reported satisfaction with implantation.

Conclusions: Transtympanic promontory stimulation remains a valuable component of the preoperative evaluation in CI candidates with long-term auditory deprivation. While speech perception outcomes vary, most patients demonstrate measurable auditory improvement after implantation, supporting the clinical usefulness of promontory testing and emphasizing the importance of individualized counseling and expectation management.

Free paper 0427

Clinical–surgical profile and early auditory outcomes in a multicenter cochlear implant registry (2019–2025)

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Introduction: In cochlear implantation, surgical approach, intraoperative findings, and electrode selection are central to counseling and early postoperative expectations. Multicenter real-world data can contextualize contemporary practice and early outcomes in routine care.

Aim: To characterize cochlear implantation practices across multiple centers, focusing on surgical approach, intraoperative findings, and electrode utilization, and to describe early postoperative audiometric outcomes and patient-reported outcome (PRO) measures in routine clinical care.

Material and methods: Descriptive analysis of consecutive cochlear implant (CI) surgeries performed between December/2019 and March/2025 across participating centers. Data are reported as *n* [%] and median (Q1–Q3). Exploratory comparisons used the chi-square test.

Results: A total of 1.627 CI surgeries were included; 60.4% were aged ≥11 years, and 39.6% were aged ≤10 years. Implantation was right-sided in 52.1% and left-sided in 47.9%. Residual hearing was documented in 6.3%, and normal inner-ear structures in 90.0%. Facial nerve monitoring was used in 54.0%. Cochlear access was predominantly via the round window (69.5%) and extended round window (21.3%), totaling 90.8%; cochleostomy accounted for 7.6%. Electrode placement was reported as satisfactory in 96.2%, and 94.7% of cases had no atypical intraoperative impedance measurements. Perioperative corticosteroids were administered in 65.8%. Electrode utilization was dominated by two models: 622 (39.6%) and 632 (27.7%). Among available measurements, open-field pure-tone average (PTA; 0.5/1/2/4 kHz) was 31.3 dB HL (26.3–37.5) at 3 months and 28.8 dB HL (26.3–36.3) at 12 months, consistent with clinically meaningful early access to sound in routine follow-up. Patient-reported outcome (PRO) capture remained a key practical challenge: COSI assessments were available for 36.6% of cases, and PRO completeness differed significantly across high-volume centers (χ^2, $p < 0.001$), indicating variability in postoperative workflows rather than isolated patient factors.

Conclusions: Across centers, cochlear implantation was characterized by predominant round-window approaches, high rates of satisfactory electrode placement, and stable intraoperative profiles. Early open-field audiometric outcomes among available measurements were favorable. Marked variability in PRO capture across high-volume centers highlights an immediate, clinically relevant opportunity to standardize postoperative pathways and documentation, thereby strengthening routine outcome monitoring and cross-center comparability.

Free paper 0304

Cochlear and bone implantation in a 76-year-old patient: Case study

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Introduction: Hearing impairment is a condition that significantly affects patients' quality of life. With increasing life expectancy and the growing possibilities for maintaining an active lifestyle among elderly individuals, there is a rising demand for accessible treatment methods for age-related hearing loss. The aim of this article is to analyze a pioneering case of a 76-year-old patient fitted with both a cochlear implant and a bone conduction implant.

Case description: This case report concerns a 76-year-old patient who underwent surgical implantation of a cochlear implant and a bone conduction implant at the Institute of Physiology and Pathology of Hearing in Kajetany. A MED-EL cochlear implant was implanted in the left ear, while an Oticon bone conduction implant (Ponto system) was implanted in the right ear.

Results: As part of the analysis of the patient's medical history, a comparison of pure-tone and speech audiometry results before and after implantation of both devices was performed. The patient's responses from the APHAB questionnaire were analyzed, along with free-field speech audiometry results obtained after treatment of the left ear. Word recognition scores for monosyllabic words using only the left cochlear implant (with the contralateral ear occluded) were 55% in quiet (signal level 65 dB) and 15% in noise (SNR 10 dB). In free-field speech audiometry, the word recognition score for the hearing aid in the right ear at 65 dB was 95%. In the free-field speech audiometry test using the BAHA device in the mid-frequency range at 65 dB, the word recognition score was 75%. Comparison of the results revealed an improvement of 55% in the left ear and 25% in the right ear.

Conclusions: Based on the obtained results, bilateral implantation significantly improved the patient's hearing and speech understanding. This had a substantial positive impact on the patient's quality of life by enhancing communication abilities in social settings, reducing the risk of social exclusion, and facilitating everyday functioning.

Free paper 0398

Cochlear duct length measurement based on computed tomography imaging of the temporal bone

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Introduction: Accurate preoperative estimation of cochlear duct length (CDL) can aid in cochlear implant (CI) planning and electrode selection. While various mathematical formlas have been proposed to calculate CDL from geometric cochlear parameters extracted from CT imaging, discrepancies between manual techniques and modern software introduce variability in clinical practice. This study aimed to compare CDL values derived from three established literature-based equations – Alexiades, Schurzig and Comined – and a proposed "Corrected-Combined" modification against OTOPLAN software to evaluate differences and correlations between them.

Material and methods: Retrospective analysis was performed on 48 temporal bone CT scans of CI candidates. Cochlear parameters, including basal turn diameter (*A*-value) and width (*B*-value), were measured using OTOPLAN (version 3.1) and applied to each formula to estimate CDL at the level of organ of Corti. The Corrected-Combined equation utilized a modified lateral wall to organ of Corti distance of 0.629 mm based on synchrotron imaging data in literature. Agreement was assessed via mean differences, standard deviation (SD) of differences and coefficient of determination (R^2). One-way non-parametric Friedman's ANOVA was performed to compare individual absolute errors. Reliability of derived conversion equations was validated using Wilcoxon test.

Results: Among literature-based equations, the Combined equation demonstrated both the lowest mean difference (1.20 mm) and SD of difference (0.12 mm) in relation to OTOPLAN. Furthermore, along with Schurzig's equation, it displayed the highest value of R^2 coefficient (0.996). However, its modification in the Corrected-Combined equation resulted in significantly lower mean difference (–0.12 mm). Friedman's ANOVA with planned comparisons confirmed that the Corrected-Combined approach yielded significantly lower absolute errors than all other manual methods. Furthermore, the derived conversion equations significantly reduced the magnitude of error across all manual methods with a median improvement in accuracy ranging from 0.082 mm to 1.975 mm.

Conclusions: The Corrected-Combined equation provides the most accurate manual reflection of OTOPLAN-derived CDL values. The proposed conversion equations enable straightforward translation of results across different techniques, facilitating reliable comparison and standardization of CDL measurements among studies.

Free paper 0155

Cochlear electrode array tip fold-over in incomplete partition-I

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Electrode tip fold-over is a rare complication of cochlear implantation (CI), especially in lateral wall (LW) electrodes. We describe a case of LW electrode tip fold-over in a patient with incomplete partition type-1 (IP-I). Preoperative measurement of cochlear length is important for optimal CI electrode selection. In cochlear malformation, Stenvers X-ray is superior to spread of excitation in detecting tip fold-over. Despite tip fold-over, the hearing threshold, speech reception threshold, and word recognition score were almost symmetrical bilaterally. Therefore, revision surgery should be reserved for patients with persistent symptoms or markedly affected speech performance, in whom deactivation did not suffice.

Free paper 0466

Cochlear implant in absent semi circular canals

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Cochlear implantation in CHARGE syndrome with absent lateral semicircular canal presents significant anatomical challenges due to distorted landmarks and abnormal facial nerve course. Preoperative imaging is essential for surgical planning. Despite intraoperative difficulty, safe electrode insertion can be achieved with modified techniques. Postoperatively, auditory outcomes show gradual but meaningful improvement, although progress is slower than in non-syndromic patients. Careful candidate selection, experienced surgical management, and intensive rehabilitation are key to achieving functional hearing benefit in this complex population.

Free paper 0290

Cochlear implant in cochlear hypoplasia type I: Drill out or lateral semicircular canal approach?

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Introduction: Inner ear malformations are congenital anomalies affecting the bony and membranous labyrinth, accounting for 10 to 20% of cases of sensorineural hearing loss. They originate from an arrest in embryonic development between the 3rd and 11th weeks of gestation. According to the Sennaroglu classification, cochlear hypoplasia type I is the most severe form of hypoplasia. In this malformation, the cochlea appears as a significantly small, rounded, empty cavity in close contact with the internal auditory canal (IAC), lacking internal architecture and the modiolus. It may be accompanied by a dilated vestibule. Type I cochlear hypoplasia results in profound sensorineural hearing loss. The treatment is the cochlear implantation, taking into account the need for short electrodes due small cavity. Intraoperative gusher is very common, increasing the risk of cerebrospinal fluid leak. There are many options to do the surgery for the cochlear implant, between them drill out and access through lateral semicircular canal are most important alternatives to conventional approach.

Material and methods: A comparison between two surgical techniques were done. Pediatric patients received cochlear implants, each one with a different technique. Only objective measurements were done. Number of active electrodes, level of electrical impedance and current charge units (CU) were compared.

Results: Patient A (10 years) received cochlear implant by drill out, had only 5 electrodes switched on, with electrical impedances from 11.23 to 20 KOhm. (avg 15.9) while patient B had 9 active electrodes with electrical impedances from 4.14 to 6.45 KOhm. (avg 5.45). However, the current CU were more intensive in patient who received lateral semicircular approach.

Conclusions: Objective measurements showed better results in patients implanted by lateral semicircular canal than drill out, however the current units needed are significantly increased.

Free paper 0108

Cochlear implant recipients' experience with remote check in King Saud Medical City

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The remote check feature enables cochlear implant users with Nucleus N7, Kanso2, and other compatible cochlear sound processor models to conduct multiple tests remotely using compatible smartphones through the Cochlear smart Nucleus application. Remote check was implemented at King Saud Medical City during the COVID-19 pandemic to ensure continuity of care and allow clinicians to monitor their performance efficiently. Since then, this feature has been adopted to support ongoing monitoring of cochlear implant recipients. A virtual clinic was established to review remote check results and document them in patients' medical records. At King Saud Medical City in Riyadh, the remote check tool has proven to be useful as the number of cochlear implant recipients continues to grow annually, and due to limited space and limited clinicians, which results in crowding appointments and schedules. With over 70 recipients enrolled and assessed through remote check, both pediatric and adults, the paper will discuss their experience from their perspective. Data were collected using 16-questions online survey that gathered comprehensive information regarding user experience obstacles and concerns, which will help improve service delivery and overall patient experience.

Free paper 0200

Cochlear implant revision surgery and long-term outcomes in a cohort of 1,770 implants

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Objective: To evaluate revision surgery after cochlear implantation in a large single-centre cohort, focusing on revision frequency, leading indications, brand-related complication patterns, and long-term device survival. A secondary aim was to compare age-stratified outcomes to identify differences in device loss between paediatric and adult recipients.

Material and methods: A retrospective implant-level analysis was conducted, including 1,420 patients who underwent cochlear implantation, representing 1,770 implants. Demographic characteristics, implant brand, revision status, and indications were extracted from clinical records. Revision surgery was assessed descriptively, and long-term outcomes were evaluated using Kaplan–Meier survival analyses. Device failure-related explantation was examined separately from all-cause device loss. Brand-related complication rates were compared using χ^2 or Fisher's exact tests. Kaplan–Meier curves were used to determine 10-year cumulative device loss, and age-group differences (<18 vs ≥18 years) were analysed using the log-rank test.

Results: Revision surgery occurred in 159 implants (9.0%), with a total of 221 revision procedures. The most common indications were device failure (57 implants, 3.2%), flap-related complications (49 implants, 2.8%), and migration (34 implants, 1.9%). Significant brand-related differences were observed in device failure ($p = 0.015$) and flap complications ($p = 0.001$). The 10-year cumulative revision rate was 15.19%. The 10-year cumulative incidence of device failure-related explantation was 4.32%. The crude 10-year all-cause device loss rate was 4.69%. Device failure-related 10-year survival was 95.6% for Cochlear/Nucleus, 95.3% for MED-EL, and

98.1% for Advanced Bionics. Age-stratified analyses showed significantly higher all-cause device loss in adults compared with paediatric patients (log-rank $p = 0.0018$), with 10-year cumulative rates of 10.93% in adults and 5.09% in children.

Conclusions: In this large cohort, revision surgery and device loss increased steadily over time. Device failure, flap-related issues, and migration were the major revision causes. Significant differences in failure and flap complication rates were identified across implant brands. Adult recipients demonstrated higher long-term device loss than paediatric patients. These results emphasise the importance of long-term surveillance, brand-specific risk evaluation, and age-informed counselling in routine follow-up of cochlear implant recipients.

Free paper 0369

Cochlear implantation after subtotal petrosectomy for auricular melanoma

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Introduction: Advanced malignant tumors of the auricle represent a major challenge not only in oncological management but also in functional rehabilitation. In patients with pre-existing severe hearing impairment, cochlear implantation (CI) may play a crucial role, even after extensive oncologic and reconstructive ear surgery.

Case presentation: We report the case of a female patient with recurrent malignant melanoma of the left auricle. Initial surgical treatment was performed externally in 2021, followed by an R1 resection at an outside institution in January 2025. Subsequent oncological work-up revealed recurrent malignant melanoma classified as rpT3b pN1c cN0 L1 Pn0 V0 R0, corresponding to clinical stage IIIc. In May 2025, extensive oncologic surgery was performed including left-sided auriculectomy, subtotal petrosectomy, obliteration with autologous abdominal fat, and bilateral neck dissection. Soft tissue reconstruction was achieved using a radial forearm free flap. In addition, bone-anchored implants were placed to facilitate future epithesis-supported auricular reconstruction. The postoperative course was uneventful, and follow-up examinations after adjuvant radiation showed no evidence of local recurrence or distant metastases. The patient is currently disease-free, with prosthetic auricular rehabilitation planned. Independent of the oncological disease, the patient suffered from a relevant pre-existing progressive hearing impairment. After completion of primary oncologic therapy and confirmation of stable tumor control, cochlear implantation was performed in January 2026 as part of the functional rehabilitation strategy. Despite the altered anatomy following subtotal petrosectomy and complex soft tissue reconstruction, CI surgery was feasible and uneventful. The aim of the intervention was to achieve meaningful auditory rehabilitation and improve the patient's quality of life. At present, the patient remains in a stable oncological condition with ongoing prosthetic auricular reconstruction and successful audiological follow-up after cochlear implantation.

Conclusions: This case demonstrates that cochlear implantation can be safely and effectively performed after radical oncologic surgery of the ear, including subtotal petrosectomy. Early interdisciplinary planning and integration of CI treatment into the overall therapeutic concept allow functional hearing rehabilitation even in complex surgical situations. Cochlear implantation should therefore be considered in selected patients with hearing loss undergoing extensive oncologic ear surgery.

Free paper 0207

Cochlear implantation after vestibular schwannoma resection: Treatment challenges and clinical-surgical outcomes

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Introduction: Vestibular Schwannoma (VS) constitutes a benign nerve tumor of the cerebellopontine angle (CPA). The reported incidence has increased after greater access to Magnetic Resonance Imaging (MRI). VS mainly affects balance, facial nerve, tinnitus and asymmetrical sensorineural hearing loss. Surgical approach to VS resection is challenging due to the delicate anatomy and noble structures of the lateral skull base. Surgery can leave many after-effects, such as paralysis of the facial nerve, injuring other cranial nerves and worsening of deafness and balance. Cochlear Implants (CIs) are already well established for the rehabilitation of patients with severe and profound deafness. However, in cases of VS, they are more challenging. The cochlear anatomy and the auditory nerve can be modified by the tumor. Often, we cannot remove the entire tumor (big tumors and/or neurofibromatosis type 2) and the electrode could not be totally inserted. This may compromise the hearing improvement. Also, these patients require periodic MRI to monitor tumor recurrence. CI promotes acoustic shadowing, so tumour recurrence analysis is difficult.

Material and methods: This was a prospective study performed over a period of 7 years, May 2018 to July 2025. VS was diagnosed with clinical and audiological features, MRI and Histopathological analysis. Only proven tumors were considered. Patients with severe/profound hearing loss were candidates for cochlear implantation after VS resection.

Results: There were six patients with VS, three men and three women. Three had bilateral VS and neurofibromatosis type 2 (NF2). All patients were implanted at the same surgical time of the VS resection by translabyrinthine approach. Nevertheless, one patient had the VS resected by retrosigmoid approach in the same ear nine years after. Five have used CI for an adequate daily amount of time and have shown good hearing improvement. The best results were in the smallest unilateral sporadic tumors and patients with the shortest time of profound deafness.

Conclusions: A greater number of studies and patients are needed for more robust assumptions and our sample size of patients was limited. However, CI in our study showed beneficial improvement for the majority of patients with VS and severe or profound hearing loss.

Free paper 0283

Cochlear implantation benefits for patients with trauma-induced bilateral hearing loss

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Introduction: Accidental or intentional head trauma can result in degrees of sensorineural hearing loss (SNHL), but if the cochlear nerve is intact, cochlear implantation is the main option to restore hearing. This retrospective study evaluated outcomes from cochlear implantation in 9 patients with bilateral severe SNHL after major head trauma.

Material and methods: The study included 9 patients who lost their hearing (profound hearing impairment) due to major head trauma and were qualified for cochlear implantation. Before surgery, each patient underwent tonal and speech audiometry in free field, using a fitted hearing aid. To assess the benefits of cochlear implants, tests were repeated 12 months after surgery, with speech audiometry conducted in quiet and noisy conditions using an active cochlear implant.

Results: The patients exhibited various consequences of major head trauma, such as fractures of various skull bones and brain tissue damage. All participants showed significant improvement in speech understanding with the active cochlear implant. Before surgery, the average speech audiometry score with hearing aids was 1.6%, which increased to 61.7% in a quiet environment and 32% in a noisy environment after surgery.

Conclusions: Cochlear implants give the ability to hear and understand speech to patients who have injuries from major head trauma. The complexity and multifaceted nature of head injury highlights the need for further research and the development of therapeutic methods.

Free paper 0504

Cochlear implantation combined with subtotal petrosectomy: Indications and outcomes based on our case series

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Introduction: Cochlear implantation is the most effective therapeutic modality for severe-to-profound sensorineural hearing loss. In certain clinical situations, however, the conventional surgical approach may be contraindicated or associated with increased risk, necessitating alternative surgical exposures and tailored operative strategies. Furthermore, in several disease entities, complete surgical eradication requires an extended approach that inevitably sacrifices residual hearing. These patients nevertheless require adequate auditory rehabilitation. The aim of this study is to outline the indications, surgical considerations, and clinical outcomes of subtotal petrosectomy combined with cochlear implantation either simultaneously or in a staged manner.

Material and methods: A retrospective review was conducted of all patients who underwent simultaneous or sequential cochlear implantation and subtotal petrosectomy in our Department from January 2023. Demographic characteristics, surgical indications and considerations, and postoperative course were analyzed. Functional and audiological outcomes were assessed.

Results: Fifteen patients were included in the analysis. In ten cases, cochlear implantation was performed simultaneously with subtotal petrosectomy. Indications for surgery included pre-existing radical mastoid cavities, chronic suppurative otitis media, inner ear malformations, biofilm-related electrode failure, radionecrosis of the external auditory canal, malignant otitis externa, and tympanojugular paraganglioma. Across the cohort, majority of the patients demonstrated favorable postoperative auditory performance. No major complications were observed during follow-up.

Conclusions: Cochlear implantation combined with subtotal petrosectomy represents a safe, versatile, and effective surgical strategy for patients in whom standard cochlear implantation techniques are not feasible due to complex anatomy, chronic infection, or the sequelae of prior surgery or radiotherapy. This approach ensures first disease eradication, thereby provides stable implant condition, and enables safe and effective auditory rehabilitation even in the most challenging clinical scenarios.

Free paper 0185

Cochlear implantation for partial deafness treatment: A case study of low-frequency stimulation

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Introduction: Ongoing improvements in cochlear implant (CI) technology and surgical methods have broadened CI candidacy to include patients with varying degrees of low-frequency hearing. Nonetheless, a subset of patients with non-functional or borderline low-frequency hearing but preserved high-frequency residual hearing remains off-label for CIs, despite limited benefit from conventional hearing aids.

Material and methods: Preoperative and postoperative hearing was evaluated using pure-tone audiometry, measuring air-conduction (AC) thresholds at 125–8000 Hz. Hearing preservation (HP) was assessed using the Skarzynski classification system, with AC thresholds measured preoperatively, and at 1, 12, 24, and 36 months post-surgery. Additionally, high-frequency hearing (2–8 kHz) was analyzed separately to evaluate HP in the basal cochlea. Word recognition scores (WRS) were assessed using the Polish Monosyllabic Word test in free-field at 65 dB SPL, both in quiet and in noise, prior to surgery with a hearing aid and at 12 and 24 months postoperatively with the CI.

Results: A 47-year-old patient with residual hearing at the functional threshold (≤75 dB HL) in the low and mid frequencies (125–1500 Hz) and functional high-frequency hearing (≤70 dB HL) in the 2000–8000 Hz range was evaluated. The patient underwent CI surgery with a MED-EL FLEX26 electrode via round window insertion. Hearing preservation (HP) was complete up to 24 months and partial up to 36 months postoperatively. For high frequencies only, complete HP was maintained throughout the 36-month follow-up. Twelve months after surgery, the patient's WRS improved by 75 percentage points in quiet and 70 points in noise.

Conclusions: This case demonstrates that functional residual hearing in the basal cochlea can be preserved following CI surgery, despite the region's susceptibility to insertion trauma. Functional high-frequency hearing alone should not withhold CI surgery, particularly when conventional hearing aids provide insufficient benefit.

Free paper 0220

Cochlear implantation in a case of single-sided deafness with prolonged auditory deprivation due to loss of functional ear after head injury

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Aim: To present a rare case study of a patient with good outcomes despite prolonged auditory deprivation.

Material and methods: A 20-year-old patient presented at our hospital with a history of severe to profound hearing loss in the right ear after an episode of Tuberculosis at the age of three. The left ear had normal hearing and remained his only functional ear. Speech and language milestones were all achieved, and communication skills were normal. Due to a recent head trauma, this patient lost hearing on the left side, which was his only normal hearing ear. After multiple surgeries and prolonged stay in the ICU, this patient was discharged with no hearing in both ears. Both ears were clinically evaluated with audiological tests and radiological investigations. Bilateral profound hearing loss was diagnosed with near complete fibrosis of the left cochlea and normal cochlear anatomy of the right cochlea. Since the left ear had normal hearing until the recent head injury, that would have been the normal choice of ear for the cochlear implantation. However, due to radiological contraindication, the right ear (the ear with prolonged auditory deprivation) was selected for the CI surgery. The patient and the family were counseled, and realistic expectations were set. OTOPLAN analysis was done, and MED-EL cochlear implant with a STANDARD electrode was selected to provide optimal coverage as per the right cochlear duct length. Full electrode insertion was achieved during surgery, and switch-on of the device was done 3 weeks later.

Results & Conclusions: Patient was able to demonstrate the abilities of localisation and from the right side after 3 weeks of rehabilitation sessions and patient continues to improve in his auditory tests of perception as well. In conclusion, despite of the prolonged period of auditory deprivation, the results seem promising in this young adult and we followed this patient further to study the progress in all aspects of hearing.

Free paper 0380

Cochlear implantation in a child with CHARGE syndrome: Navigating surgical complexities and hearing outcomes

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Introduction: CHARGE syndrome is a complex multisystem disorder frequently associated with congenital ear malformations and severe hearing impairment. Cochlear implantation in this population poses significant diagnostic and surgical challenges due to temporal bone anomalies.

Case presentation: We present a 1-year-11-month-old female, born prematurely at 36+2 weeks following a normal pregnancy and delivery. She is the first child of non-related parents. At birth, she was diagnosed with right-sided choanal atresia. She failed newborn hearing screening bilaterally, and BERA testing confirmed profound bilateral sensorineural hearing loss. High-resolution temporal bone CT demonstrated multiple structural anomalies consistent with CHARGE spectrum pathology, including a hypoplastic cochlea with 1.5 turns, an aberrant facial nerve course, absence of the lateral and posterior semicircular canals bilaterally, and cystic dilation of the vestibular aqueducts. An audiological evaluation was performed, confirming that the patient is a suitable candidate for cochlear implantation. Given the complex anatomy – specifically the aberrant course of the facial nerve and underdeveloped temporal bone – a multidisciplinary team review was undertaken, resulting in the decision to proceed with subtotal petrosectomy and blind-sac closure. *Surgical intervention:* The skin of the external auditory canal was separated in a sleeve-like manner, everted outward, and sutured externally to create a blind sac. A canal wall down mastoidectomy was performed with creation of a contained radical cavity. The facial nerve was identified passing directly over the cochlear promontory, limiting safe access to the round window. Therefore, a cochleostomy was drilled in the basal turn and partial electrode array insertion was achieved. The resultant cavity was obliterated using abdominal fat. This case highlights the substantial anatomic variability encountered during cochlear implantation in children with CHARGE syndrome. Unusual surgical landmarks such as semicircular canal aplasia and aberrant facial nerve course complicate surgical access for electrode insertion and increase the risk of intraoperative complications.

Conclusions: Successful cochlear implantation is feasible in children with CHARGE syndrome despite complex temporal bone malformations. Thorough radiologic assessment and meticulous surgical planning are essential for overcoming anatomical challenges and optimizing outcomes. Overcoming surgical challenges and achieving successful implantation represent the first step toward improved audiological outcomes.

Free paper 0174

Cochlear implantation in adult single-sided deafness: Functional outcomes and the impact of daily device use

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Introduction: Single-sided deafness (SSD) results in loss of binaural hearing, reduced speech perception, impaired sound localization, and functional limitations in everyday listening environments. Cochlear implantation (CI) is an effective rehabilitation option for adults with SSD; however, variability in outcomes persists, and factors influencing performance in real-life conditions remain unclear. This study aimed to evaluate auditory outcomes following cochlear implantation in adults with SSD and to analyze the impact of daily device use on speech performance.

Material and methods: A retrospective review was conducted of 26 adults with SSD and a normal contralateral ear who underwent cochlear implantation. Mean age at implantation was 44 years, and mean duration of deafness prior to surgery was 4 years. Free-field pure-tone thresholds were assessed preoperatively and at 12 months post-activation. Functional outcomes were evaluated using disyllabic word recognition scores at 12 months. Daily CI use (hours per day) and datalogging duration (days) were retrieved from sound processor records. Statistical analysis included paired and independent t-tests, Pearson correlation analysis, and analysis of covariance (ANCOVA) adjusting for age at implantation, duration of deafness, and device manufacturer.

Results: Twenty-six patients were included. Mean free-field thresholds improved from 92.6 ± 14.8 dB preoperatively to 36.0 ± 10.1 dB at 12 months ($\Delta = 56.6$ dB, $p < 0.001$), indicating objective auditory benefit. Mean global disyllabic word recognition at 12 months was 58%. When analyzed by manufacturer, mean scores were 60.0 ± 37.9% in Cochlear™ users and 51.4 ± 32.9% in MED-EL™ users, with no statistically significant difference between devices ($p = 0.60$). Mean daily CI use was 6.2 ± 4.0 hours (range: 0.2–14.4), with datalogging available for a median of 300 days, reflecting consistent long-term use. Daily CI use correlated positively with speech performance ($r = 0.43$, $p = 0.034$) and remained an independent predictor after adjustment for age, duration of deafness, and manufacturer ($p = 0.038$).

Conclusions: Cochlear implantation in adults with SSD provides improvements in hearing thresholds and functional speech perception. Consistent daily device use is a key determinant of auditory outcomes, highlighting the importance of patient counselling and structured follow-up to promote long-term adherence.

Free paper 0502

Cochlear implantation in adults with auditory neuropathy spectrum disorder: Auditory outcomes and prognosis factors

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Introduction: Most studies on cochlear implantation (CI) in patients with auditory neuropathy spectrum disorder (ANSD) focused on paediatric populations, and reported improvements in speech intelligibility and language acquisition in 50 to 94% of cases; In contrast, research on adults is sparse. The objective of this retrospective study was to evaluate the auditory outcomes and prognostic factors of CI in adult patients diagnosed with ANSD.

Material and methods: Thirty-one adults with confirmed ANSD, who underwent CI were included. Audiological outcomes were measured before and 6, 12, and 24 months after CI in quiet and noise, and patients were arbitrarily divided into good (>50% speech scores at 1-year in quiet) and poor performers. Pre- and post-implantation data were analyzed to identify prognostic factors for good performance.

Results: The mean age at CI was 47 ± 17 years, with a follow-up of 6 ± 0.7 years. At 1-year post-implantation, the mean speech intelligibility in quiet improved significantly by 40 ± 6.3% from preoperative baseline. For the good performers ($n = 16$), speech intelligibility in quiet and in noise increased as early as 3 months post-implantation to reach 78 ± 3.9% in quiet and 75 ± 7.1% in noise at 1-year post-implantation. In contrast, poor performers ($n = 15$) did not improve their scores. Patients with post-synaptic ANSD seemed to have poorer outcomes, although it did not reach significance.

Conclusions: Despite the challenges, CI remains a viable option for adult patients with ANSD, with nearly half of the population demonstrating improvements in speech intelligibility, in quiet and in noise. However, the patient must be informed that the result is not guaranteed.

Free paper 0593

Cochlear implantation in autosomal dominant hearing loss

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Introduction: Autosomal dominant hearing loss (ADHL) is the second most common form of hereditary hearing impairment. It is typically postlingual, progressive, and characterized by variable severity and audiological phenotypes. Most affected individuals benefit from hearing aids for many years; however, cochlear implantation (CI) may become necessary in advanced stages. Despite the increasing use of cochlear implants, data on their application in genetically confirmed ADHL families remain limited. The aim of this study was to assess the prevalence of cochlear implant users among families with genetically confirmed ADHL and to identify the genes associated with cochlear implantation in this group.

Material and methods: Sixty-eight unrelated families with a molecular diagnosis of hearing loss and autosomal dominant inheritance were included. Genetic testing was performed using a custom multigene hearing loss panel, clinical exome sequencing, or whole genome sequencing. Variant interpretation and segregation analyses were carried out in available family members. Clinical data were reviewed with particular emphasis on cochlear implant use.

Results: Cochlear implant users were identified in six of the 68 families, representing 8.8% of the cohort. The causative genes in these families were *ATP2B2*, *GSDME, KCNQ4, OSBPL2, POU4F3,* and *TBC1D24.* All families showed a clinical course typical of ADHL, with postlingual onset, progressive hearing loss, and variable severity. In most cases, hearing aids were used for many years before cochlear implantation, which was introduced after marked deterioration of hearing thresholds.

Conclusions: Although most patients with ADHL can be effectively managed with hearing aids, cochlear implantation represents an important therapeutic option for a subset of individuals. In our cohort, nearly 9% of genetically confirmed ADHL families included CI users. These findings underline the importance of long-term audiological follow-up and the integration of genetic diagnostics into clinical decision-making. Early identification of the genetic cause may support personalised prognostic assessment, timely referral for cochlear implant evaluation, and optimised counselling for affected families.

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Free paper 0494

Cochlear implantation in children with cochlear nerve hypoplasia – Clinical decision-making and the experience of one centre

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Introduction: Cochlear nerve hypoplasia (CNH) is a rare but clinically significant cause of congenital sensorineural hearing loss. Cochlear implantation in this group remains controversial, and patient selection requires careful consideration. Radiological evaluation, objective hearing tests, and prognosis regarding the realistic effects of implantation are essential elements of the decision-making process.

Material and methods: We present a clinical and radiological analysis of pediatric patients diagnosed with cochlear nerve hypoplasia based on high-resolution magnetic resonance imaging (MRI), including two children who underwent cochlear implantation at our centre. Preoperative diagnostic tests included a detailed audiological evaluation, imaging assessment of the internal auditory canal and cochlear nerve, and multidisciplinary qualification – the results of hearing rehabilitation after implantation were analysed.

Results: Both children received cochlear implants with full electrode insertion, and there were no intraoperative complications. Postoperative results showed gradual improvement in sound detection and auditory awareness. Speech perception results remained limited but functionally significant, enabling better recognition of environmental sounds and improved communication support.

Conclusions: Although cochlear implantation in children with cochlear nerve hypoplasia is associated with variable and often limited auditory outcomes, carefully selected patients can achieve significant clinical benefits. Comprehensive preoperative diagnosis, careful patient selection, and detailed counseling for parents regarding realistic expectations are essential. A broader clinical discussion is needed to refine diagnostic algorithms and treatment strategies in this challenging population.

Free paper 0284

Cochlear implantation in children with congenital herpes virus

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Introduction: The herpes simplex virus belongs to the *Herpesviridae* family. Like cytomegalovirus, it is never completely eliminated from the host's body and has the ability to cause latent infections with periodic reactivation. It is one of the most common viruses, with an infection rate of up to 90% of the population. Depending on the patient's age, the type, and the location of the infection, it can cause a range of clinical symptoms, from mild local infections to life-threatening infections involving the central nervous system. Genital herpes in women is particularly dangerous for the fetus. Infection can occur during fetal life (5–8%), during delivery (85%), or after birth (8–10%). Herpes virus infection can lead to eye and mucous membrane damage, disseminated diseases, intellectual impairment, and hearing loss. The hearing loss that occurs after the infection is sensorineural, and it can be congenital, delayed, or progressive. Therefore, children should undergo routine hearing screening at least once between the 24th and 30th months of life.

Material and methods: The study group consisted of 10 patients aged from 7 to 56 months, with a mean age of 22.5 months (SD = 15.222), operated on between 2010 and 2020. All patients underwent Auditory Brainstem Response (ABR) testing before the surgery. Postoperatively, patients underwent two tests: an adaptive speech understanding threshold test (AAST) and pure tone audiometry in free-field conditions.

Results: Preoperatively, in the ABR test, the hearing threshold for the operated ear was as follows: for 500 Hz, $M = 88.67$ dB; for 1000 Hz, $M = 98$ dB; for 2000 Hz, $M = 98.67$ dB; for 4000 Hz, $M = 99.29$ dB. In the AAST test, the average result in silence was 36.3 dB, and in noise, –10.8 dB SNR. The averaged hearing threshold obtained in pure tone audiometry in the free-field (for frequencies ranging from 250 Hz to 6000 Hz) was 36.5 dB.

Conclusions: Cochlear implantation is an effective method for treating hearing loss in children with congenital herpes virus infection. Patient outcomes may vary depending on the age of implantation, comorbidities, and the rehabilitation approach.

Free paper 0665

Cochlear implantation in Deaf community: 3 case studies

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Cochlear implantation (CI) is a standard intervention for pediatric patients with profound sensorineural hearing loss, facilitating access to the acoustic spectrum necessary for spoken language acquisition. A specific clinical group consists of children from the Deaf community, where strong cultural identity and the primacy of sign language have historically led to reservations regarding implantation. Recently, however, a shift has been observed within the Slovak Deaf community, moving from cautious rejection toward acceptance of CI as a tool for bilingual development. We present three case reports of children from Deaf families implanted in 2025 at our centre. The cohort includes a bilaterally implanted child at 2 years of age; a unilaterally implanted child at 5.5 years (peer-to-peer influence after initial parental refusal); and a bilaterally implanted child at 3.5 years (initially parents wanted unilateral implantation). We evaluate auditory perception using the LittlEARS questionnaire and the Ling sound test and describe first language and speech development at 4 and 8 months post-activation, with an extended 12-month follow-up for the earliest implanted child. The analysis focuses on the impact of implantation age and family dynamics on rehabilitation outcomes. Preliminary results indicate that CI in children within the Deaf community enables the development of their hearing and speech abilities, supporting integration into the hearing society in some children. Our findings suggest that a bilingual approach and the continued use of sign language do not constitute a barrier to spoken language development, but rather provide a stable foundation for communication. Furthermore, we emphasize the necessity of an individualized speech and language therapy approach that respects and integrates the bilingual background of these children.

Free paper 0737

Cochlear implantation in pediatrics: The effect of cochlear coverage

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Introduction: Cochlear coverage by electrode arrays may influence speech outcomes in children with prelingual hearing loss. The optimal coverage threshold remains unclear.

Objective: To evaluate the relationship between cochlear coverage and auditory and speech performance in pediatric cochlear implant users.

Material and methods: (1) Retrospective study of 57 children (85 ears); (2) FLEX28 and FORM24 electrode arrays; (3) Outcomes: PTA, SRT, SDS, CAP, SIR; (4) Cochlear coverage calculated using CDL software.

Results:
- Mean cochlear coverage: 82.78%;
- Greater coverage significantly improved Speech Discrimination Scores ($p = 0.009$);
- Coverage ≥82.78% associated with better SDS;
- No significant effect on SRT, CAP, or SIR

Conclusions: Greater cochlear coverage is associated with improved speech discrimination in prelingually deaf children. Preoperative cochlear measurements are crucial for optimal.

Free paper 0552

Cochlear implantation outcomes in preterm-born patients

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Introduction: Despite the higher prevalence of hearing loss among children born prematurely, outcomes of cochlear implantation (CI) in this population remain insufficiently reported. Early diagnosis and timely intervention are crucial to prevent secondary developmental disorders resulting from hearing impairment in infancy. However, delayed auditory maturation observed in some preterm-born children may influence auditory development and, consequently, cochlear implantation outcomes. The aim of this study was to evaluate hearing outcomes following cochlear implantation in infants born prematurely.

Material and methods: All children underwent cochlear implantation following preoperative high-resolution CT imaging of the temporal bones and ABR testing. Postoperatively, an audiometric evaluation, including hearing thresholds and speech understanding in quiet and noisy conditions, was performed in free-field conditions with an active processor, approximately 1–6 months after activation. For younger children, the assessment included additional tests such as visual reinforcement audiometry and a monosyllabic word test.

Results: Following cochlear implantation, patients demonstrated significant improvement in hearing ability across all tested frequencies. The mean postoperative free-field thresholds with an active processor ranged from 42 to 46 dB HL: 42.54 dB at 250 Hz; 43.09 dB at 500 Hz; 42.76 dB at 1000 Hz; 43.56 dB at 2000 Hz; 45.38 dB at 4000 Hz; and 41.62 dB at 6000 Hz. The mean WRS was 58.93% (SD = 21.16) in quiet conditions and 40.71% (SD = 21.8) in noisy conditions.

Conclusions: Cochlear implantation significantly improves hearing thresholds and speech understanding in patients born prematurely. However, continuous monitoring and assessment of prognostic factors remain essential for optimising the outcomes of cochlear implantation in this population. There is a need to compare premature born children to the children born at the correct time with the follow-ups.

Free paper 0191

Cochlear implantation with electrode insertion „pull-back" technique of Szeged controlled by videofluoroscopy and transimpedance matrix

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Introduction: Several studies have focused on the cochlear implant systems with the currently available electrode arrays and their distance from the modiolus. To reach smaller distance to modiolus the pre-curved perimodiolar electrode arrays were generated, those require new surgical technique and approach. One of that is called "pull-back" technique, which has also been developed for proper positioning of the inserted electrode array. It could be adjusted to its improperly positioned state after a complete retraction of the electrode array guided through the round window.

Material and methods: At our clinic, we had the opportunity to apply a measurement called Transimpedance Matrix (TIM) during CI, that provides information about the location of the electrodes. Our goal is to facilitate the proper positioning of the perimodiolar electrode array by using TIM, with simultaneous imaging check by videofuoroscopy to visualize intracochlear position of the electrode array.

Results: CI electrode array in 17 patients was implanted by pull-back technique, that could be well controlled by TIM even without intraoperative imaging method – videofluoroscopy. From the TIM measurement results, distance of the electrode array to the modiolus can be estimated to the individual stimulating electrodes.

Conclusions: In each case, our new method – TIM – was monitored by CT scanning and validated its position. Visible differences were found, which suggest the appropriation of the electrophysiological method and provides a more accurate estimation even without intraoperative imaging.

Free paper 0441

Cochlear implantation with subtotal petrosectomy: Outcomes and complications

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Objective: The aim of the study was to evaluate outcomes and risks of cochlear implantation with subtotal petrosectomy in patients with chronic or abnormal middle ear diseases.

Material and methods: Retrospective review of our cohort of cases with subtotal petrosectomy and cochlear implant between 2016 and 2025 at the Center of Cochlear Implantation for adults, Department of Otorhinolaryngology, Head and Neck Surgery, First Faculty of Medicine, Charles University and University Hospital Motol and Homolka. Surgical and functional outcomes were evaluated.

Results: Twelve patients (13 ears) in an average age of 49.4 years underwent subtotal petrosectomy before cochlear implantation. Most of the cases (10, 76.9%) were indicated due to previous surgery with radical cavity, one patient had a middle ear cholesteatoma, one had primary ciliary dyskinesia (PCD), and the last one had an intracochlear schwannoma. Ten (76.9%) surgeries were performed simultaneously and three (23.1%) as two-stage surgery. None of the patients had a severe infection or complication near the cochlear implant, but two patients had revision surgery – one due to dehiscence of residual external ear canal, the other due to migration of the implant body. All the patients were full-time users after one year follow-up.

Conclusions: Cochlear implantation after subtotal petrosectomy is a relatively safe surgery and offers further possibilities for hearing rehabilitation in a specific group of patients with chronic middle ear disease and inner ear pathologies. It could be done simultaneously or as a two-stage surgery to better control potential complications.

Free paper 0097

Cochlear implants and adult patient experiences, adaptation and challenges: A survey

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Introduction: Cochlear implants (CIs) are a life-changing treatment for individuals with severe to profound hearing loss, yet adult CI uptake remains low despite high clinical and economic effectiveness. This study investigates adult patient experiences, adaptation, and barriers to CI access in Saudi Arabia.

Material and methods: A survey of 89 adult CI recipients was conducted across three major CI centers in Saudi Arabia. The electronic questionnaire explored pre- and post-implant experiences, including referral pathways, device choice, adaptation, and satisfaction. Descriptive statistics, ranked correlations, and inferential tests were used to analyze associations between demographic and clinical variables.

Results: The median time between hearing loss diagnosis and implantation was 17 years, with most patients using hearing aids beforehand. Healthcare professionals were the primary source of CI interest for 48% of respondents, though younger recipients were more often influenced by peers. Longer daily device use was linked to faster acclimatization ($\rho = -0.26$, $p < 0.05$); however, age, wait time, and initial attitude did not affect adaptation. Outcomes exceeded expectations for 54% of participants. Major barriers included lack of awareness (23%) and fear of surgery (18%). Only 4% learned about CI through social media. Advice for future candidates emphasized confidence and proactive action.

Conclusions: Despite expanded CI availability in Saudi Arabia, structural and societal barriers persist. Empowering healthcare professionals and utilizing social media for awareness may enhance adult CI uptake and improve hearing health outcomes.

Free paper 0032

Cochlear implant's battery consumption in different type of array and time of activation

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Through cochlear implants, the treatment of hearing has changed significantly, offering individuals the chance to regain sound perception and greatly improve their quality of life. Several factors have been proven to impact cochlear implant outcomes, such as age at implantation, pre-speech recognition, pre-language level, and duration of deafness. Moreover, the effectiveness of cochlear implantation is also influenced by factors including the timing of activation (early vs later) and the type of electrode placement (perimodiolar vs lateral wall), both of which offer potential benefits in auditory performance. The battery life of cochlear implant batteries varies depending on factors such as the device's power consumption, MAP parameters, the individual's usage patterns, and the type of battery used. Non-rechargeable batteries typically last about 1–2 days before needing replacement, while rechargeable batteries may last a full day or longer on a single charge, depending on the specific model and usage. Battery consumption does not affect patient performance, but it does influence the patient's quality of life.

This paper aims to evaluate the effect of electrode array placement in the cochlea (lateral wall vs perimodiolar electrodes) and the effect of device activation timing (early vs classic) on the battery consumption of cochlear implant devices. It is a retrospective study of 40 participants (58 ears) who had agreed to undergo cochlear implant surgery. All subjects who received cochlear implants were included in the study, except cases with inner ear anomalies or revision surgeries. Participants were divided into two groups based on electrode placement (lateral wall or perimodiolar insertion) and on the timing of device activation (early or late). Battery lifespan was measured in these groups at one month, three months, six

months, and one year after device activation. Battery lifespan was calculated using the battery estimation feature in Custom Sound Pro software. The results demonstrated no significant difference in battery consumption between early and late activation times. However, perimodiolar electrodes were associated with lower battery consumption compared to lateral wall electrodes.

Free paper 0010

Cochlear morphology and its influence on electrode array Proximity to Modiolus

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Introduction: As the number of cochlear implant (CI) surgeries increases, more focus should be on minor improvements and planning for a patient-centered approach. The shape of the basal turn (BT) of the cochlea has been recently evaluated and classified into either an elliptical or round shape. However, the electrode position inside different shapes was not investigated.

Objective: This study aims to evaluate the impact of different cochlear shapes on the electrode-to-modiolus distance (EMD) among the CI patients.

Material and methods: A retrospective study was conducted on patients with normal cochleae who underwent cochlear implantation. Postoperative imaging was reconstructed using dedicated Otological planning software to assess cochlear morphology and electrode positioning. The cochlear shape was quantified using the basal turn width-to-height ratio (B/A ratio), and the EMD distance was measured.

Results: The final analysis included 41 ears. The mean EMD was 3.3 mm in the basal electrodes, decreasing to 2.8 mm in the middle region and reaching 1.9 mm at the apical electrodes. The mean basal turn width-to-height ratio (B/A) was 0.8 (range: 0.7–0.9). Simple linear regression revealed that cochleae with a round-shaped basal turn (B/A >0.75) had a slightly shorter, but comparable, EMD in the basal region compared to those with an elliptical shape (3.3 mm vs 3.4 mm). The apical region showed a bigger but non-significant distance in round-shaped cochleae (2.0 mm vs 1.8 mm). Additionally, impedance measurements at the 6-month interval demonstrated a significant difference in the apical electrodes between round and elliptical cochleae.

Conclusions: Cochlear anatomical parameters were found to correlate with EMD. In this study, the lateral wall electrode exhibited a comparable distance to the modiolus in both elliptical and round-shaped basal turn cochleae. Incorporating cochlear measurements into preoperative planning is recommended to optimize CI surgeries. Future studies with larger sample sizes are needed to further investigate the influence of cochlear morphology on electrode positioning across different electrode designs.

Free paper 0301

Cochlear nerve tracking

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Preoperative evaluation of the auditory nerve is crucial for determining candidacy for auditory brainstem implantation (ABI), especially in patients with suspected cochlear nerve deficiency (CND), where cochlear implantation is unlikely to provide optimal benefit. Accurate identification and characterization of the cochlear nerve are therefore essential for appropriate implant selection and surgical planning. Current clinical practice mainly relies on manual inspection of a single cross-sectional image within the internal auditory canal (IAC), which is radiologist-dependent, prone to inter-observer variability, and provides only a limited, static view of an inherently three-dimensional structure.

We propose an automated, image-based framework with minimal manual interaction that tracks the cochlear nerve, together with the vestibular and facial nerves, along the entire length of the IAC. This trajectory-based approach enables a more comprehensive and objective assessment of nerve morphology and continuity than single-slice analysis. The method starts with 3D volume sampling to generate cross-sections perpendicular to the IAC, enabling continuous exploration of nerve morphology. An optimal viewing orientation is selected using shape-driven criteria, including roundness and anatomical consistency. Tracking is performed using seed filling combined with template matching to ensure coherence between consecutive cross-sections. Nerve segmentation follows an unsupervised pipeline integrating contrast enhancement, binarization, contour detection, k-means clustering, and Voronoi partitioning. Semantic labeling is formulated as a linear sum assignment problem, while cascade labeling enforces identity continuity and preserves anatomical consistency along the tracked trajectory.

The framework was evaluated on a multi-center dataset of 14 T2-weighted CISS MRI volumes with resolutions ranging from 0.3 to 0.7 mm. Qualitative results demonstrate robust tracking, segmentation, and labeling of nerve structures in both normal anatomy and CND cases. Nerve integrity is quantitatively assessed by comparing the cochlear nerve area to the facial nerve area across all tracked cross-sections, providing an anatomically grounded metric that extends beyond single-slice evaluation. The average cochlear-to-facial nerve area ratio was 1.36 when computed over all slices prior to vestibulocochlear nerve merging in non-CND cases. This work advances ABI-oriented assessment from static inspection to continuous nerve tracking and characterization, enabling automatic, reproducible, and anatomically meaningful measurements along the full auditory nerve pathway.

Free paper 0027

Cognitive outcomes following cochlear implantation in the elderly: A systematic review and meta-analysis

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Introduction: Age-related hearing loss is strongly associated with accelerated cognitive decline and dementia risk. Cochlear implantation (CI) restores audibility and improves speech perception in older adults, but its broader cognitive effects remain uncertain due to heterogeneous methods and small samples.

Aim and objectives: To systematically review and meta-analyze the impact of cochlear implantation (CI) on cognitive, psychosocial, and auditory-related outcomes in adults aged ≥65 years.

Material and methods: Following PRISMA guidelines, six databases were searched up to May 2025 for randomized controlled trials and observational studies assessing cognitive outcomes after CI using validated neuropsychological tools. Random-effects meta-analyses (Hedges' *g*) were performed, with subgroup analyses by implant type (bilateral vs unilateral) and follow-up duration (≤1 year vs >1 year). Risk of bias was assessed using ROBINS-I, and publication bias via contour-enhanced funnel plots and Egger's regression.

Results: Eleven studies ($n = 407$) met the inclusion criteria. Global cognition (Mini-Mental State Examination), executive function (Trail-Making Tests A/B), attention (D2 Errors/Speed), memory (5-Word Test), and visuospatial skills (Clock Drawing Test) showed small, statistically non-significant changes post-implantation. Speech perception improved markedly (SMD = 1.70; 95% CI [0.50, 2.89]), with gains persisting or increasing beyond one year. Bilateral CI generally yielded more favorable trends than unilateral, though significance was limited. Some subgroups, particularly unilateral recipients and those assessed after one year, demonstrated declines in specific cognitive domains. Heterogeneity was high for some outcomes (e.g., speech perception, $I^2 = 92.9\%$).

Conclusions: and Significance: Cochlear implantation in older adults is associated with robust, sustained improvements in speech perception but only small, largely non-significant changes in most cognitive domains, with some evidence of decline in specific subgroups. There is a pressing need for large, standardized, longitudinal trials to provide more robust evidence regarding CI's role in cognitive health.

Free paper 0291

Cognitive testing in the elderly hearing population using MED-EL REDI App

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Introduction: As cochlear implant candidacy expands, one of the fastest growing populations are individuals over the age of 60. Studies have demonstrated that there is a substantial improvement in the quality of life in these patients. However, cognitive impairment is also a growing concern in patients in that same cohort and one of the challenges facing implantation in the elderly population is the ability to screen and following individuals that are either at risk or have some degree of cognitive impairment.

Objectives: The goals of this presentation is to: (1) Understand the rationale of the clinical need for appropriate cognitive tests for hearing impaired elderly patients; (2) Learn about the development of cognitive tests that have been adapted for the elderly hearing-impaired population; (3) Understand how these tests have been incorporated into the workflow of a busy academic adult cochlear implant program; (4) Learn about how some of this data helps with patient counselling and support.

Material and methods: We will review the development and validation of several cognitive testing batteries at the Sunnybrook Cochlear Implant Clinic from the Montreal Cognitive Assessment, the Sunnybrook Hearing Impaired Cognitive Test Battery to using more adaptive tools such as the ReDi app (MED-EL). Testing results and long term data with each of the tests will be presented.

Results & Conclusions: It is clear that there is a strong need for regular assessment of our growing elderly cochlear implant candidates. A wide range of cognitive tests that range from screening to more in-depth allows surgeons and clinicians to help identify those patients who will require more support post-implantation and also help guide families on realistic expectations post-implantation. Further research to better understand score results with patient outcomes will continue to help us better understand the relationship between cognitive impairment and hearing loss in the elderly population.

Free paper 0086

Combined abnormalities and CI

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Objective: To present the cases of cochlear implantation (CI) in patients with mixed pathology; evaluate the audiological outcomes following CI.

Material and methods: During the period from 2017 to 2025, 102 patients with inner ear malformations underwent surgery on the base of NRMCO (198 bilateral; 3 unilateral). Mixed pathology is a combination of external or middle and inner ear malformations (congenital atresia, syndromic disorders). Hearing loss is often due to structural abnormalities, inflammatory diseases of the middle ear and pathology of the Eustachian tube, nasopharynx. The data of 14 patients with deafness and CHARGE syndrome and 3 patients with congenital atresia who underwent CI on the base of the NRMCO were evaluated. Detailed pre-operative and post-operative evaluations were conducted to monitor auditory performance and developmental progress.

Results: According to CT and MRI data in patients with CHARGE syndrome, we revealed cochlear hypoplasia type III in 8 cases, incomplete partition type I in 4 cases; in 2 cases cochlea was normal as in all cases of congenital atresia. FN position was not standard, but in 5 cases it totally closed the area of round window niche. There were signs of EAC atresia type A in all cases. Standard approach with retro-auricular C-shaped incision, mastoidectomy, posterior tympanotomy was performed in most of CHARGE-cases. In 1 case, we performed transmastoid-transcanal approach. In 9 cases, the round window membrane was not identified because of the abnormal course of facial nerve on the promontory; the electrode was inserted via cochleostomy. In cases of congenital atresia electrode was placed retrofacial. The intraoperative measurements showed normal impedance and normal neuronal response telemetry. A postoperative CT scan showed adequate active electrodes position. No complications were observed. Post-operative audiological results were predominantly moderate the overall developmental progress in these patients showed marked intensification, suggesting that cochlear implantation positively influenced their broader developmental trajectories.

Conclusions: This study underscores the potential benefits of CI in patients with mixed pathology, not only in terms of auditory improvements but also in enhancing overall developmental outcomes. The findings highlight the importance of individualized surgical approaches and comprehensive post-operative care to maximize the benefits of CI in this complex patient population.

Free paper 0223

Communication accessibility and pharmaceutical counseling for patients with hearing loss in community pharmacies: Exploratory and pilot questionnaire-based study

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Introduction: Hearing loss may reduce access to healthcare information and increase the risk of medication-related problems. Community pharmacists provide essential counseling, yet communication barriers may limit the quality of pharmaceutical care for hearing-impaired patients. To assess the experiences of patients with hearing impairment regarding communication with pharmacists in community pharmacies, including understanding of provided information and availability of communication support.

Material and methods: A prospective, anonymous questionnaire-based study was conducted among 41 respondents with hearing impairment. The survey included 17 items and was collected between March and June 2025. Descriptive statistics were reported as counts and percentages. Associations between categorical variables were evaluated using chi-square tests of independence or Fisher's exact test. Effect sizes were reported using Cramér's V.

Results: The largest age group was 18–44 years (43.90%, $n = 18$). Pharmacists' communication skills were rated as high or very high by 56.09% of respondents ($n = 23$). However, 51.20% ($n = 21$) reported that pharmacists did not use communication aids adapted to hearing-impaired patients. Nearly half of respondents (46.34%, $n = 19$) experienced communication difficulties at least occasionally. Medication information was not fully adapted in 78.00% of cases (No/Partly Yes; $n = 32$). Sign language communication was rarely available (No: 92.70%, $n = 38$). A trend was observed for the relationship between adapted medication information (Q8) and clear medication instructions (Q11) ($p = 0.083$; Cramér's $V = 0.317$).

Conclusions: Despite generally positive ratings of pharmacist communication skills, major gaps remain in accessibility and adaptation of counseling for hearing-impaired patients. Standardized use of written/visual aids, and improved communication support may enhance medication safety.

Free paper 0366

Comparative long-term outcomes of lateral wall and slim modiolar cochlear implant electrodes in children with normal cochlear anatomy

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Introduction: Electrode design may influence neural stimulation efficiency, speech outcomes, and long-term stability. While both lateral wall and slim modiolar electrodes are widely used in pediatric cochlear implantation, comparative long-term outcome data in children with normal cochlear anatomy remain limited.

Material and methods: This retrospective comparative study included children with bilateral prelingual severe-to-profound sensorineural hearing loss who underwent cochlear implantation with either a lateral wall electrode (CI522/622) or a slim modiolar electrode (CI532/632) at a tertiary academic center between 2017 and 2021. All children had normal cochlear anatomy and a minimum follow-up of four years. Demographic data, surgical details, intraoperative electrophysiologic measures, postoperative audiologic and speech outcomes, data logging, and radiologic assessments were analyzed.

Results: A total of 161 ears were included (83 lateral wall, 78 slim modiolar). Mean age at implantation did not differ between groups. The slim modiolar group demonstrated significantly lower intraoperative NRT thresholds and impedance values, higher four year speech discrimination scores (75.5% vs 68.8%; $p = 0.001$), and greater mean daily device use (11.2 vs 9.7 hours; $p = 0.02$). Electrode migration occurred exclusively in the lateral wall group (8.4%), while none was observed in the slim modiolar group. Suspected scalar translocation was uncommon overall but more frequent with lateral wall electrodes (4.8% vs 1.2%; $p = 0.02$).

Conclusions: In children with normal cochlear anatomy, slim modiolar electrodes were associated with superior long term speech outcomes, lower stimulation requirements, greater device use, and improved intracochlear stability compared with lateral wall electrodes.

Free paper 0699

Comparative outcomes of standard versus anatomy-based cochlear implant fittings and the impact of music therapy on unilateral CI users

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Objective: This study aims to compare the effectiveness of standard and anatomy-based cochlear implant (CI) fittings in unilateral CI users and evaluate the influence of music therapy on their music-related quality of life.

Material and methods: 40 unilateral CI (all patients over 18 years of age with single-sided deafness or asymmetrical sensorineural hearing loss) who received cochlear implants between 2024 and 2025 were included and divided into two groups: one receiving a standard fitting and the other an anatomy-based fitting. Participants attended music therapy sessions at 1 week, 1 month, 3 months, and 6 months post-audio processor activation. Audiological performance was assessed using sound field measurements, including the Freiburger speech test and Inflation curve. Music-related quality of life was evaluated using the MMQ and HISQUI19 questionnaires.

Results: Preliminary findings indicate that anatomy-based fittings lead to quicker and more natural hearing improvements compared to standard fittings. Audiological assessments showed significant improvements in speech comprehension and sound field performance in the anatomy-based fitting group. Subjective evaluations via the MMQ and HISQUI19 questionnaires revealed that music therapy significantly enhances the music-related quality of life for all participants. Both fitting approaches showed improvements over time, but the anatomy-based group demonstrated superior outcomes at each measured interval.

Conclusions: Anatomy-based CI fittings appear to offer superior auditory outcomes, enabling users to benefit more rapidly and achieve a more natural hearing experience compared to standard fittings. Additionally, music therapy positively impacts the music-related quality of life for unilateral CI users, providing substantial subjective benefits. These findings suggest that individualized fitting approaches combined with therapeutic interventions can greatly enhance the overall auditory experience and quality of life for CI users. Further research with larger sample sizes and extended follow-up periods is recommended to validate these results and explore the long-term benefits of anatomy-based fittings and music therapy.

Free paper 0540

Comparing remote programming of cochlear implants using two methods: Remote Hosted Site and Remote Support App

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Objectives: Compare two remote programming methods implemented as clinical service in an adult cochlear implant (CI) centre for user satisfaction, ease of use, preparation time, patterns of use and difficulties encountered.

Material and methods: *Method 1 (Remote Hosted Site)*: 9 distant clinics collaborated as host sites to house CI programming hardware and software so that CI users could attend their facilities. The Remote Experts at the implant center used remote desktop control of the Host Sites' computers to adjust the subjects' CI speech processors at these distant clinics. *Method 2 (AB Remote Support App)*: CI users or their supporters downloaded an app onto their mobile devices that

allowed the Remote Experts at the implant center to remotely adjust the subjects' cochlear implant settings in real time. CI user and Remote Expert participants were asked to fill out a survey asking questions about their experience.

Results: 102 remote sessions (35 for Method 1 and 75 for Method 2) were completed and surveyed from January 2025 to January 2026. Remote Experts encountered less problems and spent more preparation time using Method 1 compared to Method 2. They also reported being more satisfied with the internet connection in Method 1. Most Remote Experts rated remote programming as being an easy process (95% for Method 1 vs 92% for Method 2). All participant CI users who filled out our survey rated remote programming as an easy process and 100% in both Method 1 and Method 2 indicated they would use remote programming again.

Conclusions: Both methods were easy to use, although problems encountered were higher in Method 2. Method 2 had higher uptake, possibly due to less preparation time required and more CI users having access to mobile apps and Wi-Fi.

Free paper 0042

Comparison of Bluetooth direct input and sound-field speech perception in cochlear implant recipients

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Objectives: This study aimed to compare the performance consistency between Bluetooth direct audio input and conventional sound-field speech perception testing in cochlear implant (CI) recipients.

Material and methods: Twenty-five unilateral or bilateral Nurotron CI recipients were enrolled (11 males, 14 females; 1 prelingually deafened, 24 postlingually deafened). The mean age was 39.28 ± 13.02 years, and none had cochlear malformations. All participants were tested monaurally in a quiet environment under two listening conditions: (1) *Standard sound-field condition*: Speech stimuli were presented at 65 dB SPL through a loudspeaker in a standard sound-treated booth. (2) *Bluetooth direct input condition*: Speech stimuli were transmitted directly to the CI sound processor via Bluetooth. The Bluetooth input level was adjusted based on the participant's subjective report until perceived loudness matched the 65 dB SPL sound-field presentation. Speech materials consisted of the Mandarin Speech Perception (MSP) disyllabic-word list and sentence list. Different lists were used for the Bluetooth and sound-field conditions to avoid learning effects. Paired-sample t-tests were performed to compare speech recognition scores across conditions.

Results: Disyllabic-word scores between Bluetooth and sound-field conditions were significantly correlated ($r = 0.509$, $p < 0.01$). The mean correct score was 0.80 ± 0.11 for Bluetooth and 0.72 ± 0.18 for the sound field. Paired-sample t-tests showed significantly higher performance with Bluetooth direct input ($t = 2.48$, $p = 0.021$). Sentence recognition scores also showed a significant correlation across conditions ($r = 0.542$, $p < 0.01$). The mean correct score was 0.78 ± 0.19 for Bluetooth and 0.66 ± 0.17 for the sound field. Bluetooth input yielded significantly better performance ($t = 3.56$, $p = 0.002$).

Conclusions: In quiet testing environments, Bluetooth direct audio input provides superior speech perception performance compared with traditional sound-field testing in CI users. Bluetooth transmission minimizes room acoustic effects and environmental interference while offering operational convenience, potentially enabling CI users to achieve improved listening outcomes.

Free paper 0551

Comparison of cochlear implantation and bone conduction implantation in patients with single-sided deafness

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Introduction: Patients with single-sided deafness (SSD) experience various hearing difficulties, such as problems with sound localization and intensity perception, reduced spatial awareness, and difficulty understanding speech in noisy environments. Cochlear implants (CIs) are the standard treatment and provide an effective means of restoring binaural function. Other management options include contralateral routing of the signal (CROS) hearing aids and bone conduction implants. Effective management of SSD requires a careful evaluation of patient anatomy and expectations. Understanding the distinct functional outcomes of cochlear implants and Bonebridge devices is crucial for evidence-based patient selection and counseling.

Objective: The aim of the study was to evaluate both treatment methods in patients with SSD.

Material and methods: Patients in the CI group underwent minimally invasive cochlear implantation via the round window approach. Patients implanted with a Bonebridge device underwent surgical placement of a bone conduction implant on the deaf side to transmit sound to the normal-hearing ear. The hearing benefits of both treatment methods were assessed using speech discrimination tests in noise.

Results: Both treatment methods significantly improved speech understanding in noise, demonstrating the benefit of the head shadow effect. CI users demonstrated superior outcomes in restoring binaural hearing. Although Bonebridge users demonstrated improved speech recognition in noise, binaural hearing was not restored.

Conclusions: Cochlear implantation remains the preferred treatment for SSD because it restores binaural hearing. Bone conduction implants are an effective alternative when cochlear implantation is not an option, providing significant, albeit unilateral, hearing improvement.

Free paper 0607

Complications of cochlear implantation (2018–2025) in Children Department of ENT MF CU and NICD Bratislava (Slovakia)

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Objectives: In 2018, the Centre for Children with Hearing Impairment NICD was established at the Children Department of Otorhinolaryngology, which is also an implantology centre.

Material and methods: Retrospective analysis.

Results: The authors analyse a cohort of 162 paediatric patients who underwent unilateral (13 children) or bilateral (44 children) cochlear implantation between 2018 and 2022. There were 101 boys and 61 girls in the cohort, we have done 51 unilateral and 97 bilateral implantation. Complications were rare in the study group, they occurred per- or postoperatively. Peroperatively, electrode kinking occurred twice requiring us to reimplant the patient, then development of liquorrhea (1x) forced us to reoperate the patient due to massive discharge of liquor from the operated ear and we had also an insufficient insertion of the electrodes into the cochlea due to partial ossification of the cochlea in meningitis (2x). Iatrogenic transection of n. VII during CI with subsequent reconstruction of the nerve with a graft from n. auricularis magnus occurred once. Due to hematoma in the bed of the inner part of the implant, we had to remove the implant in one patient with Noonan syndrome. Postoperatively, we dealt with a retroauricular abscess at the site of processor placement (2x), which led to the need for CI removal and subsequent reimplantation, and once we faced the complications of acute otitis media (acute mastoiditis and spread of inflammation intracerebrally to the temporal lobe on the right), the condition was managed with an ENT and neurosurgery revision. We are currently treating a patient due to protrusion of the inner part of the implant on its upper edge on both sides. On one side, we have already reimplanted the patient with material from another company, and she is awaiting the same procedure on the other ear.

Conclusions: Out of a total of 245 ears operated on, serious complications occurred in 11 cases (4.5%). Except for one case, we managed to resolve them successfully and patients can continue to use CI.

Free paper 0046

Confronting persistent variability in cochlear implant outcomes: Towards a neuroplasticity informed, rehabilitation centred care pathway

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Introduction: Over four decades of technological progress have transformed cochlear implants (CIs) into a routine treatment for severe-to-profound hearing loss. Yet a sizeable minority of recipients – children and adults alike – still achieve speech understanding well below clinical expectations. This remaining performance gap is increasingly traced to biological, cognitive, and service-delivery factors.

Objectives: This presentation will (1) outline the multifactorial roots of poor CI outcomes; (2) highlight the under-recognised role of auditory and cross-modal neuroplasticity; and (3) propose a practical, interdisciplinary roadmap for improving benefit across the recipient population. *Key Themes*: (a) *Timing & Brain Readiness* – prolonged auditory deprivation, older implantation age, and co-existing neurocognitive conditions can limit cortical receptivity to the new electrical input; (b) *Programming Beyond the Audiogram* – standard map optimisation still leans on clinician heuristics and patient feedback; objective cortical markers and datalogging remain under-used; (c) *Rehabilitation Gaps* – access to structured, high-intensity auditory training varies widely; protocols rarely integrate music, cognition, and multimodal stimulation known to drive plastic change; (d) *Service-Delivery Inequities* – socio-economic barriers, limited tele-rehab options, and inconsistent long-term follow-up contribute to device underuse and stalled progress.

Conclusions: Poor CI performance is no longer primarily a hardware problem; it reflects how – and how early – the brain is engaged and supported after implantation. By uniting neuroplasticity-focused science with equitable, technologyenabled rehabilitation, the field can shift from explaining variability to systematically reducing it, moving closer to consistently excellent listening and communication outcomes for every CI user.

Free paper 0696

Cooling the cochlea: Hypothermia as a strategy to protect hearing during surgery

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Objectives: This narrative review examines how body temperature influences hearing, with emphasis on extended

high-frequency (EHF; >8 kHz) thresholds, which can provide early warning of auditory damage.

Material and methods: We drew on a personal database of 216 EHF-related references and identified papers addressing whole-body or cochlear cooling. We use as a point of departure the report by Munjal et al. (2013) describing 15–30 dB EHF threshold shifts in patients undergoing cardiopulmonary bypass (CPB), where mild-to-moderate hypothermia is used to reduce metabolic demand.

Results: The literature indicates that CPB can be associated with post-operative hearing changes, but reduced body/cochlear temperature more broadly is linked to neuroprotective effects. Although the association between CPB and hearing loss has been repeatedly noted, the underlying mechanism remains unresolved.

Conclusions: Overall, the evidence supports an otoprotective role of cooling. The marked temperature sensitivity of EHF thresholds appears under-recognized and has practical implications for both research and clinical monitoring. These findings suggest that routine EHF audiometry may be valuable and that localized cochlear cooling during cochlear implantation could improve hearing preservation.

Free paper 0508

Costs for hearing restoration options in canal wall down mastoidectomy

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Objective: This study evaluates the cost-effectiveness of Bonebridge implant (BB) versus ossicular chain reconstruction (OCR) in patients with conductive hearing loss after canal wall-down (CWD) mastoidectomy in Saudi Arabia.

Material and methods: Study Design – cost-effective analysis. Using a Markov diagram model, we analyzed lifetime costs, quality-adjusted life years (QALYs), and incremental cost-effectiveness ratios (ICERs) for both interventions. A clinical management pathway was developed by experts to estimate resource use and costs. Health-related quality of life, potential adverse events, device upgrades, and device failure were captured. Unit costs were derived from the Ministry of Health governmental price list and a private hospital. This manuscript synthesizes findings from recent studies on OCR outcomes, BCD efficacy, and cost-utility analyses to provide evidence-based recommendations for clinical decision-making.

Results: Results indicate that BCDs offer a cost-effective alternative to repeated OCR, particularly in cases of advanced cholesteatoma.

Conclusions: BB offers a cost-effective and clinically superior alternative to repeated OCR in CWD mastoidectomy patients. Future research should focus on long-term outcomes and patient-reported quality-of-life measures to further validate these findings.

Free paper 0651

CSF otorhinorrhoea in incomplete partition 1 (SMS CVM 3b): Our experience

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Objective: To evaluate the efficacy of oval window closure, with or without cochlear implantation, in pediatric patients presenting with recurrent meningitis secondary to CSF otorhinorrhoea due to inner ear incomplete partition type I (IP-1).

Material and methods: A multicentric series of 15 pediatric patients with recurrent meningitis attributed to IP-1 deformity was analyzed. All patients underwent detailed audiological assessment and high-resolution radiological imaging to confirm the diagnosis and localize the cerebrospinal fluid (CSF) leak. Selected children with bilateral profound hearing loss underwent repair with staged or simultaneous cochlear implantation. Surgical techniques focused on identification of the leak site, meticulous sealing of the stapes footplate defect, and preservation of surrounding structures with endoscope assistance.

Results: Imaging confirmed IP-1 malformation in all patients and accurately localized the site of CSF leakage. Intraoperatively, a leak from the stapes footplate was identified in every case. Some patients demonstrated a CSF-filled sac protruding through the defective footplate, while others had high-flow leaks. Following repair, none of the 15 patients experienced further episodes of meningitis during follow-up. One patient required revision surgery due to recurrence of CSF otorrhea, which was successfully managed. One child developed transient postoperative facial paresis that resolved with conservative management. Hearing rehabilitation with cochlear implantation, when indicated, yielded satisfactory outcomes.

Conclusions: Inner ear malformations such as IP-1 may be an underrecognized cause of recurrent meningitis, particularly in unilateral cases. A high index of suspicion, comprehensive audiological screening, and appropriate imaging are essential for diagnosis. An endoscope-assisted approach provides an effective, minimally invasive alternative to radical procedures such as subtotal petrosectomy, with excellent control of meningitis and acceptable complication rates. Simultaneous repair and cochlear implantation can be safely performed in selected patients.

Free paper 0327

CT-like images of the temporal bone from MRI using machine learning: Development, validation and usefulness

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Introduction: For otological diagnostics and pre-surgical planning, both MRI and CT are frequently required to visualise soft tissues and bony structures. A single, radiation-free imaging modality capable of providing both soft-tissue and bone information would be ideal. Therefore, this study aimed to train and evaluate a machine-learning algorithm for generating synthetic CT (sCT) images from head MRI.

Material and methods: Paired MRI and CT scans were obtained from 73 patients. Sixty-seven paired scans were used to train a machine-learning algorithm to generate sCT images from MRI data. Fifteen MRI scans were subsequently used to generate sCT images for evaluation of technical accuracy, clinical accuracy, and clinical suitability.

Results: Geometric accuracy and radiodensity representation on sCT images were sufficient. The conspicuity of 12 clinically relevant anatomical landmarks was independently rated by two otologists and two radiologists using a 4-point Likert scale ranging from poor to excellent. Overall, landmark conspicuity was considered comparable between modalities. However, the thickness of the tegmen bone was occasionally overestimated, while the ossicles were often not depicted. More than 80% of sCT scans were assessed as suitable for anatomical localisation, but not for diagnostic purposes.

Conclusions: CT-like images of the temporal bone can be successfully generated from head MRI using a machine-learning algorithm. This enables visualisation of bony structures alongside soft tissues using a single, radiation-free imaging modality. Synthetic CT images are considered suitable for anatomical localisation in otologic procedures.

Free paper 0288

Datalogging as a tool in speech rehabilitation in very young children with cochlear implants

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Introduction: Profound bilateral hearing loss in the prelingual period limits access to spoken language and may negatively affect auditory and speech development. Due to neural plasticity and sensitive periods for sensory development, early cochlear implantation is higly recommended. Rehabilitation outcomes depend largely on systematic daily use of the speech processor, which has traditionally been assessed only through caregiver reports. Data logging technology allows therapists gained access to objective measurement of processor use.

Objective: To assess the average daily use of cochlear implant speech processors in very young children using data logging reports and to compare these data with caregiver estimates.

Material and methods: Data logging reports from cochlear implant speech processors of 64 children implanted before one year of age were analyzed, along with medical records and parents reports on daily processor usage.

Results: Differences were observed between caregiver-reported processor use and objectively recorded data. Caregivers both overestimated and underestimated the actual daily wearing time.

Conclusions: Consistent daily use of the speech processor is essential for effective cochlear implant rehabilitation, particularly during periods of high auditory system plasticity. Data logging reports provide a valuable tool for therapists to educate caregivers about the importance of systematic auditory and speech stimulation. Provide resources and solutions to improve the situation in cases of insufficient time of wearing the prosthesis by the child.

Free paper 0297

Datalogging in relation to ipsi- and contralateral speech recognition in bimodal and single-sided deaf cochlear implant users

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Introduction: The hearing outcome in cochlear implant (CI) users is determined by various factors. As well as the degree and duration of ipsilateral hearing loss, the hearing status (normal hearing (NH), asymmetric hearing loss (AHL),

symmetric hearing loss (SHL)) and provision with hearing aid (HA) of the contralateral ear may also influence outcome and duration of daily CI use. Previous studies examining the daily CI use in adults and children show positive associations with CI outcomes. This study aims to compare the datalogging entries of bimodal (CI+HA) and single-sided deaf (SSD, CI+NH) CI users, in order to identify potential differences in daily CI use and ipsi- and contralateral speech recognition.

Material and methods: We retrospectively analyzed 277 adult postlingually deafened CI users (131 SHL, 72 AHL, and 74 SSD), 203 use CI+HA and 74 CI+NH. The inclusion criteria were fluent German language skills, correct placement of the cochlear electrode, and no other known pathological findings. Datalogging and speech recognition scores – Freiburg Monosyllabic Speech Test (FMST) at 65 dB SPL – were recorded after six months of CI experience.

Results: The average daily CI use [h/day] differed significantly between the groups: 12.0 ± 3.4 (CI+HA) and 10.9 ± 3.8 (CI+NH). Mean FMST scores [%] with CI were similar: 61.8 ± 22.0 (CI+HA) and 59.9 ± 23.5 (CI+NH). Mean contralateral FMST scores were 46.5 ± 29.2 (CI+HA) and 98.2 ± 4.6 (CI+NH). A significant positive correlation was observed in both groups between FMST with CI and daily CI use (CI+NH: $r = 0.42$; CI+HA: $r = 0.40$). The contralateral FMST of all CI users correlated significantly negatively with their daily CI use ($r = –0.22$).

Conclusions: After six months of CI experience, CI users with a longer duration of daily CI use show a better speech recognition in quiet. Longer CI usage time is also associated with lower speech recognition scores in the contralateral ear. It seems that the need for daily CI use increases with insufficient hearing with HA and decreases accordingly among SSD CI users. In order to verify the results, the data from a longer CI experience should be supplemented and analyzed.

Free paper 0724

Decoding molecular determinants of cochlear implant outcomes using patient specific neurovascular models: A pilot study

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Introduction: Despite comparable audiological profiles, postlingually deaf individuals with sensorineural hearing loss (SNHL) consistently achieve superior auditory and speech outcomes following cochlear implantation (CI) compared to pre-lingual SNHL individuals. This long-standing clinical observation is primarily attributed to differences in neuroplasticity and prior auditory exposure; however, the underlying molecular details remain elusive due to the absence of patient-specific cellular models.

Material and methods: To address this gap, we established patient-specific neurons from autologous peripheral blood using the patented Plasma-Induced Transdifferentiation and Tissue Reprogramming (PITTRep) methodology – featured in the press information bulletin by the Ministry of Science and Technology, Government of India – and examined their molecular and network characteristics in vitro. Peripheral blood samples were collected from pre-lingually deaf ($n = 12$), post-lingually deaf ($n = 6$), and normal-hearing control participants ($n = 18$), with all deaf individuals exhibiting severe to profound sensory neural hearing loss on auditory brainstem response (ABR) testing. Immunofluorescence analysis evaluated neurotrophic signaling (BDNF and its receptor) and synaptic-neuroimmune architecture (Stargazin with Iba-1).

Results: Neuronal cultures from postlingually deaf individuals demonstrated better network organisation resembling normal hearing controls. While BDNF expression was comparable between the two deaf groups, Stargazin and Iba-1 levels were significantly elevated in post-lingual cultures, whereas pre-lingual cultures exhibited reduced expression, indicating impaired synaptic maturation and altered neuroimmune regulation.

Conclusions: These findings provide, to our knowledge, the first patient-specific cellular evidence that CI outcome variability is driven by differences in synaptic and neuroimmune competence rather than neurotrophic deficiency alone. By identifying biological determinants not captured by current clinical measures, this work offers a novel framework for improving CI success through biological stratification of candidates. Future studies integrating functional assays and longitudinal clinical correlations will be essential to determine predictive value. Nonetheless, this approach holds transformative potential for personalised rehabilitation, targeted adjunctive therapies and precision neuro-otology for improving the long-term success of cochlear implantation.

Free paper 0719

Dehiscence of the superior semicircular canal: Management at the initial visit to an audiologist

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Introduction: Minor's syndrome is a rare disorder of the inner ear characterized by the formation of a defect in the bony wall of the superior semicircular canal. The main symptoms include vertigo triggered by loud sounds, hearing loss, tinnitus, autophony, and balance disturbances.

Objective: To perform comprehensive functional hearing diagnostics in a female patient presenting with complaints of hearing loss and tinnitus, as well as to analyze radiological imaging data.

Material and methods: The subject of this study was a 26-year-old female patient whose main complaints included intermittent tinnitus and a feeling of fullness in the left ear, as well as discomfort in response to loud sounds. According

to her medical history, she denied any trauma and reported a predisposition to frequent upper respiratory infections.

Results: Otoscopy revealed no pathology; all anatomical landmarks were preserved. Tympanometry showed type A curves bilaterally. Acoustic reflexes were present at all probe frequencies except 4000 Hz. DPOAE testing was passed bilaterally. Pure-tone audiometry demonstrated hearing thresholds of –6 dB on the right and –23 dB on the left, with a decrease in hearing up to 35 dB at 500 and 750 Hz on the left side, indicating minimal hearing impairment. Subsequently, the patient was referred for multislice CT (MSCT) of the temporal region with a focus on the middle ear and ossicular chain. MSCT of the temporal bones revealed signs of dehiscence of the superior semicircular canal on the left side. Computerized vestibulometry showed a negative Tullio phenomenon, negative vibration-induced responses, and no abnormalities of the vestibular analyzer. The patient was referred for consultation with an otologic surgeon to determine further treatment strategy.

Conclusions: Analysis of the literature and global clinical experience indicates that Minor's syndrome is often diagnosed late. The presented clinical case confirms the importance and appropriateness of a detailed and comprehensive diagnostic approach in each individual case where the patient's dominant complaints include tinnitus, hearing dysfunction, and vestibular disturbances.

Free paper 0520

Delayed access to bone conduction devices in chronic otitis media: An informatics analysis of care pathways at a tertiary medical center

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Chronic otitis media (COM) is a leading cause of conductive hearing loss and major contributor to global hearing impairment. Despite its high prevalence, care pathways often prioritize repeated attempts at eradicating ear disease while delaying or overlooking timely hearing restoration. Many patients undergo multiple revision surgeries, yet those with refractory COM ultimately require hearing rehabilitation. Prolonged periods of untreated conductive hearing loss are particularly harmful for children during critical windows of speech and language development. Although guidelines recommend concurrent management of middle ear disease and hearing loss, real-world adoption of hearing rehabilitation, especially through bone conduction devices (BCDs), remains limited. Emerging demographic patterns, including the disproportionately low representation of minoritized groups among BCD recipients, signal potential inequities in pathway access and candidacy evaluation.

This informatics-based study used Epic SlicerDicer to analyze referral patterns, pathway timing, and BCD intervention rates at a large tertiary medical center (01/2015–01/2026). ICD10 codes (H65.2–H65.3) identified COM/COME cases. Demographics, incidence trends, and longitudinal milestones from diagnosis to ENT consultation, audiology assessment, and eventual BCD referral were extracted. Variables included age, sex, race, and intervention outcomes.

Among approximately 5 million patients, 18.7% carried a COME diagnosis. Of those, fewer than 10% were evaluated in ENT, and only 2.3% ultimately underwent evaluation for a BCD. Of those referred, 69% proceeded to BCD intervention, indicating that once patients enter the candidacy pathway, intervention is both feasible and beneficial. Mean implantation age was 9 years for children and 49 years for adults. Racial distribution among implanted patients (83.3% White, 7.4% Black, and 2.9% Asian) suggests disparities when contrasted with the broader population and disease prevalence.

Care pathways for COM demonstrate substantial delays and strikingly low referral rates for BCD evaluation despite strong candidacy and high uptake once referral occurs. These findings highlight referral based bottlenecks resulting in prolonged auditory deprivation and increased morbidity. The disproportionately low BCD pathway entry for minoritized populations underscores structural inequities requiring targeted intervention. Earlier integration of BCD evaluation may reduce morbidity, improve developmental outcomes in children, and promote more equitable access to hearing rehabilitation.

Free paper 0535

Demographic characteristics and regional cochlear implant utilization patterns among Swedish patients with specialist-diagnosed hearing loss: NPR-Barnplantorna Registry analysis

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Introduction: Despite a high burden of specialist-diagnosed hearing loss, Sweden lacks validated national estimates of cochlear implant (CI) candidacy and utilization. The National Patient Register captures all ICD-10 H90 hearing loss diagnoses across Sweden, and the Barnplantorna registry provides comprehensive documentation of CI recipients. Linking these complementary national registries enables systematic assessment of CI utilization gaps and regional disparities at a population level.

Material and methods: A national, register-based cross-sectional analysis was conducted using the 2023 Swedish National Patient Register (NPR). All patients with a recorded H90 diagnosis (conductive and/or sensorineural hearing loss) across Sweden were identified ($n = 31{,}200$). As the NPR does not provide hearing loss subcategories, a conservative estimate assuming 70% sensorineural hearing loss was applied to approximate the cochlear implant (CI) candidacy pool ($n = 21{,}840$). CI utilization data were obtained from the Barnplantorna registry, documenting 5,513 CI recipients as of January 1, 2024, including 1,606 children (<18 years) and 3,907 adults (≥18 years). Bilateral implantation rates were calculated by age group. CI penetration was defined as the proportion of recipients relative to the estimated eligible population. Regional variation was assessed by

comparing penetration rates between large and small counties using independent *t*-tests.

Results: The cohort was 52% female with a mean age of 52.3 years (SD = 28.1; median 56 years). Age distribution was bimodal, with the highest proportions observed in adults aged 65–79 years (28.1%) and ≥80 years (18.4%), while 15.6% were children (<18 years). Most diagnoses were recorded in specialized outpatient care (62%), with the remainder in inpatient settings. Among pediatric CI recipients, bilateral implantation achieved 58.5% penetration (940/1,606 recipients), versus 8.5% among adults (331/3,907). Among 31,200 patients contacting specialist, 5,513 had received CI (17.7% specialist contact penetration). Large vs small country variation reminded significant (*t*-test $p < 0.001$).

Conclusions: Despite internationally leading pediatric bilateral CI update, Sweden exhibits a substantial adult "utilization gap", particularly for bilateral implantation. Regional disparities signal systemic barriers in adult referral pathways and capacity allocation. NPR-Barnplantorna registry linkage provides a validated framework for monitoring CI equity, targeting high-burden regions like Stockholm, and optimizing bilateral implantation standards across the lifespan.

Free paper 0008

Development and standardization of a new test for the evaluation of the development of sound localization abilities in children using the Immersion 360° System

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Sound localization is a critical component of auditory perception and plays a central role in environmental awareness, safety, and social communication. Despite its importance, standardized clinical protocols for evaluating spatial hearing in children are scarce. This study aimed to develop and validate a simple test to assess horizontal sound localization in children across a wide age range, using the Immersion 360° system. We also aim at gathering normative developmental data to facilitate future assessments in hearing-impaired populations. A total of 88 participants were recruited for this study: 50 normal-hearing children aged 2.08–12.92 years and 12 normal-hearing adults. A subset of 26 hearing-impaired children with varying hearing assistive technologies were also tested for feasibility and exploratory comparisons. Localization accuracy was measured during a 27-trial loudspeaker identification task spanning 180° of the frontal plane. Localization accuracy improved significantly with age. An exponential decay model predicted 75% of adult-level performance by 3.39 years and 90% by 5.62 years. The test demonstrated high reliability (Cronbach's $\alpha = 0.896$), with fast completion times (~2 minutes). Hearing-impaired children, particularly cochlear implant users, showed poorer localization performance. The test was well tolerated across age groups, though younger children (2–3 years) exhibited greater variability and non-completion. This protocol offers a rapid, reliable, and developmentally appropriate method for assessing sound localization in children. It holds promise for clinical application in both normal-hearing and hearing-impaired populations and may inform early intervention strategies.

Free paper 0522

Development of the Hear Box System. An adaptive screening tool for independent hearing assessment using Active Noise Cancellation

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Introduction: Conventional hearing screenings and auditory processing evaluations typically require specialized personnel and sound-treated environments to ensure accuracy. These requirements limit the accessibility of large-scale screenings in public spaces. The Hear Box project, conducted by Center of Hearing and Speech Ltd in consortium with the Institute of Physiology and Pathology of Hearing, addressed this challenge. Funded under the POIR.01.01.01-00-1110/20 grant, the project aimed to develop an adaptive, independent diagnostic station capable of performing reliable tests in diverse and variable acoustic environments.

Material and methods: The development process was divided into five stages: modeling background noise in various settings, designing a prototype stand, comparing active noise reduction (ANC) methods, and conducting both laboratory and real-world clinical validations. The system integrates automated threshold detection algorithms and tests for CAPD. A critical technical focus was the implementation of a dedicated ANC interface. This module was designed to reduce ambient noise by at least 30 dB across the frequency range of 500 to 8000 Hz. Validation involved comparative testing where volunteers performed independent screenings on the Hear Box, followed by controlled audiometric examinations in professional sound booths.

Results: The implementation of the ANC module successfully enabled the determination of hearing thresholds in individuals with normal hearing, even in noisy environments. By effectively suppressing background interference, the system significantly reduced the rate of false-positive results. The final Hear Box station features an intuitive touch-screen interface, allowing patients aged 6 and older to complete the diagnostic process without the presence of a specialist. Results confirmed that the automated calibration and noise reduction protocols ensure data reliability comparable to traditional audiometry.

Conclusions: The Hear Box system represents a significant shift in audiological screening by eliminating the need for soundproof rooms and dedicated personnel. The integration of advanced ANC technology allows for high-quality diagnostics in public utility areas, thereby increasing accessibility for students, noise-exposed workers, and the elderly. This

project demonstrates that adaptive noise management is a viable solution for expanding the reach of early hearing loss detection and auditory processing assessment.

Free paper 0044

Device use time better predicts cortical and speech outcomes than time since activation in adult cochlear implant users

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Introduction: Cochlear implants (CIs) restore auditory access in people with severe-to-profound hearing loss, yet outcomes differ markedly across users. Programming ("mapping") a CI still relies heavily on clinician skill and the recipient's subjective reports, which can lead to suboptimal settings. Electrically evoked Cortical Auditory Evoked Potentials (eCAEPs) recorded through the implant promise a more objective, time-efficient way to guide map adjustments.

Objectives: To determine which measure of CI listening experience best predicts both eCAEP presence and post-operative speech understanding: (1) CI duration – months since first switch-on; (2) Median datalogging hours – typical device use per day; (3) Total cumulative device use (TDU) – lifetime listening hours (CI duration × median hours/day).

Material and methods: In this retrospective study, 119 post-lingually deafened adults (53 female) who underwent routine eCAEP testing after implantation were analysed. Participants were grouped by eCAEP presence/absence. Associations were examined between each experience metric and (i) eCAEP presence, (ii) eCAEP waveform amplitudes and latencies, and (iii) speech-perception-in-quiet scores available for a subset of users.

Results:
- eCAEP presence: Both median datalogging hours and TDU were significantly higher in users with present eCAEPs, whereas CI duration showed no significant effect;
- eCAEP morphology: None of the three experience metrics correlated with eCAEP latencies or amplitudes;
- Speech perception: For the subset with behavioural scores, higher median datalogging hours and greater TDU each correlated significantly with better speech-in-quiet performance; CI duration again showed no significant relationship.

Conclusions: Objective measures that reflect how long – and how much – a patient actually wears the implant (median daily use and TDU) are better indicators of central auditory responsiveness and speech outcomes than the simple elapsed time since activation. Incorporating realworld datalogging metrics alongside eCAEPs could improve CI map optimisation and ultimately enhance patient benefit.

Free paper 0422

Does contralateral acoustic hearing support spatial auditory processing in pediatric cochlear implant users? Preliminary findings

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Introduction: Spatial hearing and directional speech perception depend on the effective use of interaural time differences (ITD) and interaural level differences (ILD). In pediatric cochlear implant (CI) users, access to these spatial auditory cues is often limited due to device-related constraints and reduced binaural integration. Children using bimodal hearing configurations may benefit from contralateral acoustic input, which can provide complementary temporal and level information that supports spatial auditory processing. However, direct behavioral evidence comparing spatial cue use and directional speech perception between bimodal and bilateral pediatric CI users remains limited.

Material and methods: This ongoing study includes pediatric CI users aged 6–14 years who are classified into two groups: bimodal CI users (cochlear implant plus contralateral acoustic hearing) and bilateral CI users. Spatial auditory cue use is assessed using a custom-designed computer-based spatial cue test that independently evaluates reliance on ITD and ILD cues under congruent and incongruent listening conditions. Directional speech perception is measured using a spatial speech-in-noise task in which target speech and competing noise are presented from different spatial locations. Outcome measures include cue-specific accuracy rates, cue-weighting patterns, and directional speech perception performance.

Results: Preliminary findings suggest that bimodal pediatric CI users demonstrate higher overall accuracy in spatial auditory cue conditions compared to bilateral CI users. Directional speech perception scores are also higher in the bimodal group, especially when speech and noise are spatially separated. These trends indicate a potential advantage of contralateral acoustic input in supporting spatial auditory processing during childhood.

Conclusions: Preliminary results indicate that contralateral acoustic input may facilitate the use of spatial auditory cues and improve directional speech perception in pediatric CI users. These findings underscore the potential importance of preserving acoustic hearing and considering bimodal configurations to support spatial hearing development. Ongoing data collection will further clarify the robustness and clinical implications of these effects.

Free paper 0688

Does cystic cochlear anatomy affect neural synchrony? E-ABR findings in IP-II malformations: Preliminary findings

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Introduction: Inner ear anomalies may influence cochlear implantation outcomes. According to the classification by Sennaroğlu and Saatçi, Incomplete Partition Type II (IP-II) is an inner ear malformation in which the basal turn is preserved, whereas the middle and apical turns form a cystic structure. Therefore, IP-II may demonstrate electrophysiological outcomes comparable to a normal cochlea.

The electrically evoked auditory brainstem response (E-ABR) allows for the objective assessment of synchronized responses at the auditory nerve and brainstem levels. Wave latencies and amplitudes may vary according to electrode location. The aim of this study was to characterize E-ABR findings in CI users with IP-II and normal cochlear anatomy.

Material and methods: Nine CI users were included in the study: six with normal cochlear anatomy and three with IP-II inner ear malformations. E-ABR recordings were obtained from all participants, and waves II, III, IV, and V latencies and amplitudes were evaluated with respect to apical, middle, and basal electrodes. The data were analyzed descriptively.

Results: E-ABR response profiles obtained from CI users with normal cochlea and those with IP-II inner ear malformations were generally similar. In the IP-II group, no significant differences were observed compared to the normal cochlea, particularly at the apical electrodes, despite the cystic anatomy. This finding is consistent with previous literature reporting that individuals with IP-II malformations may exhibit electrophysiological responses after cochlear implantation comparable to those with normal cochlea. Furthermore, the systematic variations in latencies and amplitudes observed among the apical, middle, and basal electrodes in both the normal cochlea and IP-II groups suggest preservation of tonotopic organization following cochlear implantation. Shorter latencies and higher amplitudes were recorded at the apical electrodes, whereas amplitude reductions and latency pattern changes toward the basal electrodes indicate electrode-specific neural stimulation aligned with the physiological organization of the auditory pathway.

Conclusions: E-ABR responses in CI users with IP-II inner ear malformations are largely similar to those with a normal cochlea, and the observed response distribution among the apical, middle, and basal electrodes suggests that tonotopic organization is preserved despite IP-II anomalies. Larger studies evaluating electrode-specific E-ABR responses in IP-II may provide further clinical insight.

Free paper 0714

Does the exposure to audio-vibrotactile musical stimuli improve CI users' auditory performances?

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Introduction: The effects of audio-vibrotactile music listening on audiometric test performances have not yet been investigated on cochlear implant users and significant gaps remain in our understanding of how music induces emotions in recipients and the role of vibrotactile stimulation in this process. This study aims to evaluate the influence of vibrotactile music stimulation on auditory performances and emotions of CI users.

Material and methods: Two groups of twelve CI users were each exposed to music alone and to music with concurrent vibrotactile stimulation delivered via a vest enhanced with actuators. Standardized tonal and speech tests were conducted before and after both types of exposure (audio and audio-vibrotactile). In particular, speech audiometry was conducted in the quiet condition (with no masking sounds) for the first group and with the competing sounds for the second group.

Results: The outcomes from both groups consistently showed that the exposure to tactile music significantly enhanced CI users' ability to decode tonal and speech signals compared to the effect resulting from exposure to sounds alone. The majority of participants preferred listening to music with concurrent vibrations over an audio-only experience, as it led to higher levels of immersion and engagement. Consistent with findings from previous studies on individuals with normal hearing, an increase in arousal in CI users was observed in the audio-vibrotactile condition compared to the absence of vibrations, regardless of the type of emotion being conveyed. Nevertheless, participants emphasized the need for vibrotactile devices to incorporate personalization mechanisms, allowing them to dynamically adjust vibration intensity for different body parts.

Conclusions: The results observed in cochlear implant users with audio-vibrotactile music stimulation are promising and may open the door to novel therapeutic approaches for CI users.

Free paper 0577

Duplication of the internal auditory canal and Bonebridge implantation in CROS configuration: A case report

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Introduction: Duplication of the internal auditory canal (dIAC), which involves separate canals for the cochlear and facial nerves, is a very rare congenital anomaly.

Material and methods: This retrospective case study describes the patient with dIAC and unilateral cochlear nerve aplasia, and describes the treatment of unilateral sensorineural hearing loss (single-sided deafness, SSD) using a Bonebridge implant for contralateral signal routing (CROS).

Case report: A 14-year-old female patient who was diagnosed with hearing loss during a school health check visited the Institute of Physiology and Pathology of Hearing. Her hearing screening at birth was normal. Pure tone audiometry revealed unilateral deafness in the right ear (SSD). A CT scan showed asymmetry of the internal auditory canals; the right canal was duplicated. The right VIII nerve could not be identified on MRI, and unilateral right VIII nerve aplasia was found. A Bonebridge 602 implant was placed in the right ear to act as a CROS, taking advantage of the bone conduction phenomenon to transmit sound from the deaf ear to the functioning ear.

Results: During activation of the Bonebridge implant in the Polish sentence matrix test, the patient achieved an SRT of –10.3 dB SNR.

Conclusions: Duplication of the internal auditory canal is pathognomonic of severe cochlear nerve hypoplasia or aplasia, which may significantly impact the choice of treatment and implant. In cases of unilateral anomalies with no hearing impairment on the opposite side, bone conduction implantation should be considered as a CROS.

Free paper 0691

EAC cholesteatoma, a rare complication after cochlear implantation surgeries: An experience

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Introduction: Cholesteatoma of the external auditory canal (EAC) is a destructive and expanding growth of skin cells that can lead to persistent ear discharge and infection. It often results from chronic ear conditions. But can also develop from chronic infection following iatrogenic insult such as cochlear implant surgeries.

Objectives: To manage a post-cochlear implant child with EAC cholesteatoma.

Material and methods: Presenting a case of a 5-year-old boy, a postoperative case of sequential bilateral cochlear implantation surgery (right ear: 29/10/2021 and left ear: 06/03/2023), presented with the complaints of recurrent right ear discharge for 1 year. Examination under GA was suggestive of posterior superior? EAC cholesteatoma in the right ear. Imaging revealed Minimal soft tissue attenuation noted in a few of the mastoid air cells and the posterosuperior EAC. The child was taken for EAC exploration and canalplasty right side under GA. Surgical management included identification of the diseased part of the EAC with methylene blue dye and the same was cleared of disease. The defect was filled with cartilage and perichondrium, canalplasty done.

Results: The child developed dry ear after this surgery.

Conclusions: EAC cholesteatoma can occur in a post-cochlear implant child and can be mistaken for repeated implant site infection, but this should be identified and timely surgical intervention is crucial. The successful exploration and canalplasty resulted in a dry ear, highlighting the importance of identifying and managing complications to ensure optimal auditory outcomes and prevent further infections.

Free paper 0633

Early activation in cochlear implantation: Facts and figures

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Introduction: Early activation (EA) of the audio processor after cochlear implantation has shifted clinical practice from the traditional 3–6-week waiting period to activation within hours or days of surgery. This paradigm change has been driven by advances in surgical techniques, device technology, and postoperative care pathways.

Material and methods: This presentation is intended to summarize current evidence and trends in EA. The presentation will cover the following key aspects: (1) definitions and timing classifications of early versus conventional activation; (2) surgical factors facilitating EA, including minimally invasive approaches and wound management strategies; (3) safety outcomes and complication profiles; (4) electrode impedance behavior and biological responses following early stimulation; (5) magnet strength adjustments and retention considerations; (6) fitting strategies and early mapping protocols; (7) patient selection criteria and contraindications; (8) patient- and parent-reported satisfaction; and (9) future directions of EA research.

Results: Available evidence consistently demonstrates that EA is safe and feasible in appropriately selected adults and children. Reported complication rates are low and comparable to conventional activation timelines, with minor events such as transient swelling or magnet-related discomfort rarely preventing processor use. Electrode impedance trends following EA follow expected postoperative patterns, with no sustained adverse effects attributed to early stimulation. High satisfaction rates and early auditory responsiveness are commonly reported. Emerging workflows emphasize individualized candidacy assessment, standardized documentation of impedance and magnet strength, and coordinated multidisciplinary protocols.

Conclusions: The cumulative literature supports EA as a safe, patient-centered, and increasingly standardized component of contemporary cochlear implantation practice, with ongoing research refining optimal timing and implementation strategies.

Free paper 0080

Early activation in young and adult cochlear implant users: Insights from 1000 cases in Quebec

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Introduction: Standard cochlear implant (CI) activation typically occurs 3–6 weeks postoperatively to allow soft-tissue healing and reduce the risks of infection, edema, or device-related complications. However, the evidence supporting delayed activation is limited and inconsistent, with prior studies relying on small cohorts. Since 2019, our center has implemented a systematic early-activation protocol (<5 days post-op), prompting the need to evaluate its medical, audiological, and operational impact.

Objective: To assess the medical safety, audiological outcomes, and healthcare efficiency associated with early CI activation compared with conventional delayed activation.

Material and methods: We conducted a retrospective cohort study of 983 CI recipients aged >6 years (unilateral, bilateral, or reimplantations for device failure). Participants were divided into two groups: (1) Early activation: within 5 days ($n = 708$); (2) Delayed activation: at 4 weeks post-op ($n = 275$). Outcomes included postoperative complications, audiological performance and healthcare efficiency.

Results: No statistically significant differences were observed in medical complication rates between groups. Audiological outcomes, including speech perception scores, impedance evolution, magnet strength, and mapping profiles, were comparable at 2 and 8 weeks (all $p > 0.05$). Early activation significantly reduced the number of follow-up programming visits, with the delayed-activation group requiring approximately two additional visits ($p < 0.0001$).

Conclusions: Early CI activation is safe, audiologically equivalent, and more efficient than traditional delayed activation. It reduces patient travel burden, lowers system-level costs, and accelerates patient access to auditory stimulation, supporting value-based healthcare principles. These findings suggest that early CI activation should be considered a new standard of care in comprehensive CI programs.

Free paper 0629

Early activation of active middle ear implants: A prospective study

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Purpose: Vibrant Soundbridge (VSB) is an active middle ear implant that serves as a solution for people unable to use conventional hearing aids properly. Surgical techniques for VSB implantation have progressively advanced, improving its outcomes. Traditionally, VSB processor activation transpires around four weeks after the surgery to provide enough healing; however, contemporary practices in cochlear implant and bone-anchored hearing device activations indicate reduced waiting times. The purpose of this research is to explore the feasibility, safety, and advantages of early VSB activation.

Material and methods: This prospective study was conducted in two phases. In phase one, the patients only attempt using the device on the first business day after surgery and then return in 4 weeks for a complete and standard fitting and device use. In the second phase, participants had a thorough fitting and began using the device on a regular basis the first working day after surgery. Feasibility, safety, and audiological results were assessed throughout both phases.

Results: Early activation was successfully achieved in all patients in the early group without significant complications. When comparing the audiological examination and fitting parameters between the initial session the day after surgery and the one-month follow-up, there was no statistically significant change.

Conclusions: The study emphasizes the possibility for early VSB activation, which might minimize wait times and enhance patient satisfaction without compromising device function. Further study is required to validate these results in broader groups and investigate long-term consequences.

Free paper 0619

Early cochlear implant activation: Biological and psychosocial impact. Preliminary results

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Introduction: The timing of cochlear implant (CI) activation remains controversial. Although early activation (EA) appears surgically safe, its influence on the electrode–tissue interface, stimulation parameters, and early psychological adaptation is not well defined. This clinical study evaluates the biological and psychosocial impact of EA compared with standard activation.

Material and methods: Objective measures included intraoperative and longitudinal impedance telemetry, MCL and high-resolution ultrasound (US) assessment of soft tissue thickness. Patient-reported outcomes comprised the CIQOL-35 Profile and the CI-EAQ (Early Activation Questionnaire) to quantify threat appraisal, sensory stress, perceived control, and motivational response.

Results: We hypothesize that EA will not increase postoperative complications or impair wound healing on US assessment. We anticipate earlier impedance stabilization and lower global MCL values in the EA group. Adaptive cognitive appraisal and higher motivational scores on CI-EAQ are expected to predict superior quality-of-life outcomes.

Conclusions: Early activation may biologically influence the electrode–tissue interface while simultaneously shaping early adaptation to electrical hearing. Demonstrating both safety and functional benefit could support reconsideration of current activation timelines in adult CI recipients.

Free paper 0538

Early cochlear implantation and auditory development: Evidence from children under two years of age

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Introduction: To minimize the neurological consequences of congenital profound sensorineural hearing loss. there is general consensus that a child should be provided with a cochlear implant (CI) early on, before 24 months of age. When doing so, it is important to check that the intervention has been effective, i.e., it has allowed the child to reach age-appropriate auditory development. Consequently, the aim of this study is to evaluate early auditory development in children with profound sensorineural hearing loss who received a cochlear implant before the age of two.

Material and methods: The study group consisted of 122 children with profound bilateral sensorineural hearing loss implanted at 6–22 months of age. The mean age at CI activation was 14.3 months (range: 7.9–23.5; SD = 4.0). 54 children from the group were implanted "very early" (before 12 months of age, first group), while 68 children were implanted "early" (between 12 and 24 months of age, second group). Auditory development in all children was assessed using the LittlEARS Auditory Questionnaire (LEAQ) at CI activation and approximately 1, 3, 6, 9, and 12 months after CI use. Relative delay (the delay in relation to the patient's age) was calculated using the normative curve equation.

Results: The initial relative delay was similar in both groups and significantly decreased over time from 73% to 0% in "very early" group and form 70% to 25% in "early" group. In the "very early" group, the results indicate age-appropriate auditory development after one year of CI use.

Conclusions: In children with congenital profound sensorineural hearing loss, cochlear implantation before 12 months of age is more effective compared to implantation between 12 and 24 months.

Free paper 0181

Effect of deviated nasal septum on Eustachian tube dysfunction: A systematic review and meta-analysis

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Objective: A range of chronic ear complaints may be attributed to Eustachian tube dysfunction. Eustachian tube dysfunction secondary to a deviated nasal septum has been described in several clinical studies, with symptomatic improvement demonstrated following septoplasty. However, uncertainty exists as to the size of the effect and consistency between studies.

Material and methods: Electronic searches were carried out of PubMed, EMBASE, and the Cochrane Library for adult patients with complaints of nasal obstruction and/or impairment and/or complaints of ear fullness undergoing nasal surgery.

Results: Seven studies met the inclusion criteria. Studies evaluated the effect of nasal surgery on Eustachian tube dysfunction

using a variety of outcomes, including Eustachian tube function tests, the Eustachian Tube Dysfunction Questionnaire-7, tympanometry, and Nasal Obstruction Symptom Evaluation scores. The results demonstrated the positive impact of nasal surgery on various outcomes related to Eustachian tube dysfunction.

Conclusions: Nasal surgery has been demonstrated to have promising results as a therapeutic option for patients with Eustachian tube dysfunction and a deviated nasal septum, offering significant symptom relief and improved quality of life. Through the integration of the treatment of nasal symptoms in the management of Eustachian tube dysfunction, clinicians can adopt a comprehensive approach to addressing the underlying pathologies contributing to Eustachian tube dysfunction.

Free paper 0129

Effect of early activation and perimodiolar electrodes on cochlear implant impedance

Abdulrahman Hagr

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Introduction: Cochlear implantation (CI) is a proven treatment for severe-to-profound hearing loss, yet outcomes vary widely due to individual, device, and surgical factors. Intracochlear changes, such as fibrosis and neo-ossification, influence electrode impedance and device performance, potentially affecting speech perception.

Purpose: This study investigates the effects of early activation (EA) versus standard activation on intracochlear impedance telemetry across different electrode types (lateral vs perimodiolar). It aims to assess whether EA reduces the impedance and improves CI outcomes.

Material and methods: This study involved 38 participants (54 CI ears) with Cochlear slim-straight or slim perimodiolar electrodes. Impedance telemetry was measured at four key time points, ranging from intra-operative to 12 months post-activation. Mixed-effects regression models evaluated the influence of activation timing and electrode type on impedance levels, with statistical significance determined using Bonferroni-corrected thresholds.

Results: Perimodiolar electrodes demonstrated significantly lower impedances compared to lateral electrodes, particularly in EA cases. EA consistently resulted in reduced impedances across all cochlear regions, with the greatest reductions observed in the apical and middle regions at 3–6 months ($p < 0.0001$). By ≥1 year, impedance differences between activation modes diminished but remained significant in select regions ($p = 0.012$).

Conclusions: EA, particularly with perimodiolar electrodes, optimizes the electrode-tissue interface, reducing impedance and potentially improving CI performance. These findings highlight the clinical benefits of EA in enhancing CI outcomes and support its consideration in routine CI protocols.

Free paper 0486

Effect of early activation and perimodiolar electrodes on cochlear implant impedance

Fida Almuhawas

ENT, King Abdullah Ear Specialist Center, Riyadh, Saudi Arabia

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Free paper 0391

Effect of implant coil design on telemetry and connectivity: CI632 versus CI1032

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Introduction: Recent developments in cochlear implant technology aim to enhance device performance and clinical efficiency. The Cochlear™ CI632 implant is widely used, while the newer CI1032 (Nucleus) implant includes design updates such as a gold implant coil, which may improve telemetry connectivity.

Objective: To compare impedance values, Neural Response Telemetry (NRT) thresholds, and programming levels between CI632 and CI1032 cochlear implant systems.

Material and methods: This prospective study includes 60 patients implanted with Cochlear™ devices. Patients were grouped according to implant type (CI632 vs CI1032). Outcome measures include electrode impedance, NRT thresholds, and programming parameters including Threshold (T) and Comfort (C) levels.

Results: Preliminary Status: Initial observations indicate comparable impedance and NRT measurements between the two implant models. The CI1032 system, utilizing a gold implant coil, is expected to enhance connectivity speed and telemetry stability.

Conclusions: Final data analysis is currently in progress. Complete results will be presented at the conference.

Free paper 0446

Effective closure of a large postauricular fistula using a cervico-occipital flap in a patient after cochlear implantation with the subtotal petrosectomy technique: A case report

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Introduction: A postauricular fistula is a rare but often challenging complication after middle ear surgery. In patients following cochlear implantation, it poses a significant therapeutic challenge and may even require implant removal.

Case report: We present the case of a 47-year-old female patient after right-sided cochlear implantation performed with the subtotal petrosectomy technique. Four years after surgery, a large postauricular fistula developed above the fat-obliterated mastoid cavity. The patient underwent targeted antibiotic therapy, followed by surgical debridement of the granulation tissue, reobliteration of the cavity with autologous abdominal fat, closure of the fistula using a cervico-occipital flap pedicled on the occipital artery, and coverage of the defect with a free skin graft from the abdomen. Healing proceeded uneventfully, and long-term follow-up revealed no recurrence of the fistula and proper cochlear implant function.

Conclusions: The technique described allows for effective and durable closure of a postauricular fistula in patients after cochlear implantation, while preserving normal implant function.

Free paper 0186

Effectiveness of FLEX20 and FLEX24 electrodes in hearing preservation among partial deafness treatment patients

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Introduction: To properly evaluate how electrode length influences hearing preservation (HP), it is essential to consider this parameter and study a group of patients with comparable levels of preoperative residual hearing.

Objective: The study aimed to investigate the effect of electrode length on HP outcomes in individuals undergoing Partial Deafness Treatment–Electrical Complement (PDT-EC).

Material and methods: Twenty-three PDT-EC patients with preoperative air conduction thresholds ≤30 dB up to 500 Hz were enrolled and divided into two groups: 12 recipients of the FLEX20 electrode and 11 recipients of the FLEX24. All subjects underwent minimally invasive cochlear implantation via the round window approach. Pure-tone audiometry was conducted before surgery and at 1, 6, 12, and 24 months post-implantation. HP status was determined after surgery. Speech perception was measured preoperatively as well as at 12- and 24-month follow-ups.

Results: Individual HP analyses revealed that over half of the patients in both the FLEX20 and FLEX24 groups demonstrated complete HP at the 6-month follow-up. No participant in either cohort showed postoperative hearing loss. At activation, average low-frequency air-conduction thresholds (125–500 Hz) were marginally lower for the shorter electrode ($M = 29.03$) compared with the longer one ($M = 39.10$) ($p = 0.067$). However, electrode type (FLEX20 vs FLEX24) was not associated with significant long-term differences in pure-tone audiometry or speech performance.

Conclusions: During the early postoperative period, the majority of patients in both electrode groups maintained complete hearing preservation, with the FLEX20 electrode demonstrating marginally more favorable initial outcomes. Over longer-term follow-up, electrode length did not influence the degree of hearing preservation or speech understanding.

Free paper 0627

Effectiveness of surgical approach of insertion ventilation tubes (tympanostomy) and adenoidectomy in comparison with non-surgical approach (watchful waiting approach) in children at the age between 1 and 6 and who suffer from otitis media with effusion (OME) in a 12-month period of observation: The retrospective analysis

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Objective: Otitis media with effusion (OME) is one of the most common diseases in childhood. The objective was to assess clinically the effectiveness of the surgical approach (tube insertion with adenoidectomy) in comparison with the non-surgical approach (watchful waiting) during a 12-month observation period.

Material and methods: This study was retrospective and obtained approval from the bioethics committee. The criteria of inclusion in the first group (surgical approach) were: (1) a diagnosis of chronic otitis media with effusion in children aged between 1 and 6 years; (2) their medical history showed that they had undergone adenoidectomy and tympanostomy with the insertion of ventilation tubes (VTs). The criteria for inclusion in the second group (non-surgery) were similar to the first group except that their medical history showed they had not undergone adenoidectomy or tympanostomy with the insertion of VTs. There were 422 children included in the surgical group and 50 children in the non-surgical group, and the period of observation was 12 months.

Results: For the entire surgical group, the number of healthy days ranged from 20 to 365, with a mean of 328.0 days (SD = 91.4).In the non-surgical group, the number of healthy days ranged from 13 to 365, with a mean of 169.2 days (SD = 127.3). The difference in the number of healthy days was statistically significant ($p < 0.001$). The certainty of treatment in the first group was higher than in the second group, and the number of days without recurrence was significantly higher than in the second group. In the first group, there were 71 recurrences from 422 children (16.8%), and in the second subgroup, there were 40 recurrences of acute otitis media (AOM) from 50 children (80%). The RR was 0.21.

Conclusions: The surgical approach in children aged 1–6 years who have been diagnosed with otitis media with effusion is reasonable and beneficial for the child.

Free paper 0731

Effectiveness of the ADHEAR bone conduction device fitted bilaterally in a child with a conductive hearing loss: A case study

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Introduction: Frequently, bone conduction hearing aids on a softband are not tolerated by children due to pressure on the head or visual esthetics. By way of contrast, a non-surgical hearing system – ADHEAR (MED-EL, Innsbruck, Austria) – allows the sound processor to be attached using a noninvasive adhesive adapter. The objective of this study was to evaluate the effectiveness of the ADHEAR system and assess its subjective benefits in a child who had bilateral conductive hearing loss.

Case report: The ADHEAR system was tested in a 13-year-old child with bilateral conductive hearing loss. Pure tone audiometry and speech audiometry in quiet were performed without and then with a pair of devices placed bilaterally. Word recognition scores (WRS) at 50 and 65 dB SPL in quiet were measured using the Pruszewicz monosyllabic Polish word test. After 4 weeks, subjective hearing benefit and experience with the ADHEAR system was done using the APHAB (Abbreviated Profile of Hearing Aid Benefit) questionnaire.

Results: With ADHEAR, WRS at 50 dB SPL increased significantly from an unaided score of 10% to 80%. The result of free-field audiometry with ADHEAR on both sides indicated a hearing level within the normal range.

Conclusions: ADHEAR is an effective rehabilitation option for children with bilateral conductive hearing loss.

Free paper 0178

Effects of Alpha and Theta band monaural beat stimulation on tinnitus-related distress

Reyhan Hürriyetoğlu[1,2], Oğuz Yılmaz[3], Gözde Bayramoğlu Çabuk[4], Erol Belgin[5], Handan Yaman[6], Metin Yılmaz[7], Reyhan Hürriyetoğlu[1,2], Oğuz Yılmaz[3], Gözde Bayramoğlu Çabuk[4], Erol Belgin[5], Handan Yaman[6], Metin Yılmaz[7]

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Introduction: Tinnitus is a prevalent auditory condition that can substantially impair quality of life, yet an effective and standardized treatment approach remains lacking. Monaural beats have been reported to facilitate relaxation and modulate emotional states; however, their potential role in tinnitus management has not been sufficiently investigated. The present study aimed to examine the effects of alpha- and theta-band monaural beat stimulation on tinnitus perception and tinnitus-related distress.

Material and methods: A total of 62 individuals with chronic, subjective, idiopathic, unilateral tinnitus were enrolled in this randomized study. Participants were assigned to receive either alpha- or theta-frequency monaural beat stimulation for a 10-day intervention period. Baseline assessments included the Montreal Cognitive Assessment (MoCA), comprehensive audiological evaluation, and psychoacoustic characterization of tinnitus. Subjective outcomes were measured using the Tinnitus Handicap Inventory (THI), Beck Depression Inventory (BDI), and Beck Anxiety Inventory (BAI). All assessments were repeated following completion of the stimulation protocol.

Results: Post-intervention analyses demonstrated a statistically significant reduction in THI and BDI scores across participants ($p < 0.05$), indicating decreased tinnitus-related handicap and depressive symptoms. Although anxiety levels, as assessed by the BAI, showed an overall downward trend, a statistically significant reduction was observed only in the theta-band stimulation group.

Conclusions: The findings suggest that monaural beat stimulation may contribute to a reduction in tinnitus-related distress and depressive symptoms in patients with chronic tinnitus. The anxiolytic effects appear to be frequency-dependent, with theta-band stimulation demonstrating a more pronounced impact. Monaural beats may therefore represent a promising complementary approach in tinnitus management, warranting further investigation with larger cohorts and longer follow-up periods.

Free paper 0343

Effects of asymmetric auditory deprivation in sequential cochlear implant

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Introduction: The duration of auditory deprivation is a major determinant of speech perception outcomes in cochlear implant users and contributes substantially to interindividual variability. In sequential bilateral implantation, asymmetric deprivation between ears provides a unique model to isolate its effects on auditory performance.

Objective: To evaluate the influence of auditory deprivation on sequential cochlear implants in postlingual patients, comparing the ear with shorter deprivation (ESAD), longer deprivation (ELAD), and the bilateral condition (BIL).

Material and methods: This retrospective study included postlingually deafened patients who underwent sequential bilateral implantation between 1990 and 2021 at a tertiary referral center. Auditory performance was assessed over 24 months after activation of each implant. Outcomes included free-field pure-tone average (PTA), speech detection threshold (SDT), and sentence recognition in quiet and in noise at +10 dB SNR. Secondary variables were interimplant interval, duration of pre-implant hearing aid use, etiology, and electrode insertion depth.

Results: ESAD outperformed ELAD in quiet (73% [IQR 44–92] vs 37% [IQR 0–87]) and in noise (27% [IQR 0–62] vs 0% [IQR 0–45]) at 24 months ($p < 0.001$). BIL achieved superior results to both monaural conditions in quiet (97% [IQR 72.5–100], $p < 0.001$) and in noise (57% [IQR 23–86.5], $p = 0.008$), regardless of ESAD experience. Interimplant interval correlated positively with BIL performance ($r = 0.450$; $p < 0.001$). Longer hearing aid use was negatively associated with ESAD ($r = –0.293$; $p = 0.020$) and BIL performance ($r = –0.312$; $p = 0.018$). Partial electrode insertion in ELAD was linked to poorer BIL outcomes in quiet ($p = 0.045$). No correlations were found for age or etiology.

Conclusions: Shorter auditory deprivation and interimplant intervals are associated with better outcomes. Bilateral stimulation enhances performance even with long deprivation in one ear, and auditory experience with the first implant improves results. Complete insertion favors the more deprived ear, whereas prolonged ineffective hearing aid use may compromise outcomes.

Free paper 0468

Effects of bimodal hearing and acoustic–electric synchronization on speech perception, sound localization, and self-reported hearing quality

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Objective: To assess the impact of bimodal hearing, using a cochlear implant (CI) on one ear and a hearing aid (HA) in the contralateral ear, with or without synchronized sound processing, on speech perception in noise, sound localization, and quality of life.

Material and methods: Ten adults with a unilateral Advanced Bionics CI used for at least six months, and residual contralateral hearing, participated in a crossover study. Residual hearing was defined as hearing thresholds ≤85 dB HL at 250 and 500 Hz. Participants were evaluated under four listening conditions: CI alone, CI combined with their previously used HA, and CI combined with a Naída™ Link HA operating either in a synchronized mode with the CI (link) and in a non-synchronized mode (non-link). Assessments were conducted in a blinded manner after one month of HA use in each mode. Speech perception in noise was assessed at signal-to-noise ratios (SNRs) of 0, 5, and 10 dB. Sound localization was tested using 500 Hz and 4000 Hz stimuli. Subjective outcomes were measured using the Nijmegen questionnaire and the Speech, Spatial, and Qualities of Hearing Scale (SSQ).

Results: Bimodal hearing significantly improved speech understanding in noise compared with the CI-only listening across all tested SNRs ($p < 0.001$). No significant differences in sound localization were observed between HA modes; however, a trend toward improved localization of low-frequency sounds was noted in the synchronized mode. Sounds at 500 Hz were predominantly localized to the HA side, whereas 4000 Hz sounds were preferentially localized to the CI side. Compared with the previous HA, the link mode yielded a significant improvement in Nijmegen questionnaire items related to advanced sound perception and speech production ($p < 0.05$), including music appreciation, telephone use, and volume and pitch control.

Conclusions: Bimodal hearing significantly enhances speech perception in noise. Additionally, synchronized acoustic-electric sound processing appears to improve advanced sound perception and speech production as reported by patients. Larger, long-term studies are needed to better characterize the specific benefits of acoustic–electric synchronization.

Free paper 0456

Effects of microphone sensitivity and T-level adjustments in MED-EL SONNET 2 on speech intelligibility in early school-age children

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Objective: To evaluate the impact of reduced microphone sensitivity and elevated stimulation thresholds on speech intelligibility in noise among children with cochlear implants.

Material and methods: We enrolled 34 children (7–9 years) with a unilateral MED-EL SONNET 2 and >4 years of device use. Each child sequentially used three processor maps for two weeks each (home/school; six weeks total): (1) T-base/0 dB – clinical T levels at standard microphone sensitivity; (2)4T-mid (+10 CL)/0 dB – T increased by +10 CL with sensitivity unchanged; (3) T-mid (+10 CL)/–6 dB – same T increase with microphone sensitivity reduced by 6 dB. Automatic gain control (AGC), input dynamic range, and microphone directionality were left at default for all maps. Outcomes were assessed at the end of each two-week period: Speech-in-Noise (10 monosyllabic words) at SNR +10 dB (speech ≈65 dB SPL; noise ≈55 dB SPL); Functional Listening Evaluation (FLE; 10 monosyllabic sentences, score out of 10); and SSQ-Kids (mean parental rating, 0–10 across 10 items).

Results: With T-base/0 dB, mean performance was 63% on Speech-in-Noise (6.3/10), 60% on FLE (6.0/10), and 5.4/10 on SSQ-Kids. Raising T by +10 CL improved outcomes to 70% (7.0/10), 70% (7.0/10), and 6.3/10, respectively. Adding a –6 dB reduction in microphone sensitivity on top of +10 CL provided a modest additional gain: 72% (7.2/10) in Speech-in-Noise, 73% (7.3/10) in FLE, and 6.5/10 in SSQ-Kids.

Conclusions: In early school-age children with long-term SONNET 2 use, a moderate elevation of T (+10 CL) yields clinically meaningful improvements in speech-in-noise intelligibility and parent-reported listening ease. A further –6 dB reduction in microphone sensitivity does not compromise audibility for soft signals and confers a consistent benefit. For individualized fittings, T +10 CL can be considered a default; microphone sensitivity may remain standard or be reduced by 6 dB to attenuate listening fatigue without sacrificing performance.

Free paper 0164

Effects of the number of active channels on speech perception in Chinese cochlear implant recipients

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Objective: As cochlear implant (CI) technology advances, the relationship between the number of channels and auditory performance warrants re-examination. This within-subject design study investigated the effect of manipulating the number of active channels on speech perception in Chinese Mandarin-speaking CI recipients.

Material and methods: Thirty-four post-lingually deafened adult recipients with Nurotron CIs were enrolled. Each participant was tested with maps containing 8, 12, 16, 22, and 24 active channels. Primary outcomes were Mandarin Speech Perception (MSP) disyllable recognition scores in quiet and MSP sentence recognition thresholds in noise. Secondary outcomes comprised subjective ratings of sound clarity and sound quality in both listening conditions.

Results: Increasing the number of active channels resulted in significant overall improvements across multiple measures. In quiet, MSP disyllable recognition scores improved ($F(2.79, 75.24) = 21.28$, $p < 0.001$), as did sound clarity ($\chi^2(4) = 52.88$, $p < 0.001$) and sound quality ($\chi^2(4) = 35.59$, $p < 0.001$) ratings. In noise, MSP sentence recognition thresholds, sound clarity, and sound quality ratings also showed significant effects of channel number ($\chi^2(4) = 39.29$, $p < 0.001$; $F(4, 64) = 6.07$, $p < 0.001$; $F(4, 64) = 6.22$, $p < 0.001$, respectively). The 24-channel condition was consistently superior to the 8-channel condition (all pairwise $p < 0.05$). On average, deactivating one channel was associated with a 1.24% decrease in MSP disyllable recognition score in quiet and a 0.81 dB increase in MSP sentence recognition threshold in noise.

Conclusions: In this cohort of Chinese Mandarin-speaking CI recipients, speech perception in both quiet and noise tended to improve as the number of active channels increased up to 24. These findings indicate that modern CI users may still obtain measurable benefit from more than eight active channels, contrary to earlier reports of an 8–10 channels plateau.

Free paper 0498

Electrical otolith stimulation in patients with Parkinson's disease: A pilot study design

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This research abstract concerns the design of a feasibility study protocol with patients with Parkinson disease who suffer from bilateral severe sensorineural hearing loss and vestibular loss. The goal of the study is to (1) assess the safety of placement of a vestibular implant (VI) electrode on residual hearing and vestibular function (at surgery, 6 weeks and 12 months); (2) assess the effects on subjective and objective Parkinson's scales following electrical stimulation of the otolith organ (at 6 weeks and 12 months). The implant that is implemented was developed in a previous study called BionicVest 1 study and involves a cochlear implant with a complementary customized thin electrode replacing the ground electrode which can be positioned in the vestibule, aiming to electrically stimulate the otolith organs. This may potentially have a positive effect on gait and balance, given the central afferents of the sacculus. To evaluate those aspects we will use vestibular and hearing assessment tests, balance and gait assessment protocols and questionnaires on quality of life. The study will be executed at the Radboudumc in Nijmegen and has an observational character in a pilot phase. Therefore the number of included patients will be low and will allow descriptive statistics.

Free paper 0275

Electrode selection before and after OTOPLAN

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Introduction: Thanks to synchrotron radiation studies and research on cochlear tonotopy, we now know that the cochlear apex contains a significant number of neurons available for stimulation. Furthermore, a complete insertion promotes better sound perception, word recognition, and music appreciation. It is also well established that cochlear duct length and diameter vary significantly among individuals. Since the development of OTOPLAN, we have a tool at our disposal to customize electrode selection based on patient-specific anatomy, aiming to achieve the maximum angular insertion depth (AID) and, consequently, better stimulation of a larger neuronal population.

Objective: To demonstrate that the use of the OTOPLAN software leads to the selection of longer electrode arrays,

increasing the angular insertion depth while reducing intraoperative complications.

Material and methods: A case-control study was conducted at the "Centro Platense de Implante Coclear" (CEPIC). The "cases" consisted of patients whose electrode selection was individualized using OTOPLAN, while the "controls" underwent selection based solely on conventional imaging studies. A total of 116 ears from 108 patients were analyzed: 58 without OTOPLAN and 58 with OTOPLAN measurements.

Results: In the group without the tool, the average electrode length selected was 26 mm (60.3%). Postoperative monitoring in these patients revealed insertions that did not cover the full cochlear length; in three cases, electrodes remained at the edge of the round window, resulting in a lack of posterior stimulation (which could have been avoided with longer electrodes). In this group, the FLEX28 was used in 36.2% of patients and Soft electrodes in 3.5%. In contrast, patients measured with OTOPLAN had an average electrode length request of 28 mm (68.9%), achieving an increased average angular insertion depth of 643°. No postoperative complications were observed in this group. Other electrodes used included the FLEX26 (22.4%) and Soft arrays (8.6%).

Free paper 0083

Establishing an auditory brainstem implantation program in Canada

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Introduction: The story of establishing an auditory brainstem implantation program in Canada.

Material and methods: Retrospective analysis of the ABI program. *ABI Program Team*: The ABI program is supported by the Department of Otology and Neurotology and includes an established Cochlear Implant (CI) program. Key personnel mentioned are audiologists Kim Zimmerman and Laura Hopkins, and Pediatric Neurosurgeon Dr. Sandrine de Ribaupierre. *Initial Cases and Future Outlook*: First Pediatric ABI Case (SL): A 19-month-old girl with bilateral cochlear hypoplasia type-3, and cochlear nerve aplasia on the right with hypoplasia on the left, underwent a right ABI on July 30, 2024, followed by activation on August 29, 2024. A left CI was implanted on December 3, 2024. Second Pediatric ABI Case (MBD): A 3-year and 3-month-old girl with bilateral Michel deformity received a right ABI on May 7, 2025, with activation scheduled for June 2025.

Future cases: A 17-month-old girl with CHARGE syndrome is approved for simultaneous ABI and CI, and five more patients are currently being evaluated.

Results: Outcome Perspective: The presentation emphasizes the goal of bilateral stimulation. It notes that the audiological performance of ABI typically does not reach the level of a CI, as the more peripheral stimulation of a CI results in a better outcome.

Conclusions: The presentation reviews the background, classification, and indications for ABI, with a focus on patients with prelingual deafness and inner ear malformations. Tells the story behind establishing an ABI program in Canada.

Free paper 0308

Estimating the transimpedance matrix diagonal in cochlear implants using computational models and neural networks

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Introduction: Accurate characterization of the transimpedance matrix (TIM) is essential for the design and optimization of cochlear implant stimulation strategies. While off-diagonal TIM elements can be reliably measured in clinical practice, the diagonal terms, representing electrode contact impedances, cannot be directly obtained and are typically estimated using simple linear extrapolation methods, which often underestimate their true values. These inaccuracies can degrade the performance of multipolar stimulation strategies.

Material and methods: We propose a hybrid computational framework combining finite element method (FEM) modeling with artificial neural networks (ANNs) to estimate the diagonal elements of the conductive transimpedance matrix in cochlear implants. Patient-specific FEM models were fitted to clinical impedance measurements by optimizing tissue conductivity parameters, generating a reference dataset of impedance matrices. These FEM-derived matrices were then used to train a supervised ANN that predicts diagonal TIM elements from local off-diagonal neighborhoods. The network was trained, validated, and tested on a dataset comprising 104 FEM impedance matrices derived from 42 clinical cases, covering multiple cochlear anatomies and electrode insertion configurations.

Results: The ANN achieved substantially lower prediction errors for diagonal TIM elements compared with classical linear, quadratic, and hyperbolic extrapolation methods, with root mean square errors on the test set of approximately 17 Ω. Statistical analysis demonstrated no significant bias between ANN predictions and FEM reference values. When applied to multipolar (phased-array) stimulation strategies, TIMs incorporating ANN-predicted diagonal elements produced neural activation patterns comparable to those obtained using conventional extrapolation, while requiring markedly lower electrical power.

Conclusions: This FEM–ANN framework enables accurate and robust estimation of the diagonal elements of the

cochlear implant transimpedance matrix, overcoming key limitations of traditional extrapolation techniques. By improving the fidelity of impedance estimates, the proposed approach supports more reliable multipolar stimulation design and reduces power requirements, offering a practical pathway toward improved cochlear implant fitting and patient-specific optimization.

Free paper 0509

Evaluation of a decision support tool to review Remote Check

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Introduction: Demand for audiological services continues to rise, creating pressure on clinic resources. Remote Check (RC) is an asynchronous telehealth method that supports clinicians in triaging which cochlear implant patients require intervention and the type of intervention needed – reducing unnecessary appointments and clinical workload. Most RC questionnaire items use closed-set response options, while assessments such as the Digit Triplet Test, Aided Threshold Test, and Time on Air require clinical judgment, supported by defined critical difference values and recently established targets. These rules informed the development of a spreadsheet-based clinical decision support tool. This study evaluates the feasibility, clinical suitability, and time-saving potential of using this tool alongside RC.

Material and methods: The RC decision support tool integrates patient responses with expected outcomes and guidance. Clinicians from five sites across the UK, USA, and Saudi Arabia reviewed 184 RC submissions. Experienced RC audiologists used the tool to inform review decisions and, for each item flagged as "review recommended," recorded whether they followed the tool's guidance and their rationale. We also recorded the review duration, outcomes, and the total time each RC submission remained "pending review."

Results: Analyses are ongoing at the time of submission and will be presented in detail. The presentation will report alignment between tool recommendations and clinical judgment, explore reasons for any divergence, and describe how additional information sources influenced decisions. Clinician feedback on the tool's usefulness, efficiency, and areas for refinement will also be summarized.

Conclusions: A clinical decision support tool can streamline Remote Check reviews, potentially reducing clinician workload while maintaining patient care quality. Findings will provide insights into feasibility, clinical value, and priorities for further refinement.

Free paper 0657

Evaluation of a standardized screening process for the application of robotic assistance in a Cochlear Implant Program

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Introduction: The development of a minimally invasive inner ear access with robotic assistance represents a significant advancement in cochlear implant surgery. As part of the initial integration of the HEARO system into a German cochlear implant program, a structured workflow has been developed in an iterative process following the first successful implantations. This workflow systematically identifies suitable candidates and standardizes the decision-making process.

Material and methods: All patients undergoing evaluation for a cochlear implant are systematically assessed for suitability for minimally invasive implantation after imaging procedures. Following standardized consultations, patients can choose between conventional and robot-assisted implantation. The descriptive statistical analysis of this process is the subject of this study.

Results: The systematic screening process was implemented from January 1 till December 31, 2024. In this period, 184 patients have undergone evaluation. Of these, 85 patients (46%) met the eligibility criteria for further anatomical assessment with OTOPLAN. Among them, 34% (29/85) had sufficient safety margins to proceed with robotic-assisted surgery. Following informed discussions, five patients opted for a HEARO-compatible implant system and robotic assistance.

Conclusions: Our findings demonstrate that the integration of new and innovative therapies can be effectively structured through a standardized process, ensuring an individualized treatment approach with a strong patient-centered focus.

Free paper 0098

Evaluation of an impedance-based method to monitor the insertion of the electrode array during cochlear implantation

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Purpose: Cochlear implantation is a prevalent remedy for severe to profound hearing loss. Optimizing outcomes, hearing preservation and minimizing insertion trauma, requires precise electrode placement. Objective monitoring during the insertion process can provide valuable insights and enhance surgical precision. This study assesses the feasibility and performance of an impedance-based method monitoring electrode insertion, compared to the surgeon's feedback.

Material and methods: The study utilized the Insertion Monitoring Tool (IMT) research software, allowing real-time measurement of impedance and evoked compound action potential (eCAP) during electrode insertion in 20 patient implantations. This enabled an impedance-based method to continuously assess the status of each electrode during the insertion process. The feasibility and performance was evaluated and compared to the surgeon's feedback approach. eCAP measurements focused merely on feasibility without searching for specific responses.

Results: The IMT demonstrated feasibility in measuring real-time impedances and eCAP during the insertion of the electrode array. The impedance-based method exhibited potential for accurate monitoring the insertion depth, with a high success rate. However, further development is needed to improve the number of usable contacts.

Conclusions: Objective monitoring with the impedance based method shows promise as a valuable tool enhancing precision in cochlear implant electrode insertion of cochlear implant electrode insertion respecting insertion distance estimation. The IMT research software proved feasible in recording real-time impedances and eCAP during electrode insertion. While this impedance-based method exhibits high success rates, further improvements are required optimizing the number of usable contacts. This study highlights the potential of objective monitoring techniques enhancing cochlear implantation outcomes.

Free paper 0414

Evaluation of the Sentio system: Initial findings in young children

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Introduction: The St Thomas' paediatric hearing implant team offers all clinically available percutaneous and transcutaneous bone conduction implants (BCI). The team has seen a shift in device choice with families and children opting for transcutaneous BCI's if clinically appropriate. Transcutaneous BCI's are increasingly utilized in paediatric populations with conductive or mixed hearing loss, as well as single-sided deafness (SSD). The Sentio system from Oticon Medical is currently approved for use in children aged 12 years and older. A clinical trial is underway to evaluate implantation feasibility, audiological outcomes, and patient-reported outcomes in a younger paediatric population aged 3–11 years (Clinicaltrials.gov identifier: NCT06976086)

Material and methods: This is a prospective, multicenter, single-arm clinical investigation of the Sentio system in children. The study evaluates multiple objective and subjective outcomes including device usability and safety, patient satisfaction, quality of life, and listening fatigue following implantation. Outcome tools include aided levels, age-appropriate speech perception tests (in quiet and noise), the Vanderbilt Fatigue Scale for Paediatrics (VFS-Peds), the Glasgow Children's Benefit Inventory (GCBI), and other tools to evaluate safety and performance.

Results: Preliminary findings from seven children (aged between 4 and 10 years) will be presented. Among these, the distribution of hearing impairments comprised unilateral sensorineural hearing loss ($n = 3$), bilateral conductive hearing loss ($n = 3$), and unilateral conductive hearing loss ($n = 1$). These children are at different stages within the trial and results to date will be discussed. The teams experience with the Sentio system including assessment and post-op audiological management, performance outcomes, user satisfaction and safety with younger children will be discussed.

Conclusions: Our experience so far indicates that the Sentio 1 Mini sound processor is straightforward to fit and user-friendly for younger paediatric patients and is indicating high user satisfaction. Objective and subjective outcomes indicate positive experience and auditory performance for this younger patient population.

Free paper 0416

Experiences with remote programming of cochlear implants from the perspectives of CI users and professionals

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Introduction: Since 2023, AB has offered the ability to perform adjustments for unilateral, bilateral and bimodal CI users remotely with the Target CI 1.5 fitting software in combination with the AB Remote Support App. For many CI users, attending in-person programming appointments is time-consuming and difficult. Traveling is especially burdensome for users with limited mobility. Various studies have investigated the practicality and safety of the system to evaluate the benefits of remote care for CI users and healthcare professionals (HCPs), as well as to develop counseling recommendations. Additionally, a global survey was conducted to collect user experiences worldwide. This paper summarizes the results, focusing on the experiences of CI users and HCPs with remote programming.

Material and methods: Via two online questionnaires, one for CI users and one for HCPs, data from eight countries were collected so far. The questions addressed, among other things, satisfaction with programming, as well as the advantages and disadvantages. In addition, potential future use was assessed and the willingness to recommend programming was measured. In further studies speech perception scores measured after a remote programming session were compared to the outcomes after a traditional in-clinic fitting.

Results: In general, CI users and HCPs were satisfied with their experiences with the remote programming solution. The reduced time and cost compared to a traditional appointment was advantageous. Many respondents would choose remote programming again for future appointments. In the online survey, CI users were more likely than professionals to indicate that they would consider remote programming for annual check-ups. Just a few CI users reported minor shortcomings with internet connectivity or audio quality. Speech perception scores are similar after a remote session compared to after a traditional in-clinic fitting.

Conclusions: Overall, both CI users and health care professionals expressed positive views on incorporating remote programming as an integral component of cochlear implant care. Positive assessments from diverse international settings suggest that remote programming is a promising strategy to improve access to care and to optimize CI programming for unilateral, bilateral as well as bimodal and EAS solutions.

Free paper 0285

Exploring factors that contribute to decision-making for pursuing cochlear implantation in adults with severe-to--profound hearing loss

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Introduction: Decision-making for Cochlear Implantation (CI) is a complex and multidisciplinary process for individuals who suffer from severe-to-profound sensorineural hearing loss (SNHL). For many, reduced speech perception and a diminished ability to connect with the world around them are primary motivations for pursuing hearing restoration. Moreover, these individuals often face substantial communication barriers in daily life, which can lead to social isolation, depression, anxiety, and an overall reduced quality of life. Therefore, decision-making includes several factors on audiological, medical, and psychosocial measures.

Objective: This study aims to provide comprehension of these factors, and may shed light on a deeper understanding of factors that impact pursuing, delaying, or declining implantation over time. Ultimately, this study contributes to improving overall personalized counseling and care throughout the CI eligibility assessment.

Material and methods: This inductive study is part of SMILE, a prospective multi-center study including severe-to-profound SNHL individuals who were referred for unilateral CI. Continuous data from the Nijmegen Cochlear Implant Questionnaire (NCIQ) and nominal data from intake visits, both as the road to CI before surgery, were analyzed by computing differences in individuals pursuing CI and individuals not pursuing CI (yet). For this study, 148 patients were included and divided based on age (<67 years of age as the working group, and >67 years of age as non-working, retired population group among Dutch standards).

Results: Preliminary analysis suggests that decision-making for a CI is characterized by high heterogeneity across individuals. Decisions appear to emerge from various factors related to patient demographics and background (social network, occupation), medical and audiological characteristics (Quality of Life, referring physician and intake policy), diagnostics (etiology), and most importantly expectations and doubts these individuals carry along their CI trajectory.

Conclusions: Preliminary conclusions include that a longer CI trajectory, often with more visits, primarily indicates greater complexity, not inefficiency. It underscores the need for personalized care. Also, patient doubts do not directly lead to a longer trajectory, but they do lead to more interim consultations. These additional consultations are a hallmark in the process of careful decision-making.

Free paper 0736

External auditory canal cholesteatoma following cochlear implantation: A rare surgical sequela

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Introduction: Cholesteatoma of the external auditory canal (EAC) is a destructive and expanding growth of skin cells that can lead to persistent ear discharge and infection. It often results from chronic ear conditions. But it can also develop from chronic infection following iatrogenic insult such as cochlear implant surgeries.

Objectives: To manage a post-cochlear implant child with EAC cholesteatoma.

Material and methods: Presenting a case of a 5-year-old boy, a postoperative case of sequential bilateral cochlear implantation surgery (right ear – 29/10/2021 and left ear – 06/03/2023), presented with the complaints of recurrent right ear discharge for 1 year. Examination under GA was suggestive of posterior superior EAC cholesteatoma in the right ear. Radiological imaging revealed minimal soft-tissue attenuation in a few mastoid air cells and the posterosuperior EAC. The child was taken for EAC Exploration and Canaloplasty right side under GA. Surgical management included identification of the diseased part of the EAC with methylene blue dye and the same was cleared of disease. The defect was filled with cartilage and perichondrium, and canaloplasty was done.

Results: The child developed a dry ear after this surgery.

Conclusions: EAC cholesteatoma can occur in a post-cochlear implant child and can be mistaken for repeated implant site infection, but this should be identified and timely surgical intervention is crucial. The successful exploration and canaloplasty resulted in a dry ear, highlighting the importance of identifying and managing complications to ensure optimal auditory outcomes and prevent further infections.

Free paper 0734

Failures after cochlear implant surgery in profound hearing loss and deafness

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Introduction: Human speech is the primary mode of communication, and its development relies heavily on auditory function. With approximately 12% of the global population experiencing hearing loss, cochlear implantation has become a vital intervention when traditional hearing aids provide insufficient benefit. Achieving optimal outcomes depends on three critical pillars: rigorous patient qualification, precise surgical technique, and consistent post-operative processor fitting and rehabilitation.

Material and methods: This study analyzes the cochlear implant treatment program established at our department in 2004. We reviewed the outcomes of 216 patients, aged 4 to 87 years (average age 45), who underwent implantation over a 20-year period. Treatment failures were categorized into "major" and "minor" groups. Potential causes for failure were identified as insufficient diagnostic qualification, surgical complications, and issues regarding rehabilitation or processor compliance and fitting.

Results: In our clinical material, the incidence of major failures ranged from 0.3% to 9.5%. Minor failures were observed at a significantly lower frequency, ranging from 0.3% to 0.5%.

Conclusions: Continuous analysis and long-term follow-up of cochlear implantation procedures are essential. Monitoring these outcomes allows clinical teams to refine surgical and rehabilitative methods, avoid recurring failures, and ultimately enhance the quality of patient care.

Free paper 0140

Family support and data management of pediatric auditory brainstem implant cohort

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Introduction: In 2019, our team performed the first auditory brainstem implant (ABI) surgery in China on a child with congenital deafness and established a prospective clinical ABI cohort, which has now included 120 participants. Data from ABI patients include audiological, imaging, developmental assessments, and multidisciplinary team (MDT) consultations. Establishing a database can assist researchers in comprehensive evaluation and analysis, help build a systematic framework for device programming and outcome evaluation in pediatric ABI recipients, and play a significant role in data management.

Objective: To adopt a more effective data management model for the digital management of ABI cohort data, ensuring the authenticity and validity of research data while enabling more intuitive follow-up outcome evaluation. This will assist in optimizing post-implant device programming, improving patients' auditory and speech recognition abilities, establishing a sustainable data management system, and safeguarding data security.

Material and methods: Based on the nature and content of data to be collected for the ABI cohort database, the database content and primary purposes were determined, and the database structure was designed. After database design, the clinical research coordinator (CRC) implemented the system architecture program, conducted debugging, communicated and provided feedback to engineers, and refined the program iteratively. The final entry system was formed through repeated modifications based on issues identified during use.

Results: Through standardized diagnosis and treatment under unified protocols, emphasis on source data quality, improvement of the ABI database architecture, maintenance of data preservation, reasonable facilitation of data sharing while prioritizing patient privacy protection, researchers can develop individualized plans for different patients by visually comparing follow-up data over time.

Conclusions: The establishment of the database ensures both security and convenience, improves existing data quality, assists researchers in optimizing post-implant adaptation and auditory-speech development in patients, and supports in-depth analysis by researchers. This contributes to achieving further breakthroughs in ABI outcomes and research, while also enabling more standardized management of project data.

Free paper 0118

FDA clinical trial to expand cochlear implant pediatric indications

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Objectives: There is growing evidence that cochlear implant (CI) during infancy, and broader audiologic indications are advantageous to auditory and language outcomes. In the United States, an important barrier to early implantation is insurance coverage by public and commercial payers based on outdated Food and Drug Administration (FDA) approved indications. MED-EL sponsored a multicenter FDA clinical trial to expand pediatric age of implantation and audiologic criteria. This study demonstrated safety and efficacy of MED-EL cochlear implants in children <12 months of age and children aged 12–71 months with residual hearing.

Material and methods: Prospective and retrospective study of safety and auditory outcomes of children with bilateral sensorineural hearing loss (SNHL) implanted with the MED-EL SYNCHRONY between 7 months and 5 years 11 months, with low frequency thresholds of severe to profound (<12 months) or mild to profound (≥12 months). Primary outcome measures were 1. device and surgical adverse events; 2. Auditory outcomes by 12 months post activation measured by the Little Ears Questionnaire (LEAQ) or the MLNT/LNT with clinical endpoints score ≥25 or improvement ≥10%, respectively.

Results: Prospective arm included 38 children (73 ears) with 80% achieving clinical endpoint. As a group, subjects developed auditory skills faster than children with normal hearing. Retrospective arm included 209 children (294 ears). Of the 92 subjects with audiologic data available, 88% achieved clinical endpoint. The rate of serious adverse device effects was <6% in both arms. For subjects implanted <12 months, 84% of the prospective and 86.5% of the retrospective subjects reached clinical success. Clinical success for subjects implanted 12–71 months of age was 100% of prospective and 88% of retrospective groups.

Conclusions: The study supports (1) safety of implantation of children with the MED-EL SYNCHRONY as young as age 7 months; and (2) expansion of audiologic criteria to include infants with severe to profound SNHL and children 12 months to six years with mild loss in the low frequencies, sloping to a severe to profound loss in the high frequencies. Expansion of FDA-approved indications is important to reduce barriers to pediatric implantation and to improve outcomes.

Free paper 0530

Feasibility of day surgery for cochlear implantation under conscious sedation with same-day fitting

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Objectives: To evaluate the feasibility of performing cochlear implantation under conscious sedation (CS) as day surgery with same-day fitting.

Material and methods: All patients underwent cochlear implantation under CS between November 2017 and April 2018. The data collected included demographic information, preoperative clinical characteristics, surgical details, postoperative fitting information and side effects, if any.

Results: Nine patients had 11 cochlear implants (CIs) placed under CS (2 patients received bilateral CIs). One patient's data were excluded from the audiological results because conversion to general anesthesia (GA) was necessary. One patient (11%) vomited just before the end of the procedure. Seven patients had uneventful procedures. Eight (88%) patients were discharged home the same day. There was a statistically significant difference in recovery time between the CS group and the GA group ($t = -2.26$, $df = 12$, $p < 0.05$). In the CS group, there was no statistically significant change in the maximum comfortable loudness level (MCL) for all electrodes from the day of the surgery to the following day. However, there was a statistically significant difference in the threshold (THR) levels of all electrodes from the day of the surgery to the following day ($Z = -2.04$, $N = 120$, $p < 0.05$). Further analysis revealed a statistically significant difference in the 4 most apical electrodes ($Z = -3.496$, $N = 40$, $p < 0.0001$), but not in the middle or basal electrodes.

Conclusions: Cochlear implantation can be performed under conscious sedation with careful patient selection. This approach facilitates same-day fitting and day surgery by minimizing comorbidity.

Free paper 0390

Feasibility of diagnostic-quality MRI in patients with implantable hearing aids

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Introduction: Although modern hearing implants are MRI-compatible, metallic components and built-in magnets severely compromise cranial image quality, directly affecting diagnostic decision-making in implant patients. Evidence-based MRI strategies tailored to magnet-containing bone conduction systems remain scarce. This study evaluates MRI artifacts caused by implantable hearing aids and identifies strategies to improve diagnostic image quality.

Material and methods: An Osia®-2 active bone conduction implant was surgically placed in a human cadaver head. Cranial and inner ear MRI examinations were performed on 1.5 T and 3 T scanners with adherence to the standard protocols of sequences. Metal artifact reduction imaging (MAVRIC) was systematically added. Image quality was graded on a four-point scale based on artifact severity and anatomical visibility of 14 anatomical structures of the head.

Results: Conventional sequences showed extensive artifacts, predominantly on the ipsilateral side; DWI and SWAN sequences were also affected contralaterally. Magnet removal substantially reduced artifacts, while insertion of a spacer had no negative effect. MAVRIC sequences consistently improved image quality and interpretation abilities of key anatomical structures. No clinically relevant differences were observed between 1.5 T and 3 T examinations.

Conclusions: Despite the artefacts, diagnostic-quality cranial MRI is achievable in in patients with Osia®-2 implant and other magnet-containing implantable hearing aids. MAVRIC sequences provide a practical and effective solution for overcoming magnet-related artifacts and should be considered standard in MRI protocols for implant recipients. These findings support informed MRI referral and protocol selection for patients with implantable hearing aids.

Free paper 0309

Feasibility of individualized early activation in Humanitarian Cochlear Implant Missions

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Introduction: Humanitarian cochlear implant (CI) missions often face logistical and time-related constraints that challenge the use of conventional postoperative pathways. Standard activation timelines may be impractical in mission settings where rapid patient turnover and limited follow-up opportunities exist. This study examines the feasibility and clinical impact of implementing an individualized early activation protocol that includes same-day postoperative imaging followed by anatomy-based fitting (ABF) on the day after surgery. The objective was to determine whether this streamlined workflow could be executed efficiently without compromising patient outcomes or mission productivity.

Material and methods: All participants underwent cochlear implant surgery within humanitarian mission programs. Immediately following surgery, each patient received a same-day X-ray to confirm electrode placement and obtain Cochlear View (CV) and Anatomy-Based Insertion Depth (AID) measurements. These radiological assessments were used to support individualized mapping adjustments. On postoperative day one, patients underwent early device activation. During activation, anatomy-based fitting was applied to tailor frequency allocation according to each patient's cochlear anatomy, enabling a personalized map from the first day of device use. Workflow timings, clinical responses, and implementation practicality were documented and analyzed.

Results: The individualized early activation protocol proved feasible and well-suited to the fast-paced environment of humanitarian missions. Same-day radiological assessment combined with next-day activation did not increase overall clinical time requirements or disrupt mission workflow. The protocol demonstrated strong operational efficiency, allowing teams to maintain patient throughput without delays. Clinically, patients exhibited stable early auditory responses, and no adverse events were associated with expedited activation or anatomy-based fitting. Outcomes reflected comparable effectiveness to traditional timelines, despite the accelerated pathway.

Conclusions: Implementing individualized early activation supported by same-day imaging and anatomy-based fitting is both practical and effective in humanitarian CI missions. The streamlined approach preserves workflow efficiency while maintaining high-quality clinical outcomes. These findings suggest that early activation models can be safely integrated into resource-limited mission settings, providing timely auditory access without compromising patient care or operational performance.

Free paper 0166

Feasibility study on the safety of the Nucleus® Nexa™ implant in the 7T MR environment

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Introduction: The use of magnetic resonance (MR) imaging and spectroscopy in patients with active implanted auditory prostheses has become daily practice for diagnostic medical assessment. Today's implants provide conditional labelling for the 1.5 T and 3 T MR environment. Recently, scanners with a static magnetic field strength of 7T have become more widely available. This feasibility study investigated the interactions between the Nucleus Nexa implant CI1032 (Cochlear Ltd) and the 7 T environment.

Material and methods: Based on relevant industry standards, six potential interactions were investigated: (1) Magnetically-induced force and (2) torque experienced by the implant housing and the implantable retaining magnet, (3) demagnetisation of the implantable retaining magnet, (4) electrical function of the implant following scanning, (5) heating of the implant by radiofrequency pulses and gradients during scanning, (6) quantification of image artefacts.

Results: With the non-magnetic cassette in place, the force ratio defined as the magnetically induced force divided by the force induced by gravity was 0.54. With the magnet in place the force ratio increased to 10.41. Torque ratios in these cases were 0.57 and 139.38, respectively.

In line with industry standards, a total of 10 exposures were performed covering the need of 99.9% of the population. An increase in magnetization of 7% was observed for the retaining magnet and device functionality was unaffected. Device heating remained well below the 2°C safety limit after 15 minutes consecutive scanning at 3.2 W/kg (RF) or with a gradient field strength of 41.8 T/s (gradient). Image datasets were acquired for a series of pulse sequences selected based on commonly-used clinical examinations.

Conclusions: This represents the first results of a feasibility study investigating several interactions between the Nexa implant and the ultra-high field 7T MR environment. These preliminary findings revealed no adverse effects on the implant under predefined test conditions, and image artefacts were similar to those reported in the 3T environment.

While these early outcomes are promising, formal device verification activities are required to confirm safety and to label a device for use within the 7T MR environment.

Free paper 0278

First clinical evaluation of robot-assisted cochlear implantation

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Introduction: Robot-assisted cochlear implantation enables a minimally invasive and highly precise approach to the inner ear. This technique aims to improve access in anatomically challenging cases, reduce intracochlear trauma, and better preserve residual hearing. A 1.8-mm tunnel is drilled directly through the mastoid into the cochlea, requiring strict adherence to safety margins relative to critical anatomical structures, including the facial nerve, chorda tympani, and stapes footplate. This study reports the first clinical experience with the HEARO system in Austria, with a focus on feasibility, accuracy and safety.

Material and methods: Cochlear implant candidates were screened for eligibility for a robot-assisted procedure. Preoperative planning was performed using an otological planning software based on high-resolution computed tomography imaging. Between September 2021 and May 2025, ten robot-assisted cochlear implantations were performed. Outcomes related to the HEARO system, including procedural success rate, adverse events, and system accuracy, were evaluated. Insertion outcomes, including successful electrode array insertion, insertion depth angle, and procedure duration, were also assessed.

Results: Robot-assisted cochlear implantation was completed successfully in nine of ten cases; one case required intraoperative conversion to a conventional approach. No severe adverse events occurred. Mean accuracy was 0.23 ± 0.09 mm to the target and 0.16 ± 0.09 mm to the facial nerve. In all nine completed HEARO procedures, electrode arrays (one FLEX20, one FLEX26, and seven FLEX28) were fully inserted, with a mean insertion angle of 564 ± 50°. Mean procedure duration was 242 ± 24 minutes.

Conclusions: Robot-assisted cochlear implantation is a feasible and highly accurate technique. Initial clinical experience demonstrates promising results while also highlighting current technical and procedural limitations. Continued clinical application and further studies are required to optimize the system and broaden its indications.

Free paper 0240

First clinical experience with an automated insertion tool for cochlear implantation

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Introduction: To preserve residual hearing during cochlear implantation, it is necessary, among other things, to insert the electrode gently and slowly. The automated insertion tool OTODRIVE (MED-EL GmbH, Austria) enables a slow, even movement of the forceps at a predetermined speed and should thus facilitate gentle electrode insertion. The aim of the present study is to gain initial experience with the automated insertion tool regarding surgical handling and to investigate any influence on residual hearing retention.

Material and methods: Patients who were routinely fitted with a cochlear implant between September 2024 and December 2025 and inserted with the automated insertion tool will be included in the evaluation. In the case of existing pre-operative residual hearing, the extent to which this can be preserved during the operation will be investigated. In addition, parameters such as complication rate, duration of insertion and final insertion depth are documented.

Results: The initial results show a complication-free electrode insertion and a mean postoperative bone conduction hearing loss of approx. under 10 dB HL. The average time for electrode insertion is about 4 minutes, whereby a minimum insertion speed of 0.1 mm/s can be achieved.

Conclusions: Initial clinical experience with the OTODRIVE automated insertion tool shows that it is easy to use during surgery, although there is a certain learning curve to overcome. Automated insertion has the potential to enable good residual hearing retention.

Free paper 0067

First insights into the clinical application of a hydraulically driven system for robot-assisted cochlear implant electrode insertion

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Introduction: The Cochlea Hydrodrive (CHD) is a hydraulically driven system designed for automated insertions of cochlear implant electrode arrays. Previous in vitro studies have shown that the CHD provides a significantly slower and steadier feed rate compared to manual insertions, thereby reducing intracochlear insertion forces. These factors are associated with decreased occurrence of intracochlear trauma and potentially improved hearing outcomes. Consequently, clinical translation is required to evaluate the relevance of these promising laboratory findings.

Material and methods: This study investigates the first intraoperative application of the CHD by integrating it into the standard surgical routine. The system is fixed to the patient's head with a surgical retractor and aligned towards the cochlea using a flexible, lockable arm. An integrated guide tube enables stable guidance of the electrode up to the entrance (round window) of the cochlea. Adult patients with no relevant residual hearing electing a MED-EL FLEX-series implant have been included. The insertion was performed at a constant speed of 0.05 mm/s. Following surgery, surgeons provided feedback on their experience with the system.

Results: Five patients have been implanted successfully using the CHD. Sterile assembly of the tool was straightforward, and secure fixation to the patient was achieved using the surgical retractor. The flexible arm enabled rapid tool alignment (mean <2 min), with the guide tube simplifying the process by visualizing the set insertion path. No repositioning of the aligned tool was necessary during insertion. Electrode buckling was effectively minimized through the guide tube, with a mean insertion time of 12 min ± 4 min. The surgeons consistently assessed the insertions as successful.

Conclusions: These initial clinical experiences show that the CHD enables precise and controlled electrode insertions with seamless integration into the surgical workflow. The ultra-slow insertion speed of 0.05 mm/s was successfully implemented without complications, while the guide tube simplified tool alignment, eliminated repositioning during insertion and minimized electrode buckling. The CHD represents a promising advancement towards greater standardization and precision in cochlear implant surgery at significantly lower costs compared to robotic or mechatronic alternatives.

Free paper 0377

First report of MT-TS1: m.7445A>G causing non--syndromic hearing loss in an Argentine family: Phenotypic variability driven by heteroplasmy and noise exposure

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The mitochondrial variant *MT-TS1*: m.7445A>G is rare worldwide and shows a very low prevalence in cohorts of non-syndromic hearing loss (NSHL). This variant is located in the mitochondrial gene MT-TS1 (NC_012920.1), which encodes $tRNA^{Ser(UCN)}$. Its clinical expression is variable and has been associated with both genetic factors, such as the heteroplasmy state, and environmental factors. Age at onset is heterogeneous, ranging from childhood to adulthood.

Accumulated evidence has allowed this variant to be classified as pathogenic. The aim of this study was to evaluate the contribution of the *MT-TS1*: m.7445A>G variant to the genetic etiology and clinical phenotype of NSHL in a cohort of unrelated Argentine patients, as well as to analyze its clinical expression and associated environmental factors. A total of 487 probands diagnosed with NSHL were analyzed by PCR-RFLP and Sanger sequencing. The percentage of heteroplasmy was estimated by analyzing overlapping peaks in chromatograms obtained from mitochondrial DNA sequencing. A single proband carrying the *MT-TS1*: m.7445A>G variant in a homoplasmic state was identified, corresponding to a prevalence of 0.2% (1/487). The index case presented bilateral severe sensorineural hearing loss with prelingual onset, progressing to severe-to-profound hearing loss. Subsequently, a family cascade study was performed, including 22 maternally related family members. The variant showed generational segregation, with initial heteroplasmy followed by a predominance of homoplasmy in subsequent generations. In the family analysis, all homoplasmic individuals exhibited hearing loss, generally of greater severity and earlier onset. In heteroplasmic individuals, clinical expression depended on the mutational threshold, with hearing loss manifesting when the mutational load exceeded approximately 60–70%. None of the patients reported exposure to aminoglycosides; however, in one heteroplasmic individual, hearing loss developed during the second decade of life and was associated with noise exposure, suggesting an environmental modulatory effect. This study represents the first report of the *MT-TS1*: m.7445A>G variant in Argentine patients with NSHL and underscores the importance of its inclusion in diagnostic algorithms and neonatal auditory and genetic screening programs, in order to optimize early diagnosis, clinical follow-up, and family genetic counseling, and to anticipate preventive interventions.

Free paper 0160

First-in-man robotic superior canal dehiscence surgery: A hybrid transmastoid approach using the HEARO® System

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Introduction: Superior canal dehiscence syndrome (SCDS) is caused by a bony defect in the superior semicircular canal (SCC), producing symptoms such as sound/pressure-induced vertigo, autophony, pulsatile tinnitus, and low-frequency conductive hearing loss. Surgical canal plugging is an effective treatment. We report the first use of a robotic system, originally designed for cochlear implantation, adapted for SCDS surgery.

Material and methods: A 64-year-old woman with bilateral SCDS underwent robot-assisted transmastoid plugging on the left ear. The robot drilled two trajectories of 1.8 mm diameter to the ampullated and non-ampullated end of the SCC with submillimetric accuracy, followed by minimal manual mastoidectomy. Fenestrations (1 mm) were robotically created and the SCC manually plugged.

Results: Postoperative computed tomography showed 0.37–0.48 mm target accuracy. Lateral and posterior semicircular canal function, as well as hearing, remained preserved. Autophony and pulsatile tinnitus resolved on the operated ear.

Conclusions: This approach enabled minimally invasive, precise, and safe SCDS surgery.

Free paper 0153

Five years of Point-of-Care Ultrasound (POCUS) in the Cochlear Implant Clinic

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Introduction: Point-of-care ultrasound (POCUS) is increasingly used across surgical specialties, but its role in cochlear implant (CI) services remains under-reported. Cochlear implant patients present unique soft-tissue, magnet-related, and implant-adjacent challenges where rapid, non-irradiating imaging may offer clinical advantages. Over the past five years, we have integrated POCUS into routine CI clinic practice. This abstract describes its applications, technique, and clinical impact.

Material and methods: POCUS was performed in a dedicated CI clinic using high-frequency linear probes (10–18 MHz). Standardised protocols were developed for measurement of skin flap thickness over the implant magnet, assessment of post-operative complications, and identification of implanted hardware. Particular emphasis was placed on light probe contact and liberal gel use to minimise soft-tissue compression, in line with our published validation studies comparing ultrasound with CT.

Results: POCUS provides rapid, reliable measurement of skin flap thickness, enabling safe and objective magnet strength selection and adjustment. Longitudinal monitoring demonstrated clinically meaningful changes in scalp thickness over time, allowing proactive magnet downgrading and avoidance of pressure-related skin complications. Ultrasound reliably detected complications including magnet displacement, haematoma, and seroma, facilitating prompt conservative or surgical management without additional imaging. POCUS also enabled accurate identification of the location of BAHA screws and other cranial or intracranial implants, improving procedural safety during examination and intervention. Inter-rater reliability between multidisciplinary clinic staff (surgeons and audiologists) was very good. Scan times incorporated into routine clinic appointments were typically under five minutes and were well tolerated by adult patients.

Conclusions: Five years of experience demonstrate that POCUS is a valuable adjunct in the cochlear implant clinic. It is accurate, quick, inexpensive, safe, and non-irradiating, with clear advantages for skin flap assessment, complication detection, and implant localisation. When performed with appropriate technique to avoid soft-tissue compression,

POCUS supports safer magnet management and improves patient care. Wider adoption of POCUS in CI services is feasible and justified.

Free paper 0306

Focus stimulation improves speech discrimination: Evidence from an electro-anatomical cochlear model

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Introduction: Speech discrimination with cochlear implants is strongly influenced by how electrical stimulation recruits auditory nerve populations. Computational approaches that integrate peripheral stimulation modeling with central decoding can provide mechanistic insight into how different stimulation strategies affect speech outcomes. This study presents an electro-anatomical modeling framework linking cochlear implant stimulation physics to word recognition performance.

Material and methods: We developed an electro-anatomical finite element (FEM) model of the cochlea and electrode–nerve interface to simulate cochlear implant stimulation and to compute time-resolved neural activation patterns, expressed as auditory-nerve current density distributions. Using identical acoustic inputs, neural activation profiles were generated for monopolar and multipolar stimulation across configurations with 8, 12, and 16 active channels in ACE strategy. These activation patterns were then used as inputs to a deep neural network modeling the central component of word recognition. A training dataset was generated using the first 20,000 non-repeated words from *Don Quixote*, for which corresponding neural activation profiles were computed under each stimulation mode. The network was trained to decode words from neural activation patterns, and recognition accuracy was used as the outcome measure.

Results: Multipolar stimulation consistently yielded higher speech recognition accuracy than monopolar stimulation across all channel configurations. Recognition accuracy with multipolar stimulation reached 78% with 8 channels, 79% with 12 channels, and 81% with 16 channels, compared with 77%, 76%, and 76%, respectively, under monopolar stimulation. Performance increased with the number of channels for multipolar stimulation, while monopolar stimulation showed no improvement beyond 8 channels. Mean recognition accuracy for normal hearing reference data was 82%, indicating that multipolar stimulation with higher channel counts approached normalhearing performance within the proposed model framework.

Conclusions: An electro-anatomical FEMbased cochlear model combined with deep neural decoding demonstrates that multipolar stimulation improves speech discrimination compared with monopolar stimulation across multiple channel configurations. This end-to-end peripheral-to-central modeling approach provides quantitative evidence that stimulation strategy significantly impacts speech recognition performance and offers a powerful framework for benchmarking cochlear implant stimulation paradigms.

Free paper 0608

From backlog to breakthrough: Recovering cochlear implant waiting times through Connected Care, Remote Pathways, and assessment to first-year pathway redesign at Oxford University Hospitals

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Aims: Since 2021, the OUH Cochlear Implant Programme has aimed to eliminate its CI review backlog and create a sustainable lifelong follow-up model amid rising demand. Priorities included reducing review and assessment waits, embedding Connected Care tools, Cochlear Care, Remote Check, Remote Programming, intraoperative monitoring, K2R and U2R, to shift routine care remotely, and redesigning the first-year pathway for the stable 80%. Success was measured by full backlog recovery, shorter assessment waits, and stable long-term remote follow-up.

Material and methods: Between 2021 and 2025, OUH implemented a staged redesign integrating Connected Care. Spares and repairs were outsourced, and a two-branch review model introduced: annual Remote Checks with 2.5-yearly reviews for remote users, and annual or extended intervals for stable non-remote patients. SmartNav, Remote Assist, K2R and U2R supported self-management. Audiology-only triage weeks enabled focused candidacy screening, and the first-year pathway was streamlined for routine cases. Evaluation used waiting-list trends, clinic activity, Remote Check data and feedback.

Results: A drop from ~400 overdue reviews (late 2021) to full backlog recovery was achieved. Successive pathway changes freed 0.64–0.8 WTE capacity and enabled stable remote monitoring. Triage weeks showed ~50% were not NICE-eligible, preventing unnecessary MDT assessments. The streamlined first-year pathway cut routine visits for the stable 80%, preserving capacity for complex cases and supporting rollout of the Advanced Management Pathway.

Conclusions: Using connected technology, redesigned pathways, and targeted triage, the OUH CI Programme cleared its review backlog without extra staff, sustaining care quality, supporting wellbeing, and strengthening foundations for future CI and BAHA/MEI improvements.

Free paper 0716

From clay to clarity: A new approach to teaching middle ear anatomy

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Introduction: Understanding middle ear anatomy is fundamental to ENT training, yet its complexity makes teaching challenging. Existing educational tools, including: endoscopic

video, 3D-printed models, papercraft, and micro-CT imaging, each have limitations in cost, accessibility, or tactile engagement. To address these challenges, we developed a panoramic clay model of the middle ear to provide an affordable, hands-on, and highly customizable learning tool.

Material and methods: A panoramic model was created using plain, self-hardening clay, chosen for its low cost, ease of manipulation, and ability to represent right-or-left-sided anatomy. Key structures were sculpted with exaggeration of critical landmarks to improve clarity. Anatomical variants can be incorporated, allowing tailoring the model to specific objectives. To support reproducibility, we produced an instructional video demonstrating the construction process.

Results: Ten otologists evaluated the model through a structured survey assessing overall design, practicality, educational value, and potential improvements. Feedback was positive. Most participants preferred the exaggerated, non-scale representation for teaching purposes over a strict 7: 1 scale. Respondents highlighted the model's tactile quality and its value in helping trainees visualize spatial relationships not easily appreciated through endoscopic footage.

Conclusions: The panoramic clay model is a reproducible, low-cost, and engaging tool that enhances understanding of middle ear anatomy. The accompanying instructional video supports widespread adoption and integration into ENT training programmes.

Free paper 0379

Future CI care: Longitudinal analysis of cochlear implant stimulation levels in the first year: Optimizing adult fitting

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Objectives: The main objective of this study was to investigate the evolution in stimulation levels (C-/M- and T- levels) in adult CI users from both Advanced Bionics™ and Cochlear™, and to assess whether this trajectory differs between the two brands. The secondary objective was to assess individual patterns of stimulation levels during the first year post-activation.

Material and methods: This retrospective study was conducted at the Erasmus University Medical Center in Rotterdam, the Netherlands. A total of 183 post-lingually deaf adults were included with a unilateral cochlear implant (CI) from either Advanced Bionics™ or Cochlear™. Stimulation levels (C-, M- and T-levels) were collected from these adults for six fitting sessions during the first year post-implantation. Linear mixed-effects models were used to analyze longitudinal changes.

Results: Our findings were comparable for both Advanced Bionics™ and Cochlear™ implants users. Mean M/C and T levels changed over time, showing a similar characteristic pattern for each patient with a rapid increase during the initial period, followed by gradual stabilization. Post-hoc comparisons revealed significant differences between appointments up to the fourth fitting session for M/C levels and up to the third fitting session for T-levels. There were no significant differences after these fitting sessions. These findings were consistent across the different electrode segments (apical, medial, upper basal, lower basal), although earlier stabilization occurred in the lower basal segment for M/C-levels and in both basal segments for T-levels.

Conclusions: The present study gave valuable insights into the temporal evolution of M/C- and T-levels during the first year post-implantation of both Advanced Bionics™ and Cochlear™ implants users. The mean M/C- and T-levels stabilized after approximately 3 months and 1.5 months, respectively, showing equivalent trajectories between the two brands. A consistent pattern was observed across patients, with stimulation levels rising significantly in the first few months and gradually stabilizing over time.

Free paper 0638

Genomic profiling of sensorineural hearing loss: Diagnostic yield and clinical implications in a 20-patient cohort

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Objective: To evaluate the diagnostic utility of Whole Exome Sequencing (WES) in a cohort of 20 patients with sensorineural hearing loss (SNHL) and to distinguish between causative variants, incidental carrier status, and benign polymorphisms using strict ACMG criteria.

Material and methods: WES data from 20 unrelated patients with SNHL were processed and analysed using the Franklin bioinformatic platform. Variants were filtered based on minor allele frequency (gnomAD), quality metrics, and phenotype correlation. Pathogenicity was assessed by integrating zygosity with inheritance patterns to differentiate true biallelic diagnoses (recessive) and dominant mutations from non-causative monoallelic carrier findings.

Results: A definitive or highly probable genetic etiology was established in 40% (8/20) of the cohort. Confirmed diagnoses included homozygous pathogenic variants in *GJB2* (DFNB1), *MYO15A* (DFNB3), and *CDH23* (DFNB12). One case of Autosomal Dominant Waardenburg Syndrome type 2 (*MITF*) was identified. Three patients presented likely compound heterozygosity in *MYO15A* and *CDH23*, requiring segregation analysis for confirmation. Notably, 30% (6/20) of patients were

classified as inconclusive carriers, presenting isolated monoallelic variants in recessive genes (e.g., *SLC26A4*, *MYO7A*). The remaining 30% were negative for SNHL causes, presenting only benign polymorphisms (e.g., *KCNE1*) or incidental non-audiological findings (e.g., *F2*, *ABCA4*).

Conclusions: WES proved effective for etiological diagnosis in a significant portion of the cohort, particularly for non-DFNB1 causes like *MYO15A* and *CDH23*. However, the high prevalence of monoallelic variants in recessive genes underscores the importance of rigorous interpretation to avoid diagnostic errors. These results highlight the necessity of complementary strategies – such as MLPA for *GJB6* in *GJB2* heterozygotes and family segregation studies – to resolve complex cases and provide accurate genetic counselling.

Free paper 0606

Harm-benefit analysis of active middle ear implant for sensorineural hearing loss: A decision-analytic model

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Introduction: This study aimed to evaluate the expected cumulative long-term harms and benefits of an active middle ear implant (aMEI) for patients with mild to severe sensorineural hearing loss (SNHL).

Material and methods: A decision-analytic Markov model with cohort simulation was developed to follow a patient population with mild to severe SNHL in Saudi Arabia. These patients are not suitable for cochlear or bone conduction implants, therefore, they are left untreated. The expected harms and benefits of an aMEI compared to no treatment were evaluated over a lifelong time horizon. To populate the model, a systematic review was conducted to identify studies reporting implant-related complications, word recognition scores (WRS) and quality of life using the Health Utilities Index (HUI-3) questionnaire. Pooled incidence rates of minor and major complications for consecutive 6-month follow-up intervals were calculated. Random-effects model meta-analyses were conducted for unaided and aided WRS and HUI-3 scores. The cumulative model outcomes assessed were: harms expressed as implant-associated minor and major complications; benefits expressed as quality-adjusted life years (QALYs) and WRS-adjusted life years; and incremental harm-benefit ratios (IHBR) expressed as either incremental major complication per QALY gained or per year living with 100% WRS. One-way deterministic sensitivity analyses were performed to evaluate the robustness of the results.

Results: The base-case analysis resulted in 6 minor and 16 major complication events expected during lifetime for every 100 patients receiving an implant. The expected QALY for a patient treated with an aMEI is 13 compared to 11 QALYs in a patient without implant. The expected WRS-adjusted life years for a patient treated with an aMEI is 12 years compared to 5 years in a patient without implant, that is, the benefit is equivalent to additional 7 years living with 100% WRS. IHBR were 0.08 major complication per QALY and 0.02 major complication per year living with 100% WRS.

Conclusions: In accordance with the Kingdom's Vision 2030 to meet the needs of every member of society, implementing aMEI for the patient population with mild to severe SNHL in Saudi Arabia would provide measurable health benefits at a low risk of harm.

Free paper 0682

Healing through volunteering: Psychological well-being in humanitarian missions

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Introduction: Psychological well-being is a critical component of overall health, particularly for healthcare professionals who face high-stress environments. Volunteering has been associated with positive mental health outcomes, yet limited research has explored its impact on specialized medical missions. This study investigates the psychological effects of participating in a cochlear implant humanitarian mission on healthcare professionals, assessing changes in their mental well-being before and after the experience.

Material and methods: A descriptive, questionnaire-based study was conducted on volunteers who participated in a cochlear implant mission for Syrian children with hearing loss in Turkey. The Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) was administered in two phases – before and after the mission. A Generalized Estimating Equations (GEE) model was applied to assess changes in well-being scores, adjusting for socio-demographic predictors.

Results: A total of 31 participants completed both phases. The average WEMWBS score significantly increased after the mission ($\beta = 9.19$, $p < 0.001$), indicating improved psychological well-being. Positive changes were observed across multiple well-being indicators, including optimism, confidence, and emotional resilience. Notably, participants with prior humanitarian experience showed greater well-being improvements. Despite the demanding nature of the mission, all participants expressed high satisfaction, with 100% willing to participate in future missions.

Conclusions: Participation in a cochlear implant humanitarian mission positively influenced healthcare professionals' psychological well-being, reinforcing the value of structured volunteer programs in mitigating stress and enhancing resilience. These findings highlight the potential role of medical volunteering in improving mental health and professional fulfillment among healthcare workers.

Free paper 0750

Hearing and phonation as biomarkers of communication health: Conclusions from the literature review

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Introduction: Communication health is the ability to effectively perceive, process, and produce speech and voice, enabling successful interpersonal communication. Hearing and phonation serve as inextricably linked biomarkers of communication health, operating within an integrated auditory feedback loop. Their mutual dependence is critical for both early diagnosis of hearing deficits and monitoring of auditory rehabilitation outcomes.

Objective: The aim of this study was to review the medical literature on the use of communication health biomarkers in clinical practice, with particular emphasis on the role of voice – as a product modulated by auditory self-monitoring – in the detection and monitoring of hearing loss rehabilitation.

Material and methods: A review of the PubMed database covering the last five years, using the keywords "hearing loss" and "phonation", identified 14 publications, while a search of the Google Scholar database yielded 2,140 results. The literature review demonstrated three main trends in the use of biomarkers.

Results: (1) *Phonation as a Biomarker of Hearing Loss*: Changes in voice production reflect hearing status, as impaired auditory feedback disrupts cortical encoding and laryngeal control. Individuals with untreated hearing loss often present with elevated fundamental frequency (F_0), increased loudness, and instability of acoustic parameters such as jitter and shimmer. Audiogenic dysphonia manifests as vocal tremor, poor modulation, and a monotonous tone. These features may support early detection of hearing loss, particularly in noisy environments. (2) *Hearing as a Marker of Phonatory Efficiency*: Central auditory processing (CAP) is essential for self-monitoring of voice production. Temporal processing deficits are associated with functional dysphonia, with patients performing worse on Pitch Pattern Test (PPT) and Duration Pattern Test (DPT). Impaired tone reproduction suggests central auditory dysfunction rather than purely peripheral laryngeal impairment. (3) *Phonation as a Marker of Rehabilitation Success*: Normalization of vocal parameters following hearing aids or cochlear implants reflects recovery of communicative control. Restoration of auditory input leads to reduced F_0 and vocal intensity, often within weeks. The ability to discriminate speaker identity or gender further reflects auditory cortical plasticity.

Conclusions: Hearing and phonation features are closely interrelated and may serve as clinically valuable biomarkers of communication health, supporting diagnosis and monitoring of hearing rehabilitation.

Free paper 0254

Hearing every patient: The creation of a National Implant Registry

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Introduction: Cochlear implants (CIs) are the most widely used and effective neuro-prostheses worldwide, offering reliable hearing restoration for individuals with severe to profound hearing loss. Despite their strong safety record, variability in outcomes persists across populations, clinics, and surgical teams. Ensuring equitable and consistent results requires systematic monitoring at a national level. Without a National Registry, opportunities are lost to detect outlier data, identify early warning signals of device failures and complications, and evaluate long-term, population-wide outcomes. The establishment of a National Registry of Hearing Implants (NRHI), rolled out across the United Kingdom in June 2025, provides a model for how large-scale data collection can strengthen patient safety, guide clinical best practices, and improve outcomes across diverse patient groups.

Material and methods: A National Registry of Hearing Implants was developed as a prospective, population-based database designed to capture standardised information on all cochlear implant recipients across the United Kingdom, beginning with England. Data is collected at pre-implant, surgery, 1 year and 5 year intervals, and adverse events recorded at any time. Data includes demographic details, device and surgical factors, audiological outcomes, and rehabilitative outcomes, and complications. Contributing clinics submit data through a secure online platform, with built-in quality control and validation checks. Governance was established through collaboration with national health authorities, professional societies, and patient representatives. Analyses are focussing on monitoring safety signals, identifying outcome variability between centres, and evaluating population-level trends.

Results: Implementation of NRHI demonstrates successful nationwide data capture with high participation rates from implanting centres, enabling benchmarking of outcomes across clinics and highlighting early patterns in device-related complications. Ongoing data collection is supporting the development of quality improvement initiatives and informing evidence-based clinical guidelines.

Conclusions: The establishment of a National Registry of Hearing Implants provides a robust framework for monitoring safety, improving clinical outcomes, and ensuring equitable access to care. National data collection enhances early detection of complications, informs best practices, and strengthens patient safety. The model introduced in the United Kingdom in June 2025 demonstrates the feasibility and value of registry-based approaches to hearing health surveillance.

Free paper 0121

Hearing performance after cochlear implantation in children: Lateral wall vs perimodiolar electrode arrays

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Introduction: Cochlear implants (CIs) have revolutionized the treatment of sensorineural hearing loss in prelingually deaf children, enabling them to develop hearing and speech skills. However, factors influencing postoperative auditory outcomes remain variable.

Objectives: This study aims to retrospectively analyze the outcomes of cochlear implantation in prelingually deaf children, comparing two commonly used electrode array designs: Lateral Wall (LW) and Perimodiolar (PM). Specifically, we examine which electrode type yields better hearing performance, the incidence of postoperative device failure and the frequency of revision surgeries.

Material and methods: This study included children aged 6 months to 6 years with normal cochlear anatomy who underwent cochlear implantation at Al-Nahdha Hospital, Muscat, Oman, between 2014 and 2021. Patients with cochlear malformations, auditory neuropathy, or associated developmental disabilities were excluded from the study.

Results: A total of 153 patients out of 274 were included in the study, with a male-to-female ratio of 1.4: 1. The median age at implantation was 32 months (IQR: 22–45), with the youngest patient being 7 months old. Preoperative hearing-aid use was reported in 30.7% of patients. A history of meningitis was noted in 2.6% of patients, while 10.5% had a history of neonatal jaundice. The aided air conduction thresholds did not differ between (LW) and (PM) electrode designs at 6, 12 and 24 months postoperatively ($P = 0.59$, $P = 0.59$, $P = 0.54$). The overall revision rate was 8.5%, while the overall device failure rate was 7.8%. The LW electrode group had a higher revision surgery rate (13.19%) compared to the PM electrode group (1.61%) ($P = 0.01$). Device failure rates by manufacturer were 12.5% for Oticon 11.9% for MED-EL. and 1.6% for Cochlear.

Conclusions: In prelingually deaf pediatric patients with normal inner ear structures, hearing performance was comparable between lateral-wall (LW) and perimodiolar (PM) electrode designs, suggesting that, in this population, the choice of electrode array does not significantly influence postoperative hearing outcomes. Device failure remains the primary cause of revision surgery, consistent with previous reports, highlighting the importance of ongoing device monitoring in pediatric cochlear implant management.

Free paper 0079

Hearing preservation after cochlear implantation: A comparative analysis of four electrode designs

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Introduction: Hearing preservation (HP) after cochlear implantation is influenced by electrode array design, which interacts with delicate intracochlear structures. The optimal design for HP remains debated. This study primarily evaluates HP one month post-implantation in patients with preoperative residual hearing (RH), comparing four electrode arrays. A secondary aim includes assessing the impact of patient characteristics, time interval (preoperative, 1, 3, and 12 months postoperative), and array design on HP.

Material and methods: A retrospective analysis was performed on patients with RH who received Slim Straight, Slim J, Slim Modiolar or Mid-Scala arrays between February 2014 and May 2025 at Ghent University Hospital. Unaided puretone thresholds were measured preoperatively and at 1, 3, and 12 months postoperatively. HP was quantified as (1) absolute threshold shift (TS) and (2) relative HP [%] using the HEARRING Group formula, for both low-frequency puretone average (LFPTA: 250–500 Hz) and four-frequency puretone average (PTA4: 250–2000 Hz).

Results: 120 patients (mean age: 50 years) were included. At 1 month, no complete RH loss occurred, and most showed partial or complete HP. For relative HP based on PTA4, electrode design significantly affected outcomes ($p = 0.005$), with Slim Straight outperforming Slim Modiolar and Mid-Scala. Absolute HP declined markedly at 1 month, then stabilized over time. Slim Straight yielded superior absolute HP for LFPTA and PTA4 compared to Slim Modiolar and Mid-Scala. Older age correlated with greater TS at 1 month. A significant Electrode × Time interval interaction for PTA4 indicated that HP trajectories varied by array design.

Conclusions: In CI candidates with preoperative RH, overall partial HP was demonstrated at 1 month for LFPTA and PTA4. Slim Straight provided the best initial HP, while age, time interval, and electrode design were key predictors of absolute HP. These findings highlight the importance of electrode selection and patient counseling regarding postoperative HP outcomes.

Free paper 0077

How deep is deep enough in cochlear implantation: Systematic literature review

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Objective: The aim of this review is to identify the impact of the insertion depth of a cochlear implant (CI) electrode array on CI users' speech perception outcomes. It was searched for English-language articles that were published in a peer-reviewed journal from 1997 to 2025. A systematic electronic search of the literature was carried out using PubMed to find relevant literature on the impact of insertion depth on speech perception. The review was conducted according to the preferred reporting items for systematic reviews and meta-analyses guidelines of reporting. Studies in both children and adults with pre- or postlingual hearing loss, implanted with a CI were included in this study. Articles written in languages other than English, literature reviews, meta-analyses, animal studies, histopathological studies, or studies pertaining exclusively to imaging modalities without reporting correlations between insertion depth and speech outcomes were excluded. The risk of bias was determined using the "Risk of Bias in Nonrandomized Studies of Interventions" tool. Articles were extracted by 2 authors independently using predefined search terms. The titles and abstracts were screened manually to identify studies that potentially meet the inclusion criteria. The extracted information included: the study population, type of hearing loss, outcomes reported, devices used, speech perception outcomes, insertion depth (linear insertion depth and/or the angular insertion depth), and correlation between insertion depth and the speech perception outcomes. A total of 215 relevant studies were assessed for eligibility. Twenty-three studies met the inclusion criteria and were analyzed further. Seven studies found no significant correlation between insertion depth and speech perception outcomes. Fifteen found either a significant positive correlation or a positive effect between insertion depth and speech perception. Only 1 study found a significant negative correlation between insertion depth and speech perception outcomes. Although most studies reported a positive effect of insertion depth on speech perception outcomes, one-third of the identified studies reported no correlation. Thus, the insertion depth must be considered as a contributing factor to speech perception rather than as a major decisive criterion.

Free paper 0675

How the factors influencing paediatric cochlear implant language outcomes have changed over the last 20-years

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Introduction: Many of the factors (e.g., age at implant, aetiology) that affect the variability in speech and language abilities in infants with cochlear implants are known but the importance of the different factors and the interaction with other influencing factors change over the years and can be modified by changes in the healthcare system (e.g., introduction of newborn screening, changes in candidacy) and in society.

Material and methods: The goal was to determine how the patient profile of pediatric cochlear implant recipients changed over a 20-year period in an inner-city clinic and to understand how these changes were influenced by clinical practice and changes in society and to relate changes in patient profile to long-term language outcomes. We conducted a retrospective analysis of children implanted between 1998 and 2019 and related demographic factors to longitudinal language outcomes from pre-implant to five-years post-implant. Demographic factors of home language, onset of severe-to-profound deafness (congenital, progressive, or acquired), age at implantation, and socioeconomic status were collected for the entire sample (414 children). Logistic regressions were conducted to understand factors predicting language outcomes.

Results: Over the 20-year period we observed: a significant increase in the percentage of children from non-native English-speaking families (24% to 67%), influenced by population migration, a significant increase in the percentage of children with progressive onset of deafness (8% to 45%), influenced by changes in audiometric candidacy criteria such that more children with progressive losses were eligible. Age at implantation significantly decreased due to greater surgical confidence, increased awareness of the benefits of implanting babies under 12 months and the introduction of newborn hearing screening. There was a significant reduction in the Index of Multiple Deprivation (proxy for socio-economic status) believed to be related to recession, austerity, and population migratory trends. Regression analyses suggested that onset of deafness, age at implantation, year of implantation, income deprivation and parental education were key predictors of five-year post-implantation language abilities.

Conclusions: If this complex and dynamically changing landscape of influential factors is well understood, appropriate interventions can be introduced for families who are most in need to facilitate faster rates of language acquisition.

Free paper 0193

Hyperacusis and CI aftercare in adults with cochlear implants (CI): Case series

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Introduction: Hyperacusis is a pathological intolerance to everyday sounds (H93.2). There is a lack of prevalence data for cochlear implant (CI) patients and it is unknown whether hyperacusis changes during CI aftercare. To get started, we are conducting case series. In addition we are investigating the frequency of hyperacusis in two Austrian CI centers.

Material and methods: To determine the frequency, we compare the number of adult CI patients with bilateral hearing loss and hyperacusis attending the CI centers with the number of adult CI patients (with bilateral hearing loss) without hyperacusis. Regarding the case series, we collect data about hearing thresholds (PTA), duration of daily CI use, comprehension of monosyllabic words, comprehension of sentences in noise, uncomfortable loudness levels, subjective listening comprehension, hyperacusis impact, sound sensitivity symptoms, and a visual analog scale. Additional validated screening questionnaires assess tinnitus burden and listening effort, as well as anxiety and depressive symptoms. Measurement time points are before CI, around the time of first CI fitting, and at three, six, and twelve months post-CI. There is no specific hyperacusis treatment.

Results: *Preliminary outcomes:* Between July 2023 and December 2025, 90 CI patients with bilateral hearing loss attended the CI-center in Salzburg. In 5 patients (6 percent), hyperacusis were diagnosed. Regarding the case series, the first follow-up data is available for three cases. Case 1 is a 57-year-old man with hyperacusis and severe tinnitus for three years, as well as suspected depressive disorder. Six months after CI, the hyperacusis symptoms and social withdrawal increased. At the same time, subjective hearing, depressive symptoms, and tinnitus severity improved. Twelve months after CI, the symptoms of hyperacusis decreased while speech recognition improved. Case 2 is a 77-year-old man with hyperacusis for 40 years. Twelve months after CI, the symptoms of hyperacusis and tinnitus decreased while speech recognition and subjective hearing improved. Case 3 is a 68-year-old woman with hyperacusis for 10 years. Six months after CI, the hyperacusis score and tinnitus severity decreased.

Conclusions: Preliminary outcomes suggest that more than every 20th CI patient with bilateral hearing loss is suffering under hyperacusis. Hyperacusis declines after CI.

Free paper 0245

Hyperacusis Assessment Questionnaire: A tool for assessment hyperacusis in tinnitus patients

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Introduction: Hyperacusis is a condition where everyday sounds seem abnormally loud, painful, or intolerable, often accompanied by tinnitus, significantly impacting quality of life by causing social withdrawal and anxiety.

Objective: The aim of the study to create a questionnaire capturing hyperacusis in terms of loudness, fear, and pain and then to evaluate its psychometric properties.

Material: The study group consisted of 106 patients, made up of 51 men and 55 women. They were aged between 19 and 72 years, mean 45.2 years (SD = 12.4).

Material and methods: An initial pool of 33 questions capturing hyperacusis was subjected to expert evaluation and pilot testing. Then, a shortened 19-item version of the tool was checked out. Medical interview, audiological examination and a set of questionnaires: Tinnitus Handicap Inventory, Hyperacusis Questionnaire, State-Trait Anxiety Inventory, and Visual Analogue Scale was completed by all subjects.

Results: The final 14-item Hyperacusis Assessment Questionnaire showed an appropriate three-factor structure that explained 70.5% of the variance. Convergent validity and divergent validity were confirmed by correlations with other measures of hyperacusis, anxiety, tinnitus severity, misophonia, and hearing thresholds. Internal consistency as assessed with Cronbach's alpha was excellent ($\alpha = 0.91$) as was reproducibility (intra-class correlation, ICC = 0.96).

Conclusions: The new Hyperacusis Assessment Questionnaire is a reliable tool that can assess the severity of hyperacusis in terms of loudness, fear, and pain. It can be used in clinical practice and scientific research for patients with hyperacusis and tinnitus.

Free paper 0680

Imaging-guided prediction of cochlear health and hearing preservation in pediatric cochlear implant users: A multi-center Indian analysis using CiMago and the AIM System

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Introduction: Optimizing cochlear implant (CI) outcomes requires a balance between effective neural stimulation and preservation of delicate intracochlear structures. While precurved arrays are designed for closer modiolar proximity, lateral wall positioning may better support structural and hearing preservation. However, the relationship between electrode position and functional outcomes is not fully understood, largely due to limited routine analysis of post-operative imaging. Advanced imaging software such as CImago now enables detailed three-dimensional evaluation of electrode location within the cochlea. When integrated with physiologic measures from the AIM system (real-time ECochG, automated audiometry, neural response metrics), a more comprehensive assessment of cochlear health becomes possible.

Aim: To evaluate whether electrode array position analyzed using CImago correlates with audiological outcomes, and to explore predictors of cochlear health and hearing preservation via AIM system in a Pediatric cohort.

Material and methods: This predominantly retrospective, multi-center study will enroll a 60 pediatric CI users implanted with Advanced Bionics devices using SlimJ or Mid-Scala electrode arrays. High-resolution pre- and post-operative CT/CBCT scans (≤0.5 mm pixel size) would be analyzed via CImago for cochlear dimensions, insertion depth, scalar position (including trans-scalar deviation), and electrode-to-modiolus distance, generating 3D reconstructions. Clinical measures include impedances, NRI, Automated Audiometry, M-levels, PTA, and bi-syllabic speech discrimination up to 12 months. Optional measures are intraoperative ECochG in relevant cases. Correlation analyses will examine relationships between imaging-derived metrics and clinical outcomes.

Results: Data collection is ongoing. By the time of conference presentation, preliminary findings are expected to demonstrate a positive correlation between structural preservation - particularly lateral wall positioning without scalar deviation and improved hearing preservation. Early trends are also anticipated to suggest that CImago-derived positional metrics may help predict impedance patterns and speech outcomes.

Conclusions: By integrating structural imaging with functional electrophysiology, this study aims to clarify the clinical impact of electrode positioning. Anticipated findings may guide surgical approach, electrode selection, and objective prediction of hearing preservation outcomes, while evaluating the feasibility of incorporating CImago into routine practice. One of the first pediatric data. This investigation seeks to establish imaging-based predictors of cochlear health and performance, supporting evidence-based surgical strategies and personalized Pediatric-CI care in India.

Free paper 0470

Impact of anesthetic regimen on intraoperative ESRT and its relationship to comfort levels during the first 6 months after cochlear implantation: A multicenter Colombian experience

Introduction: The electrically evoked stapedius reflex threshold (ESRT) is an objective measure used for intraoperative verification and as a programming support tool to approximate comfort (C) levels. However, anesthetic conditions may influence intraoperative ESRT, potentially creating discrepancies with postoperative measurements.

Objective: To integrate intraoperative and postoperative ESRT findings in order to (1) describe ESRT occurrence and thresholds during surgery under different anesthetic regimens and (2) examine the relationship between ESRT (visual and objective) and programmed C levels during early follow-up.

Material and methods: Prospective, multicenter observational study conducted in five centers in Colombia (November 2023 – August 2024). Eighty-five recipients (93 implanted ears) underwent cochlear implantation under general anesthesia. Intraoperatively, ESRT was assessed via intracochlear stimulation on representative electrodes (E22, E11, E1) using visual observation and, in a subgroup, objective measurement with an immittance system. Anesthetic agents, dose, and route were recorded. Postoperatively, objective ESRT was measured at activation, 3 months, and 6 months, alongside C levels at the same time points.

Results: Visual intraoperative ESRT was observed in 65.5% of cases. Mean current level to elicit ESRT was 225.2 CL (intraoperative visual) and 209.4 CL (intraoperative objective), and decreased postoperatively to 187.3 CL (activation), 186.0 CL (3 months), and 190.0 CL (6 months). Mean C levels were 153.0 CL (activation), 162.7 CL (3 months), and 164.3 CL (6 months). ESRT–C alignment improved over time, reaching an average difference of approximately 25 CL at 6 months. The most frequently used anesthetics were remifentanil (91.3%), propofol (66%), and sevoflurane (43%). Sevoflurane was associated with larger discrepancies between intraoperative and postoperative ESRT (≈27.3 CL) compared with propofol (≈16 CL), and with a greater gap between intraoperative visual ESRT and later objective ESRT (≈53.6 CL vs ≈29.6 CL). No meaningful differences were attributed to electrode type/design.

Conclusions: Intraoperative ESRT thresholds appear sensitive to anesthetic regimen, with inhalational agents (notably sevoflurane) potentially elevating thresholds relative to postoperative measurements. Postoperatively, ESRT stabilizes

and its relationship to C levels improves by 6 months. These findings support anesthetic protocol standardization when intraoperative ESRT is used and reinforce the value of serial objective ESRT measures to optimize early programming.

Free paper 0368

Impact of auditory deprivation and cortical reorganization on speech perception after cochlear implantation in adults with postlingually unilateral and bilateral deafness and possible patient outcome predictions

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Introduction: Prolonged deprivation has been linked to cortical reorganization that may influence postoperative rehabilitation and is a key factor influencing speech perception outcomes after cochlear implantation (CI). Data about the influence of the period of time between severe hearing loss/deafness and cochlear implantation is rare. Similarly, it remains unclear whether a critical time period exists beyond which rehabilitation outcomes are clearly worse.

Objective: This ongoing study investigates speech perception outcomes after cochlear implantation in two patient groups: (1) postlingually deafened adults with unilateral deafness up to 10 years and (2) postlingually deafened adults with unilateral deafness more than 10 years. The study aims to examine cochlear-implanted patients and their relationship to duration of deprivation in a CI specialized clinic in Austria.

Material and methods: Approximately 50 postlingually unilateral deafened adults who received a cochlear implant within the past three years were retrospectively included, divided into two groups based on the 10-year cutoff. Postoperative speech perception was assessed using standardized speech recognition tests and analyzed in relation to duration of deprivation.

Duration of deprivation will be analyzed both as a categorical variable (< vs >10 years) and as a continuous variable to assess whether outcomes decline gradually or demonstrate a threshold effect.

Results: Data collection and analysis are ongoing, and no definitive outcome patterns can yet be identified.

Conclusions: This study seeks to improve understanding the clinical impact of deprivation duration on speech perception after CI-surgery in postlingually deafened patients. Comparative analysis of postlingual unilateral short-term and long-term deafness may help clarify the role of cortical reorganization and find a prediction about possible patient outcome.

Free paper 0022

Impact of bone conduction hearing devices on health-related quality of life in chronic otitis media-related hearing loss: A systematic review and meta-analysis

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Introduction: Chronic otitis media (COM) is a major contributor to global hearing disability and is frequently associated with reduced health-related quality of life (HRQoL). Bone conduction hearing devices (BCHD) represent an important intervention for adults with COM-related conductive or mixed hearing loss; however, the extent of their impact on HRQoL has not been comprehensively synthesized. This systematic review and meta-analysis evaluated HRQoL outcomes following BCHS use in adult COM populations.

Material and methods: A systematic search of PubMed, Embase, Scopus, and the Cochrane Library identified studies published between February 1, 2015, and February 15, 2025. Eligible studies included adults with COM-related hearing loss who received BCHD and reported HRQoL using validated patient-reported outcome measures (PROMs). Study selection followed a predefined PICO framework. Data were synthesized narratively and through meta-analysis when PROMs were sufficiently comparable. Risk of bias was assessed using the Newcastle–Ottawa Scale (NOS) and sensitivity analyses conducted using ROBINS-I.

Results: Nine non-randomized studies ($n = 107$ participants) met inclusion criteria. HRQoL was assessed using the Abbreviated Profile of Hearing Aid Benefit (APHAB), Speech, Spatial, and Qualities of Hearing Scale (SSQ), and Health Utilities Index Mark 3 (HUI-3). Across all studies, BCHS use was associated with consistent and clinically meaningful post-intervention improvements in HRQoL domains, accompanied by audiological gains in pure-tone thresholds ranging from 38 to 52 dB. Meta-analysis of a subset of studies demonstrated moderate to large improvements in HRQoL, with a pooled standardized mean difference of 35.50 (95% CI: 20.37–50.62). Methodological heterogeneity and small sample sizes limited subgroup analyses. Most studies were rated moderate to high quality (6–9 NOS stars), supported by ROBINS-I findings.

Conclusions: BCHD provide substantial benefits in HRQoL for adults with COM-related hearing loss, with improvements consistently reflected across PROMs and audiological outcomes. Nonetheless, heterogeneity in outcome measures and limited controlled evidence highlight the need for standardized HRQoL assessment frameworks and larger comparative studies to strengthen the evidence base for clinical and public health decision-making in hearing rehabilitation.

Free paper 0276

Impact of targeted neck and shoulder training on muscle tension in cochlear implant surgeons

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Introduction: Ear surgeons and especially cochlear implant surgeons are frequently exposed to static strain on the neck and shoulders for prolonged periods during microsurgical procedures. This can lead to muscular tension as well as chronic complaints. The aim of this study was to investigate whether targeted training of the neck and shoulder girdle muscles can reduce muscular load during and after surgery.

Material and methods: Four ear surgeons completed an app-based, supervised training program for the neck and shoulder muscles over a period of eight weeks. Muscle tension in the trapezius muscle and the neck muscles was measured using electromyography during cochlear implant surgeries. Measurements were taken before and after the start of the training program. In addition, participants completed questionnaires on physical activity, stress levels, and other relevant influencing factors.

Results: Data from 100 surgical procedures was analysed. The training program resulted in a significant reduction of trapezius muscle tension during surgery by 20% ($p = 0.05$). Moderate physical activity on the previous day led to a 31% reduction in muscle tension ($p = 0.01$), while intesive activity on the previous day resulted in a 20% reduction ($p = 0.40$). All participants also reported subjective improvements and expressed their willingness to continue the exercises after the end of the study.

Conclusions: Targeted training as well as moderate physical activity on the previous day can effectively reduce muscular load during ear surgical procedures. This highlights the importance of preventive training programs to reduce physical strain in everyday surgical practice.

Free paper 0073

Impedance based evaluation of manual cochlae implant insertion compared to roboter suported insertion

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Introduction: The need to preserve hearing and intracochlear structures during cochlear implantation has intensified interest in achieving the most atraumatic electrode insertion possible. In recent years, various insertion robots have been developed to ensure a very slow and continuous electrode advancement. This presentation compares manual insertion with robot-assisted insertion.

Material and methods: Using an insertion monitoring tool (MED-EL, Austria), the insertion process can be objectively recorded and visualized based on real-time impedance measurements. This allows for retrospective analysis of insertion speed, continuity, and duration. This method was applied in 20 cochlear implantations (SYNCHRONY II PIN FLEX28) with manual insertion and 20 implantations with robot-assisted insertion (OTOARM/OTODRIVE system, MED-EL, Austria), and the results were subsequently evaluated.

Results: Real-time impedance measurement was successfully performed in all 40 implantations. Insertion time for manual procedures ranged from 60 to 200 seconds, compared to 250 to 350 seconds with the robot. The insertion curve for the robotic system showed a continuous progression without pauses. In contrast, manual insertions exhibited numerous interruptions. In addition, the target insertion speed of 0.1 mm/s could not be achieved manually.

Conclusions: A continuous and slow insertion is advantageous for preserving hearing and cochlear structures. The impedance-based real-time measurements demonstrate that these requirements can be met even more effectively with robot-assisted insertion.

Free paper 0475

Impedance-based real-time tracking in cochlear implantation

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Introduction: There is a need for real-time monitoring inside the cochlea to prevent damage and improve the insertion technique. Intraoperative X-ray imaging is time consuming, exposes to radiation and needs interpretation experience. Electrode voltage telemetry is a promising approach to analyze the position of the electrode array. Currently, there's no automated tracking system for MED-EL electrode arrays.

Material and methods: We developed an algorithm for real-time insertion feedback. Impedance data from Med-el electrode arrays was used that is collected during surgery continuously. Postoperatively, the data was analyzed using four algorithms (Baseline-Algorithm, Neighbor-Refined-Algorithm, Speed-Constrained-Algorithm and Sliding-Window-Algorithm) that were compared to a ground truth (Surgeon annotation).

Results: The Baseline-Algorithm is prone to errors, i.e. false negative and false positive values, e.g. due to Tissue contact. The Neighbor-Refined-Algorithm improves upon the

Baseline by correcting impedances from tissue contact and air bubbles before detection. Speed-Constrained-Algorithm achieved 76.3% error reduction.

Conclusions: The Speed-Constrained-Algorithm showed the least deviation from the ground truth. This is most likely due to the fact that a metronome was used for continuous insertion. This algorithm is limited for its surgeon-specificity and is velocity-based only. The Sliding-Window-Algorithm combines the Speed-Constrained-Algorithm with the Neighbor--Refined-Algorithm so that the individually desired insertion speed is taken into account. This development is particularly significant for use in robot-assisted insertion, where visibility is greatly reduced due to the minimally invasive approach and provides radiation-free real-time insertion feedback.

Free paper 0443

Implementation of cochlear Remote Check

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Aim: To reduce patient waitlists and decrease the number of face-to-face appointments required by implementing the Cochlear Remote Check into our standard appointment protocols for adult patients.

Method: A new protocol was created which replaced annual tunings with a routine Remote Check. All adult Cochlear recipients were added to a waitlist and exclusion criteria were applied. When due their next annual tuning, an e-mail was sent advising of the new protocol, introducing the cochlear Remote Check, explaining what is required to complete the Remote Check and asking patients to contact us if they do not believe themselves eligible. The Remote Check was scheduled shortly thereafter, with further emails being sent as necessary. Once submitted, a 30-minute 'remote appointment' was scheduled for a qualified audiologist to review the results, decide on an appropriate outcome and close the submission with feedback for the patient. If not submitted, then a 15-minute remote appointment was created, marked as 'did not attend' (DNA) and a DNA letter posted to the patient.

Results: Over a 31-week period, 409 Remote Checks were sent to adult patients. Of these, 63% were submitted and 37% expired. Of those submitted, less than a third required a face-to-face clinic appointment to be scheduled. The implementation of the Remote Check has ultimately proven to save clinic hours, better manage expanding patient loads and provide a convenient and quick method for checking the basic functionality of the implant and processor.

Free paper 0514

Importance of intracochlear implant electrode position on structure preservation and hearing outcomes

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Introduction: Cochlear implantation reliably improves speech perception in most patients; however, postoperative outcomes vary considerably despite similar preoperative conditions. Patient-related factors, electrode positioning and insertion depth have been discussed as potential contributors to this variability.

Material and methods: Forty patients who received MED-EL SYNCHRONY 2 cochlear implants (CI) between 2023 and 2024 were retrospectively included. Pre- and postoperative computer tomography (CT) and audiological assessments were analysed with respect to cochlear size, variable FLEX electrode lengths and electrode position. Preoperative imaging of the temporal bone was performed using high-resolution CT (slice thickness: 0.6 mm) and postoperative imaging using flat panel CT (0.26 mm). Audiological evaluation included pure-tone audiometry and monosyllabic word recognition scores at 65dB, assessed preoperatively with and without hearing aids and 12 months postoperatively with CI. Radiological analyses were conducted using 3D-slicer (v.5.8.1) and OTOPLAN (v3.1), including A-value, cochlear duct length (CDL) at organ of corti (CDL(oc)) and lateral wall (CDL(lw)), angular insertion depth (AID), cochlear coverage (CC), electrode position in relation to round window (RW), electrode tip fold over (ETFO), basal buckling and scalar deviation.

Results: Cochlea size as measured by A-value was in average 9.34 mm (7.98–10.83 mm), CDL(oc) at RW was 32.89 mm (25.32–41.36 mm), classical CDL(oc) was 34.85 mm (29.22–41.07 mm) and CDL(lw) 38.52 mm (32.93–44.68 mm). Mean AID and CC was 505° (435–630°) and 56.1% (40–70%). Partial insertion was identified in 10–25% and most basal channel at RW in 8–18%. Accordingly, deviations of 48° in predicted AID and 5.3% in cochlear coverage were observed depending on the selected FLEX electrode and cochlear size. No ETFO and basal buckling was detected. Three-dimensional reconstruction suggested scalar deviation at the apical end in 12.5%. CDLs showed moderate negative correlation with AID. Hearing outcomes demonstrated non-significant positive correlations with AID and negative correlation with partial insertion, but not with CDL.

Conclusions: This study suggests that FLEX24/26/28 electrodes can be safely inserted without ETFO or basal buckling. However, apical scalar deviation could not be excluded in 12.5% of subjects. Hearing outcomes with CI is positively influenced by the increase in AID and negatively by partial insertion.

Free paper 0261

Improving hearing performance in middle ear implant users: A comparison of the Samba 2 and previous Vibrant Soundbridge audio processors

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Introduction: The Vibrant Soundbridge (VSB) middle ear implant is a partially implantable solution that has been used in clinical practice for over 25 years. It consists of an internal part (implanted behind the ear) and an external part (audio processor). As technology advances, audio processors are constantly being improved to enhance communication, performance and hearing function for users. Samba 2 is the latest audio processor introduced for VSB. The aim of this study is to compare the benefits of using the latest Samba 2 processor with previous generation processors in a group of experienced VSB users.

Material and methods: Twenty-two experienced VSB users (mean time using VSB = 9 years, SD = 2) had their processor upgraded to the latest model (Samba 2). The mean age of the subjects was 56 years (SD = 20). Assessment included free-field audiometry, speech tests in quiet and noise, and patient-reported outcome measures (PROMs). In addition, the group of users who underwent subjective assessment using PROMs was expanded to 45 patients.

Results: Free-field audiometry showed statistically significant improvements in hearing sensitivity and speech discrimination in quiet and noise with the Samba 2 compared to the previous technology. PROMs confirmed the benefits of using the latest audio processor and there was greater satisfaction with its ease of use.

Conclusions: The results of the tests performed and the evaluation of the questionnaires indicate that the use of the new audio processor improves the audiological results and the functioning of the users. Access to modern technology for VSB patients provides measurable benefits.

Free paper 0076

Improving manual insertion force control with acoustic feedback

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Introduction: Insertion monitoring methods are increasingly included in cochlear implant (CI) surgery, aiming to minimize trauma and preserve residual hearing. Insertion force measurement can offer valuable data, but effective and intuitive feedback to the surgeon remains a significant challenge. A promising approach relies visual feedback through a digital microscope, which requires the availability of such devices, can disrupt focus on the delicate insertion process and may become elusive with live data streams. This study investigates the potential of acoustic feedback as an infrastructure-independent method for real-time force monitoring during CI insertion.

Material and methods: We modified the Forception Tool, our previously developed manual force-sensing insertion tool, by integrating a speaker for acoustic force feedback. Two strategies were tested: one where pitch increased and pulse width decreased stepwise with increasing force (on average 10 mN steps), and one with proportional changes in pitch and pulse width. Eight participants used the modified tool to push a hidden elastic string forward for 20 seconds, simulating an insertion pose. The task was to maintain interaction forces close to but not above a target force value, guided by the acoustic feedback. Force levels were chosen in a random order out of five values below 100 mN. An external speaker played a reference sound associated with the respective target force threshold.

Results: Both strategies enabled participants to maintain forces close to the target value. The discrete feedback resulted in an average target difference of –6.3 mN ± 10.5 mN, while the continuous feedback yielded –2.6 mN ± 8.8 mN. Importantly, exceedances of the target forces were significantly lower with continuous feedback ($p < 0.05$). Discrete feedback prompted slightly but not significantly faster reactions to overshooting forces.

Conclusions: These findings demonstrate that acoustic feedback is a viable and potentially advantageous monitoring method that can enable more fine-grained control over insertion forces when using the Forception Tool. Continuous tonal modulation facilitated more precise force control. A key benefit of this approach is its independence from specialized equipment like digital microscopes. Future work will evaluate the effectiveness of this feedback during in vitro insertions, paving the way for clinical translation.

Free paper 0539

Indications and long-term results of the Osia system without fixation

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Introduction: The Cochlear™ Osia® 2 is an active transcutaneous implant developed for the rehabilitation of various forms of hearing loss. Owing to its relatively large size, implantation requires sufficient surgical expertise, as the creation of an extended flap and the necessary bone work may pose technical challenges in certain cases. In our previous study, we demonstrated that the Osia system is capable of providing satisfactory vibroacoustic performance even without fixation to the skull using the BI300 titanium implant.

Material and methods: In the present investigation, we assessed the audiological outcomes of patients who had previously received a non-fixed Osia system. Unaided pure-tone audiometry and suprathreshold testing were performed using the Osia sound processor on the non-fixed implant. The obtained results were compared with earlier postoperative audiological data. In addition, ultrasound examinations were conducted to evaluate the thickness of the peri-implant capsule and to monitor any potential implant migration.

Results: The findings indicate that the absence of fixation does not result in a clinically relevant deterioration of Osia 2 system performance, even at 12–24 months following implantation. Audiological outcomes showed that the non-fixed Osia 2 system consistently outperformed the BAHA 5 on Softband in both pure-tone audiometry and suprathreshold speech tests, with stable results observed over time.

Conclusions: These results suggest that implantation using a subperiosteal pocket technique without BI300 fixation represents a feasible surgical alternative. This method appears to offer favorable hearing outcomes while potentially reducing surgery-related risks and complications.

Free paper 0616

Inertial sensor-based assessment of manual precision during cochlear implant surgery

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Introduction: Cochlear implantation requires high manual precision and stable hand control, particularly during electrode insertion into the cochlea. Despite its clinical importance, objective quantitative assessment of surgeon hand motion during real surgical procedures remains limited.

Objective: To objectively quantify hand motion precision, stability, and fatigue-related changes in a surgeon performing cochlear implantation using inertial measurement unit (IMU)-based motion analysis.

Material and methods: During cochlear implantations, a compact inertial measurement unit (WT9011DCL, WT, CN) was mounted on the dominant hand of the surgeons. Linear acceleration, angular velocity, and orientation data were continuously recorded throughout the procedure. Quantitative motion metrics were calculated, including root mean square (RMS) acceleration, RMS angular velocity, jerk-based smoothness indices, tremor spectral power (8–12 Hz), and temporal stability measures. The recording was segmented into early and late phases to assess fatigue-related changes in hand motion precision.

Conclusions: IMU-based motion analysis provides a feasible and objective method for quantifying surgeon hand motion precision during cochlear implantation. The outcomes support the potential utility of this approach for surgical skill assessment, intraoperative ergonomics evaluation, and future training in ear surgery.

Free paper 0068

Inflectional morphology in German children with cochlear implants: The case of final consonants

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Introduction: Cochlear Implants (CI) enable spoken language perception, but certain limitations remain – for example, aided hearing thresholds with CIs do not reach those of individuals with normal hearing. This may impair the perception of low-intensity speech sounds, particularly at word-final positions. In German, this could affect final consonants in nouns such as [hɛɐts] (heart), but also morphosyntactic markers that are added to the word stem, as, for example, in subject–verb agreement inflection (e.g., *–st* for 2nd person singular = du lachst 'you are laughing'). Perceptual limitations might therefore hinder the acquisition of such phonological and grammatical features.

Material and methods: We investigated the production of subject–verb agreement markers and word-final consonants in nouns in children with bilateral CI. To elicit inflected verb forms, we used a video description task targeting 2nd and 3rd person singular and 3rd person plural forms, which are marked by *–st*, *–t* and *–n*. Word-final consonant production in nouns was assessed with a picture-naming task including nouns ending in /n/, /t/, and /s/. We tested (i) a group of 4-year-old children with normal hearing (to confirm that production is typically error-free at this age) and (ii) a group of 30 German-speaking children with bilateral CI aged 4–6 years.

Results: The group of children with normal hearing achieved average correctness scores of 99% in the picture-naming task and 100% in the video description task. The children with CI scored lower, with 63% and 65%, respectively. Both tasks yielded significant group differences (picture-naming: $t(29.98) = -6.13$, $p < 0.001$; video description: $t(24) = -4.90$, $p < 0.001$). In children with CI, correctness scores ranged

from 0 to 100% in both tests, indicating substantial interindividual variability.

Conclusions: These findings indicate that children with CI exhibit a pronounced deficit in producing word-final consonants, both in nouns and as subject–verb agreement markers. Comparable performance across tasks suggests that this deficit is not exclusively grammatical in nature but rather stems from limitations in speech perception. Nevertheless, this deficit has consequences for grammatical development in children with CI and should be assessed and addressed in speech and language therapy.

Free paper 0078

Insertable electrode insertion depth in every inner ear malformation type

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Estimation of cochlear length is gaining attention in the field of cochlear implants (CIs), mainly for selecting of CI electrode lengths. The currently available tools to estimate the cochlear duct length (CDL) are only valid for normal inner anatomy. However, inner ear malformation (IEM) types are associated with different degrees of cystic apices, limiting the application of CDL equations of normal anatomy inner ear. Therefore, this study aimed to understand the degree to which the outer wall (OW) is observed in different malformation types and to formulate mathematical equations to estimate the OW length (OWL) from cochlear parameters, namely the basal turn diameter (A-value) and width (B-value). Three-dimensional (3D) segmentation of promontory and fluid parts of the inner ear was performed to understand the extent to which the OW is visible to measure the OWL manually. Enlarged vestibular aqueduct syndrome (EVAS) was diagnosed in 37 ears, which consistently showed the extent of the OW to an angular depth of 540°, beyond which the cystic apex starts. Incomplete partition (IP) type I was observed in 30 ears, with the OW extending to only 360° of angular depth. IP type II was observed in 35 ears, with the OW extending to 450° of angular depth. IP type III was identified in 24 ears, with the OW observed for 540° of angular depth. Cavity-type malformations were observed in 36 ears, and circumference was measured in the axial view. A strong positive linear correlation was observed between the manually measured OWL and cochlear parameters for all malformation types analyzed. A multiple linear regression model was applied to formulate mathematical equations, which was further used to create a software application for estimating OWLs in IEM types, using cochlear parameters as inputs.

Free paper 0059

Instant Hearband: Optimizing fit and sound transmission for bone conduction hearing

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Introduction: Non-surgical options play a pivotal role in the clinical management of bone-anchored hearing systems (BAHS). These solutions represent the initial step in auditory rehabilitation with BAHS, either as part of the preoperative assessment and trial phase or as a long-term solution for pediatric and adult populations who are not candidates for surgical implantation. For a non-surgical solution, key challenges include achieving a comfortable, secure fit that maintains close contact with the head to ensure optimal sound transmission. The Instant Hearband from Oticon Medical is a newly developed option within the category of nonsurgical BAHS solutions, designed to address these key fitting and performance challenges.

Material and methods: Design parameters and geometries were guided by anthropometric head-form data to ensure suitability for patients aged 3 years and older. The Hearband was evaluated for comfort, retention, and stability – key factors for patient compliance and long-term wear. Acoustic performance, including sound transmission and feedback behaviour, was compared with the softband to determine its potential as an effective non-surgical solution for bone-anchored hearing systems.

Results: The Hearband, is designed to provide secure retention and evenly distribute pressure across head dimensions from children to adults. It applies a gentle force of 1.4–1.8 N, remaining below the capillary pressure threshold, while achieving sound transmission performance comparable to the softband. Feedback performance was equal or superior to the softband across the frequency range.

Conclusions: The Hearband demonstrated secure retention and effective sound transmission, comparable to the softband. Applied pressure remained below the capillary threshold, supporting safety and comfort. These findings suggest that the Instant Hearband is a feasible, non-invasive option for patients who are candidates for a bone anchored device.

Free paper 0666

Intra op facial nerve monitoring in cochlear implant surgery: Our experience

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Introduction: Facial nerve injury remains one of the most feared complications of cochlear implant (CI) surgery due

to the close anatomical relationship between the facial nerve and the surgical field, particularly during posterior tympanotomy and electrode insertion. Although the incidence of permanent facial nerve palsy is low, even transient paresis can significantly impact patient morbidity and medicolegal outcomes. Intraoperative facial nerve monitoring (IOFNM) has emerged as an adjunctive tool to enhance surgical safety, especially in anatomically variant or high-risk cases. This study evaluates the role, indications, and clinical implications of IOFNM in cochlear implantation.

Material and methods: A review of available literature, surgical guidelines, and institutional experiences was conducted focusing on the application of electromyographic (EMG)-based facial nerve monitoring during CI surgery. Parameters analyzed included indications for monitoring, technical setup, sensitivity in detecting nerve proximity or irritation, and outcomes in routine versus high-risk cases such as congenital inner ear malformations, revision surgeries, ossified cochlea, and aberrant facial nerve course. Data regarding complication rates and intraoperative decision-making were evaluated.

Results: IOFNM provides real-time auditory and visual feedback during drilling of the facial recess and electrode insertion, aiding in identification and preservation of the facial nerve. Its utility is particularly significant in cases with narrow facial recess,anomalous nerve course, cochlear ossification, or distorted anatomy due to prior infection or surgery. Monitoring enhances surgeon confidence, allows immediate detection of mechanical irritation or thermal injury, and facilitates modification of surgical technique. Although routine CI surgery in anatomically normal cases demonstrates low facial nerve injury rates even without monitoring, IOFNM significantly reduces the risk in complex cases. Limitations include false-positive responses, added operative cost, and the requirement for proper electrode placement and anesthetic considerations.

Conclusions: Intraoperative facial nerve monitoring serves as a valuable adjunct in cochlear implant surgery, particularly in high-risk and anatomically challenging cases. While not universally mandatory in routine procedures, its selective use enhances surgical precision, improves safety margins, and minimizes the risk of facial nerveinjury. Adoption of IOFNM should be guided by patient-specific anatomical factors, surgeon experience, and institutional protocols to optimize outcomes.

Free paper 0741

Intracochlear PRP in CI: Does it improve audiologic outcomes? A pilot study

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Protein rich plasma (PRP) has been used in many situations to improve healing in many tissues of the body, in case of sudden sensory neural hearing loss it has also been recently used through intratympanic injections with very promising results, PRP has the potential to deliver a high concentration of growth factors to target tissues by virtue of the contents within the contents of the alpha and dense granules. The process of cochlear implant (CI) although is usually done in severe cases of hearing loss with minimal residual functional cochlear hair cells, still carries the potential of insulting the residual remaining cells, specially in hearing preservation surgery. In this pilot study, a sum of 6 patents undergoing CI for severe SNHL and approved use of this trial therapy were included and followed up for their postoperative hearing responses as thresholds, intensity and duration of electroacoutic stimulation by the CI used, and compared to 15 cases done in the same time interval, of comparable selection criteria, for 6 months. Results will be tabulated and revised and compared, to determine if any benefit is achieved for such additional procedure.

Free paper 0614

Our experience of 328 cases of cochleovestibular malformations using SMS classification

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Objective: To use the new classification of inner-ear anomalies that is more clinically oriented and surgically relevant: the SMS (Sawai Man Singh) classification of cochleovestibular malformations and share our experience.

Material and methods: A retrospective-cum- prospective multicentric study was conducted of 2300 cochlear implantations carried out in 5 Indian tertiary care institutes. Patients with anomalous anatomy were included and classified, as per the new SMS classification, into cochleovestibular malformation types I, II, III, and IV, based on cochlear morphology, modiolus and lamina cribrosa.

Results: There were 328 patients with inner ear malformations. Out of these, 101, 189, 24 and 14 patients with cochleovestibular malformation types I, II, III and IV, respectively.

Intraoperative findings were recorded. Two-year post-operative Meaningful Auditory Integration Scale scores were statistically analysed. We also developed a radiology based algorithm to analyse and approach patient with inner ear malformations.

Conclusions: This new classification for inner-ear anomalies is a simpler, more practical, outcome-oriented classification that can be used to better plan the surgery. These merits make it a more uniform classification for recording results. The algorithm makes the approach easier for students to understand the pathology and management.

Free paper 0072

Outcome after cochlear implantation in children with single-sided deafness (SSD)

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Introduction: Cochlear implantation (CI) is a well-established therapy for single-sided deafness (SSD) in adulthood. Data regarding its effectiveness in childhood are limited so far.

Material and methods: In a monocentric study covering 27 children with SSD (20 congenitally, 4 progressively and 3 acquired deaf) the congenitally deaf children who received their CI at an age of 2.6 (1.7) years were analyzed. Age-adjusted assessments were conducted to evaluate speech understanding in quiet (Freiburg/Göttingen/Mainz) and in noise (OLSA/OLKISA), as well as localization (RMSE) and lateralization abilities. Subjective evaluation by parents and children using the SSQ, the E-HAK, the Bochum Questionnaire and daily usage time were also recorded.

Results: In the group of the congenitally deaf children, a significant improvement was found in speech understanding in quiet on the implanted ear (0% pre- versus 37% post-operatively) as well as in background noise in the SSDNNH setting (without CI SNR 1.01 and with CI SNR –1.67; $p = 0.0021$), and in sound localization, assessed by RMSE (without CI 69.8° versus 52.4° with CI, $p = 0.004$). The subjective evaluation of the postoperative outcome judged by parents and by children was also mainly positive. Daily usage time correlated only with the child's acceptance of the implant ($p = 0.013$), but not with objectively measured speech understanding or sound localization abilities (both $p > 0.05$). No correlation was found between the SSQ total score or any subtest and the audiometric data ($p \geq 0.05$).

Conclusions: Although the presented data underline the need for early cochlear implantation in congenital SSD, thorough preoperative counseling of the parents and close postoperative follow-up are essential with regard to the large inter-individual variability of the postoperative outcome, which could not be explained solely by age at implantation, daily CI usage or CI experience.

Free paper 0738

Outcomes of cochlear implantation at Tripoli Medical Center (2012–2022): A 10-year single-center review

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Introduction: Cochlear implantation is the treatment of choice for severe-to-profound sensorineural hearing loss (SNHL). We reviewed a decade of experience at Tripoli Medical Center (TMC) to describe the SNHL population and identify factors associated with speech rehabilitation outcomes.

Material and methods: Retrospective cross-sectional review of medical records and supplemental phone follow-up for all patients who underwent cochlear implantation at TMC between 2012 and 2022 ($n = 324$). Extracted variables included demographics (age, sex, residence), clinical features (pre-/post-lingual SNHL, congenital anomalies, comorbidities, history of meningitis, jaundice, preterm birth, incubator admission, family history, parental consanguinity), implant revision history, and categorized speech rehabilitation outcome (very good/moderate/bad). Data were analyzed using SPSS v2022; chi-square tests assessed associations between variables and rehabilitation outcome.

Results: Patients ranged from 1 to 66 years (mean 4.7 ± 6.3 years); 89.8% were preschool age and 54.6% were male. Most resided in western Libya (95%) and 93.5% had pre-lingual SNHL. Congenital anomalies were present in 9.6% and other medical problems in 18.8%. Notable histories included preterm birth (13.9%), incubator admission (23.1%), neonatal jaundice (8.6%), meningitis (2.5%), sibling SNHL (33.3%), and parental consanguinity (48.1%). Revision surgery was required in 3.7%. Speech rehabilitation outcomes were: very good 36.4%, moderate 36.1%, bad 21.3% (6.2% lost to follow-up). On bivariate analysis, type of SNHL (pre- vs post-lingual) was significantly associated with outcome ($p = 0.023$), with post-lingual patients more likely to achieve very good speech outcomes. The history of neonatal jaundice was also associated with poorer outcomes ($p = 0.017$). Other factors – age group, sex, residence, congenital anomalies, meningitis, prematurity, incubator admission, family history, consanguinity, and implant revision – showed no significant association.

Conclusions: In this large single-center series, cochlear implantation led to substantial speech rehabilitation for many recipients. Post-lingual status predicted better outcomes, while a history of neonatal jaundice correlated with worse speech rehabilitation. These findings can inform preoperative counseling and targeted postoperative rehabilitation strategies for similar resource-limited settings.

Free paper 0280

Outcomes of cochlear implantation in Mumps-induced single-sided deafness

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Introduction: Mumps, a viral infection from the *Paramyxoviridae* family, is a rare but significant cause of sensorineural hearing loss (SNHL), especially in children. While typically unilateral, mumps-induced SNHL can result in profound single-sided deafness (SSD), for which cochlear implantation (CI) may be considered when hearing aids are ineffective. This study aimed to evaluate outcomes of CI in patients with SSD caused by mumps.

Material and methods: This retrospective study included 14 patients (10 females, 4 males; mean age 39.4) with Single-Sided Deafness caused by mumps. Inclusion criteria included a hearing threshold ≥90 dB HL and no benefit from hearing aids. Audiometric evaluations and speech discrimination tests were conducted preoperatively and 12 months postoperatively. Surgical procedures followed the six-step Skarżyński method with a round window approach.

Results: Implants were successfully placed in all patients, with full electrode insertion achieved in 92.9% of cases. The mean time from hearing loss to implantation was 28.1 years. Postoperative speech discrimination improved significantly: from 0–10% preoperatively to 48.9 word-recognition score (WRS) without and 66.8 WRS with an active processor. Hearing preservation was achieved in 11 out of 12 evaluable patients, with partial preservation in 58% and minimal in 33%.

Conclusions: Cochlear implantation in patients with single-sided deafness caused by mumps provides substantial auditory benefits, particularly in speech perception. Favorable surgical outcomes were achieved even in cases with cochlear ossification. Given the scarcity of evidence specific to this etiology, the present findings underscore the effectiveness of CI and warrant further validation through large-scale, prospective investigations.

Free paper 0726

Outcomes of cochlear implantation in patients with far-advanced otosclerosis who had previously undergone stapes surgery

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Objective: The aim was to assess the hearing outcomes in cochlear implant patients with far-advanced otosclerosis who had previously undergone stapes surgery.

Material and methods: We studied 17 implanted patients with far-advanced otosclerosis who had previously undergone stapes surgery. They comprised 15 women and 2 men, aged 37–73 years; the duration of hearing impairment was 9–42 years. Pure-tone audiometry (0.125–8 kHz) was performed preoperatively and at 1, 6, and 12 months postoperatively. Free-field speech audiometry was conducted before and 12 months after surgery, and word recognition scores were assessed.

Results: Average preoperative hearing thresholds were 108 dB HL for air conduction and were at the limit of the audiometer for bone conduction. Word recognition scores before surgery averaged 7.4% (at 70 dB) and increased significantly to 66.2% about 12 months after surgery. Adverse surgical events were rare.

Conclusions: Patients with far-advanced otosclerosis and who have previously undergone stapes surgery are likely to experience a deterioration in hearing and receive insufficient benefits from hearing aids. Cochlear implantation can improve their hearing and provide good speech understanding.

Free paper 0732

Outcomes of cochlear implantation using FLEX26 electrode: Audiological results and quality of life after 12 months

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Introduction: The electrode length is one of the many factors impacted on results of cochlear implantation. Among lateral wall flexible electrode arrays the latest one is FLEX26 (MED-EL GmbH, Innsbruck, Austria). The main aim of the study was to evaluate the preservation of residual hearing, the level of speech understanding, and quality of life after cochlear implantation with FLEX26 electrode array.

Material and methods: The study was conducted in a tertiary referral centre. Fifty-two patients were implanted unilaterally with FLEX26, including 10 EAS patients (electric acoustic stimulation) and 42 ES patients (electric stimulation). The intervention was minimally invasive cochlear implantation via the round window. Pure-tone audiometry (0.125–8 kHz) was performed preoperatively and at 1, 6, and 12 months postoperatively. Twelve-month hearing preservation was established using the HEARING Group formula. Quality of life was measured with AQoL-8D (Assessment of Quality of Life-8 Dimensions) pre- and postoperatively.

Results: Residual hearing was preserved in 88.8% EAS patients. Quality of life was significantly better postoperatively in comparison to preoperative period (the effect size for overall quality of life was 0.49). Especially, it increased in relationships and senses dimensions (the effect sizes 0.47 and 0.44, respectively).

Conclusions: Preservation of residual hearing can be achieved in the majority of patients implanted with FLEX26. Improvement of quality of life was also documented. FLEX26 seems to be an option for surgeons who seek an electrode providing sufficient cochlear coverage.

Free paper 0214

Outcomes of simultaneous bilateral cochlear implant surgery in patients with bilateral profound hearing loss due to bomb blast-induced acoustic trauma

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Aim: To evaluate the surgical candidacy and quality of life and audiological outcomes for simultaneous bilateral cochlear implant surgery in patients with bilateral profound hearing loss due to bomb blast-induced acoustic trauma.

Material and methods: Three patients who were exposed to bomb blast-induced acoustic trauma, presenting with bilateral profound hearing loss, were implanted bilaterally and simultaneously. They presented with bilateral profound hearing loss averaging 3 to 5 years duration after the acoustic trauma. Three patients were evaluated radiologically to rule out structural trauma to the inner ear, audiological and psychological evaluation was done. They were implanted simultaneously with bilateral MED-EL devices FLEX series electrode after OTOPLAN evaluation by VERIA technique. Complete insertion of the electrodes were achieved as per the pre-operative OTOPLAN evaluation. Patients were followed up for 6 months duration and their audiological outcomes and quality of life were assessed.

Results: Simultaneous bilateral cochlear implant surgery in post bomb blast acoustic trauma has favourable outcomes in hearing and improved quality of life index. This requires careful evaluation prior to surgery to rule out anatomical contraindications and psychological support pre- and post-surgery.

Free paper 0213

Parental involvement in the success of pediatric cochlear implantation

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Introduction: Cochlear implantation is an effective intervention in the treatment of severe to profound sensorineural hearing loss in children, allowing significant improvements in auditory perception and in the acquisition and development of oral verbal language. Despite this, considerable variability is observed in post-implantation results. Clinical, surgical, environmental, and psychosocial factors are crucial to the success of auditory rehabilitation with cochlear implantation, particularly parental involvement.

Objective: This study aims to understand the impact of parental involvement on the auditory rehabilitation process and how it can contribute to the adoption of more effective and family-centered intervention strategies.

Material and methods: A retrospective study was conducted involving children with cochlear implants followed at the Reference Center for Cochlear Implants. Parental involvement

was assessed through clinical and functional indicators, including attendance at appointments and auditory stimulation in the family context. Auditory and linguistic outcomes were evaluated using tonal gain assessment, standardized sound detection tests, and oral language development scales at 6 and 12 months after cochlear implant activation.

Results: The results demonstrated that children with high parental involvement showed better tonal gain results with an average of 20 dB and better performance in sound detection and oral language development (greater number of words produced) when compared to children with lower caregiver involvement. A faster progression of auditory skills was observed in the post-implant period in cases with greater family adherence to rehabilitation. Parental involvement proved to be a significant predictor of better outcomes, regardless of the age at implantation and the duration of hearing loss.

Conclusions: This study concludes that parental involvement plays a crucial role in the success of cochlear implantation in children, positively influencing auditory and linguistic outcomes. These findings reinforce the need for multidisciplinary, family-centered approaches, as well as the development of parental empowerment strategies, in order to optimize clinical outcomes in children with cochlear implants.

Free paper 0410

Pediatric cochlear implantation in incomplete partition type III (IP-III): A case series and the impact of electrode position

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Introduction: Incomplete partition type III (IP-III) is a rare inner ear malformation linked to *POU3F4* variants, defined by absence of the modiolus and an abnormal communication between the cochlea and the subarachnoid space. Cochlear implantation in IP-III is technically demanding and carries characteristic risks, particularly cerebrospinal fluid gusher and electrode misplacement into the internal auditory canal (IAC). Despite these challenges, data correlating electrode position with functional auditory outcomes remain limited.

Objective: To analyze the relationship between electrode position and postoperative auditory performance in pediatric patients with IP-III undergoing cochlear implantation.

Case series: We retrospectively reviewed five children with radiologically confirmed IP-III and bilateral profound sensorineural hearing loss treated at a tertiary referral center. Cochlear implantation was performed in eight ears, either unilaterally or bilaterally, using a round window approach or cochleostomy depending on individual anatomy. Intraoperative CSF gusher occurred in four patients and was successfully controlled; one child showed no gusher due to near-complete cochlear bony obliteration. No major postoperative complications were observed. A notable and unexpected finding emerged in one bilaterally implanted child: the ear with partial electrode translocation into the IAC demonstrated superior auditory outcomes compared with the contralateral ear with correct intracochlear placement. Limited benefit was observed in the child with Turner syndrome and in the patient with post-meningitic cochlear ossification, although in the latter, auditory performance improved gradually over more than two years with frequency-restricted responses. To our knowledge, this represents one of the first reported cases of cochlear implantation in a patient with IP-III coexisting with Turner syndrome.

Conclusions: Cochlear implantation in children with IP-III is generally safe and enables auditory pathway stimulation in most cases, although outcomes remain inferior to those observed in children without inner ear malformations. Importantly, auditory performance is not determined solely by intracochlear electrode positioning. In selected IP-III cases, partial electrode placement within the IAC may paradoxically provide more effective neural stimulation than placement within a severely malformed cochlea, challenging traditional assumptions about optimal electrode location.

Free paper 0381

Pediatric subtotal petrosectomy with blind-sac closure and cochlear implantation: Evaluating surgical and audiologic outcomes

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Introduction: Subtotal petrosectomy (STP) with blind-sac closure (BSC) combined with cochlear implantation (CI), whether as a single or double-stage procedure, is an established technique for managing complex otologic cases in adults. However, data on outcomes in pediatric populations remain limited.

Objectives: To evaluate the surgical and audiological outcomes, complications, and long-term follow-up of STP with BSC and CI in pediatric patients.

Material and methods: A retrospective review was conducted of all pediatric patients (age <18 years) who underwent STP with CI at our institution. Patient demographics, indications, intraoperative and postoperative complications, and audiological and surgical outcomes were analyzed.

Results: Fourteen pediatric patients (16 ears) were included with a mean age of 10.1 years. Seven patients (50%) had undergone previous otologic surgeries. Indications included

chronic otitis media ($n = 6$, 37.5%), cholesteatoma ($n = 5$, 31.3%), and inner ear anomalies ($n = 5$, 31.3%), including common cavity malformation and CHARGE syndrome. Single-stage procedures were performed in 10 ears (62.5%), while 6 ears (37.5%) underwent CI at a second-stage surgery. Intraoperative complications occurred in one case (gusher in a patient with common cavity malformation). Postoperative minor complications included abdominal wound hematoma and dehiscence in two patients. Mean follow-up was 78.4 months. All patients with available follow-up demonstrated normal findings on last examination. One revision surgery was required due to device failure. No cases of residual or recurrent cholesteatoma, device extrusion, or meningitis were observed. Speech recognition outcomes were variable. Most CI users exhibited full Ling sound detection and good to excellent open-set word identification (85–100% accuracy). Several recipients achieved ceiling-level sentence recognition in quiet (100%) and high VCV discrimination scores. However, a subset showed notable limitations, including partial Ling sound detection or absence of measurable speech recognition.

Conclusions: STP with BSC and CI is a safe and effective approach in pediatric patients with complex middle ear cleft pathology, inner ear malformations, or prior failed surgeries. Single-stage procedures are feasible in most cases with low complication rates and favorable long-term outcomes. Most CI users demonstrated stable auditory performance, with some individual variability in higher-level speech recognition tasks.

Free paper 0553

Perceptions of social support by adults with postlingual hearing loss who came for cochlear implant surgery

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Introduction: A significant deterioration of hearing is a difficult, sometimes crisis-inducing situation for many people. One of its consequences may be experiencing a sense of loss. Communication difficulties resulting from hearing impairment can lead to withdrawal from social activities and a decrease in self-esteem. Due to limitations in activity and participation in social life, people with hearing loss often require both professional support and support from their immediate environment. The aim of the study was to examine how adults who applied for cochlear implant surgery assess their perceived social support and to investigate its relationship with the type of hearing loss and sociodemographic variables such as education, gender, age, employment status, place of residence, and relationship status.

Material and methods: The study involved 541 individuals with severe or profound postlingual hearing loss who were qualified for cochlear implant surgery at the Institute of Physiology and Pathology of Hearing (IFPS) and who presented for the procedure. Women constituted 50.6% of the participants and men 49.4%; the patients' ages at the time of the study ranged from 18 to 87 years. The research tool was the Multidimensional Scale of Perceived Social Support (MSPSS), which assesses perceived support from three sources: family, friends, and a significant other.

Results: In the studied group, the mean overall MSPSS score was 5.80 on a scale from 1 to 7. Patients aged 45–64 expected the greatest support from a significant other. Employed individuals expected greater support from friends than from family or a significant other. The overall level of perceived social support was significantly lower among patients who were not in a relationship compared with those in a formal relationship. Additionally, patients living in rural areas reported a greater sense of support than those living in urban areas.

Conclusions: The findings indicate that individuals with hearing impairment awaiting cochlear implantation report a higher or comparable level of perceived social support relative to most other groups assessed with the MSPSS. This suggests they possess a resource they can draw upon during difficult situations, such as adapting to hearing with a cochlear implant.

Free paper 0267

Performance of ChatGPT in pediatric audiology as rated by students and experts

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Introduction: Despite the rapidly growing popularity of artificial intelligence (AI)-based systems such as ChatGPT, evidence regarding their effectiveness in audiology remains limited, particularly in the field of pediatric audiology. The aim of the present study was to evaluate the performance of ChatGPT in audiology-related queries, as assessed by both students and experienced professionals.

Material and methods: ChatGPT was presented with a set of 20 domain-specific questions. A total of 20 students and 16 professionals in audiology and otolaryngology independently evaluated the generated responses using a 5-point Likert scale. The answers were rated in terms of correctness, relevance, completeness, and linguistic accuracy.

Results: Overall, ChatGPT's responses were rated as satisfactory by both students and professionals. For the majority of questions, students assigned slightly higher ratings than professionals; however, statistically significant differences between the groups were observed only for completeness and linguistic accuracy.

Conclusions: ChatGPT may serve as a useful tool for rapid information retrieval, particularly for non-experts. However, it currently lacks the depth, consistency, and reliability required by professionals. The differing evaluations by students and professionals suggest that AI-based systems are best used as supplementary resources rather than replacements for verified sources, especially in healthcare-related contexts.

Free paper 0332

Personalized and fine structure coding strategies for optimal CI hearing quality: A personal case report

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Introduction: Cochlear implantation (CI) remains the only effective way to restore auditory function in patients with severe deafness. However, CI sound processing continues to present challenges for subjective sound perception. These limitations include poor music and speech in noise perception, sound localization, temporal processing in CI users. MED-EL has introduced sound coding protocols to address the aforementioned issues relating to the fine structure (FS) of sound (FS4 and FS4-P) and minimizing tonotopic mismatch through anatomy-based fitting (ABF) and full cochlear coverage. Even though FS and ABF coding benefits are established in scientific literature, majority of clinical research lack detailed inside perspective of an individual patient. The present case report is a rare combination of personal perspective of patient and researcher (Mariia Pazi), that is backed up with data from standardized audiological testing and published research.

Case report: A CI-recipient (female, 31 years old, postlingual sensorineural loss, CI right ear 2021, left ear 2025) tested CIS, FS4, FS4-p and ABF coding strategies. Self-report sound quality was assessed for music, speech in quiet and speech in noise perception. Personal impression was further verified using standardized auditory testing: pure tone discrimination test, Matrix sentence test, speech detection in multi-talker babble-noise ("cocktail party effect" imitation) and azimuthal sound source localization. Albeit CIS enabled sufficient speech recognition in quiet, music and speech in noise perception was dissatisfactory. FS4-p strategy provided optimal results under assessed conditions and tests. Conversion from default mapping to ABF on right ear and initial ABF mapping on left ear (using OTOPLAN) improved sound quality despite minimal initial tonotopic mismatch: provided a more natural, pleasant sound both for speech and music; better speech perception in noise; diminished irritation with patient's own voice.

Conclusions: The report complements the existing data and further confirms that optimal CI outcome depends on maximal cochlear coverage, minimal place-pitch mismatch and sufficient FS processing. Noteworthy, the report demonstrates that even patients with minimal tonotopical mismatch may benefit from switching to ABF and experience a tangible improvement in sound quality. Report elucidates importance of apical stimulation as it provides discernible tonal processing in lower frequencies.

Free paper 0713

Polish results of tinnitus therapy using bimodal neuromodulation with the Lenire device

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Introduction: Tinnitus is defined as the perception of sound without an external acoustic stimulus. Currently, there is no single effective treatment method for tinnitus that works for all patients. One of the newer approaches is bimodal neuromodulation, which combines acoustic stimulation with somatosensory pathway stimulation. The goal of therapy is to reduce the severity of tinnitus and improve the quality of life for patients suffering from tinnitus.

Objective: The aim of this study was to evaluate the effectiveness of bimodal neuromodulation using the Lenire device in reducing tinnitus severity in 25 patients.

Material and methods: The authors present the results of their own research on the use of bimodal neuromodulation therapy in 25 patients with tinnitus. The results of the Tinnitus Handicap Inventory (THI) questionnaire were analyzed.

Results: The results of the authors' own research on the use of bimodal neuromodulation with the Lenire device showed a clinically meaningful reduction in tinnitus severity. The median THI score decreased from 46 at baseline to 26 at the first follow-up visit and further to 20 at the second follow-up visit. In our study, 68% of participants reported at least a 7-point reduction in their tinnitus severity on the THI at the first

follow-up, and this increased to 76% at the second follow-up compared to their initial scores.

Conclusions: Bimodal neuromodulation using the Lenire device may be an effective treatment method for patients with tinnitus.

Free paper 0054

Postauricular muscle reflex in normal hearing: A step toward objective CI fitting

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Introduction: The postauricular muscle reflex (PAMR) is an involuntary, sound-evoked response originating from vestigial auricular muscles. Its non-invasive nature makes it a promising candidate for objective auditory assessment, particularly in populations where behavioural feedback is limited, such as infant cochlear implant (CI) users. This study aimed to establish a standardized PAMR measurement protocol and characterize short- and mid-latency responses in normal-hearing adults.

Material and methods: Forty-three adults with normal hearing (pure-tone thresholds ≤20 dB HL) underwent bilateral PAMR recordings using surface electromyography. Tone bursts (50 ms) at 500, 1000, 2000, and 4000 Hz were presented monaurally at 80–100 dB SPL under varying conditions of stimulation side (ipsilateral/contralateral) and eye position (forward/rotated). Reflexes were identified based on latency and amplitude criteria (>10 μV peak-to-peak). Linear mixed-effects models assessed the influence of experimental factors on reflex amplitude and threshold.

Results: Short-latency PAMRs (10–25 ms) were detected in 98% of participants, with contralateral stimulation producing significantly stronger responses and lower thresholds than ipsilateral ($p < 0.001$). Reflex amplitude increased with stimulus frequency and intensity and was potentiated by lateral eye rotation. A novel mid-latency PAMR (37–50 ms) was observed in 91% of participants, exhibiting lower amplitude and higher thresholds compared to short-latency responses. Both reflex types were significantly modulated by stimulation side, eye position, frequency, and intensity (all $p < 0.001$). Gender showed a moderate effect, while age was not significant for short-latency responses.

Conclusions: This study provides a robust protocol for PAMR assessment and demonstrates its high prevalence and modifiability in normal-hearing adults. The identification of a mid-latency component expands current understanding of PAMR physiology and suggests a polysynaptic contribution. These findings support PAMR's potential as an objective auditory measure, with promising implications for CI users, particularly for closed-loop fitting and maximum comfort level estimation.

Free paper 0626

Postoperative hematoma after cochlear implantation in a child with Noonan syndrome: Case report

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Noonan syndrome is a multisystem genetic disorder frequently associated with congenital heart defects, hematological abnormalities, including polycythemia, and sensorineural hearing loss. The combination of these comorbidities presents unique perioperative risks, particularly an increased tendency for abnormal bleeding due to elevated erythrocyte production and blood viscosity. We present the case of a 5-year-old boy with Noonan syndrome and multiple comorbidities, including mild pulmonary artery stenosis, status post resection of infantile hemangioma of the head, cryptorchidism, bilateral mild sensorineural hearing loss, and mild polycythemia. The patient was indicated for sequential cochlear implantation (CI). The left-sided CI was performed in January 2025 without complications. Following the right-sided CI in June 2025, the attending physician observed a hematoma in the implant bed during a routine evening ward visit. Revision surgery was indicated. Intraoperatively, the retroauricular area was tense with accumulated hematoma; blood was leaking through the suture line. After suture removal, coagula were evacuated from the implant bed. Diffuse bleeding was identified, the fascia overlying the implant was released, and the implant itself was found displaced laterocranially outside its bed. The reference electrode had been dislodged from beneath the temporalis muscle. Bleeding was controlled with bipolar forceps, Surgicel was applied, the implant was repositioned and fixed with fascial sutures, and the reference electrode was replaced beneath the temporalis muscle. Wound closure and a pressure bandage were applied. Postoperative X-ray confirmed correct electrode position in the cochlea. The patient received systemic antibiotic therapy and corticosteroids and healed without further complications. Polycythemia, characterized by excessive erythrocyte production leading to increased blood viscosity and thrombotic tendency, likely contributed to the hematoma formation in this case. In children with Noonan syndrome undergoing cochlear implantation, careful preoperative hematological assessment and heightened postoperative vigilance are essential to prevent and promptly manage this potentially serious complication.

Free paper 0101

Predicting round window accessibility using preoperative temporal bone CT for cochlear implantation in older adults

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Introduction: Preoperative temporal bone computed tomography (TBCT) plays a critical role in surgical planning for cochlear implantation; however, reliable radiologic predictors

of round window (RW) visibility via posterior tympanotomy remain limited. This study evaluated the diagnostic performance of a simple CT-based prediction line for anticipating RW visibility during cochlear implantation.

Material and methods: Seventy consecutive cochlear implantation procedures performed between May 2024 and July 2025 were retrospectively reviewed. All patients underwent high-resolution TBCT with axial, coronal, and oblique reconstructions. A prediction line was defined between the lowest portion of the cochlear basal turn and the anterolateral aspect of the facial nerve. Intraoperative RW visibility through posterior tympanotomy was assessed and compared with preoperative CT predictions.

Results: RW insertion via the standard facial recess approach was feasible in 51 cases (72.9%). In 19 cases (27.1%), RW visibility was limited, requiring alternative approaches including partial posterior canal wall takedown, transaditus, or endomeatal approaches. The CT-based prediction line yielded 48 true-positive, 17 true-negative, 3 false-negative, and 2 false-positive cases. The resulting diagnostic performance showed a sensitivity of 94.1%, specificity of 89.5%, and an overall accuracy of 92.9% for predicting RW visibility via posterior tympanotomy.

Conclusions: The proposed CT prediction line demonstrates high diagnostic accuracy for preoperative assessment of RW visibility and provides a practical guide for surgical planning, enabling early identification of cases requiring alternative cochlear implantation approaches.

Free paper 0182

Predicting round window niche visibility using one measurement in high-resolution temporal bone computed tomography

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Introduction: To evaluate the accuracy of a single measurement in temporal bone computed tomography in predicting the round window niche (RWN) visibility during cochlear implantation.

Material and methods: A prospective study was conducted on 148 patients (165 ears) who had a cochlear implant (CI) from January 2010 to December 2018 at a tertiary CI center. The measurement was done for the angle of the basal turn of the cochlea (ABTC), which we defined as the angle formed by the cochlear basal turn and the cranium mid-sagittal plane, by 2 readers blindly from the axial images of computed tomography. The RWN visibility was classified according to the observation during surgery (through posterior tympanotomy) into full visibility, partial visibility, and invisibility. The measured angle was then correlated to the intra-operative visibility of the RWN.

Results: The average ABTC was 57.48° ± 4.05° (range: 45.0–68.0), and the RWN was found to be fully visible in 85%, partially visible in 11%, and invisible in 4% of the studied ears. The receiver operating characteristic analysis revealed a significant discriminating ability in predicting RWN visibility ($P < 0.001$) at a threshold ABTC angle of 58.5°. The mean ABTC was 56.71° ± 3.74°, 61.00°, and 63.86° ± 2.67° for fully visible, partially visible, and invisible RWN, respectively. A statistically significant difference was found ($P = 0.0002$) when comparing the ABTC in patients with partially visible/invisible RWN (61.80° ± 2.87°) with the fully visible RWN (56.71° ± 3.74°).

Conclusions: Round window niche visibility could be predicted by measuring the ABTC in relation to the cranium's mid-sagittal plane in CT preoperatively. An ABTC bigger than 58.5° could be an indication of poorly visible RWN.

Free paper 0493

Prediction of cochlear implant electrode position based on preoperative computed tomography

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Introduction: Anatomy-based fitting of a cochlear implant system requires appropriate programming of frequency parameters to match the tonotopic organization of the cochlea. Accurate frequency mapping depends on knowledge of the electrode position within the cochlea; however, postoperative imaging such as computed tomography may be not always available. Therefore, there is a need to develop methods that enable reliable prediction of electrode placement without the necessity of additional postoperative imaging.

Purpose: The aim of this study was to develop a method for predicting the position of a cochlear implant electrode based on cochlear duct length measured from preoperative computed tomography, taking into account the electrode type and the number of inserted electrode contacts.

Material and methods: The study included 42 patients following cochlear implantation of MED-EL electrodes. Electrode position was estimated using established mathematical models of cochlear tonotopy, including the Greenwood and Stakhovskaya functions. Predicted electrode locations were compared with actual electrode positions determined from postoperative computed tomography. The agreement between predicted and measured values was assessed using correlation analysis.

Results: The results demonstrated a strong agreement between predicted and actual electrode positions, with a Pearson correlation coefficient of 0.79596. These findings indicate that the proposed method provides a reliable estimation of electrode placement along the cochlea.

Conclusions: The results suggest that the presented method may serve as a useful tool to support the cochlear implant

programming process, particularly in cases where postoperative imaging is unavailable. Application of this method may contribute to more precise adjustment of frequency parameters and improved outcomes of auditory rehabilitation in cochlear implant users.

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Free paper 0070

Prediction of cochlear implant fitting parameters in children using a machine learning model

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Introduction: Fitting cochlear implant stimulation parameters, particularly the minimum audible threshold level (THR) and the maximum comfortable level (MCL), is a critical step in auditory rehabilitation. These parameters are commonly determined using behavioral methods, which may be unreliable or unavailable in pediatric patients, individuals with additional disabilities, or in the early post-implantation period. The objective of this study was to investigate the feasibility of predicting THR and MCL values at the individual electrode level using a machine learning approach and to evaluate its predictive accuracy and potential clinical relevance.

Material and methods: A Random Forest regressor with 100 trees was used to predict THR and MCL values, with each electrode (1–12) and each target variable modeled separately. The data were obtained from pediatric patients with cochlear implants treated at University Hospital Brno between 2014 and 2024. The dataset consisted of 40,416 clinical measurements for THR and an equal number for MCL. Input features included electrode-specific impedance values, patient age at implantation, time since implantation (in days), type of audio processor, and patient sex. Model performance was assessed using the coefficient of determination (R^2), root mean squared error (RMSE), and mean absolute error (MAE), and further evaluated through scatter plots and histogram analyses.

Results: High predictive accuracy was achieved for MCL values, with R^2 values, ranging approximately from 0.75 to 0.77, across most electrodes. Predicted MCL values showed strong agreement with clinical measurements, and histogram analyses demonstrated close correspondence in both distribution shape and range. Prediction accuracy for THR values was generally lower, with R^2 values approximately 0.66 to 0.77 depending on the electrode, reflecting the higher variability and subjectivity of THR measurements. Despite this, the model successfully captured both inter-individual variability and overall population-level distributions.

Conclusions: The findings indicate that a Random Forest–based machine learning model can reliably predict MCL values and, with slightly reduced accuracy, THR values at the individual electrode level in cochlear implant users. This approach represents a promising decision-support tool for clinical cochlear implant mapping, particularly when behavioral responses are unreliable or unavailable, and may contribute to shorter fitting times and improved standardization of programming procedures.

Free paper 0092

Predictive factors affecting CI outcomes of adult patients with ski-slope hearing loss

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Objectives: Although prolonged high-frequency deprivation may hinder cochlear implant (CI) adaptation in adults with sensorineural ski-slope hearing loss, implantation is often delayed due to functional preoperative low-frequency thresholds and large CI outcome variability. This study evaluated whether preoperative audiogram characteristics, residual hearing loss, and duration of hearing loss relate to one-year postoperative speech recognition in quiet and noise, and quality of life, in adults with ski-slope hearing loss. We hypothesized that timely implantation, reflected by better preoperative hearing thresholds and shorter duration of hearing loss, leads to better CI outcomes.

Material and methods: A retrospective review included 166 Dutch-speaking adults with ski-slope hearing loss who received a unilateral CI or electric-acoustic stimulation (EAS). Outcomes one year after implantation included speech recognition in quiet (Dutch NVA test) and noise (Dutch Digits in Noise test), and quality of life (Nijmegen Cochlear Implant Questionnaire, NCIQ). Associations between preoperative audiogram characteristics, residual hearing loss, and duration of hearing loss with postoperative outcomes were evaluated using correlation analysis. Linear regression was used to evaluate the individual and interactive effects of preoperative low-frequency thresholds and slope steepness on postoperative speech recognition in quiet.

Results: One year after implantation, aided speech recognition in quiet and quality of life improved significantly. The mean postoperative speech reception threshold in noise was 2.5 ± 2.4 dB SNR. Correlation analysis revealed that (1) a higher frequency corresponding to the location of the maximum slope, (2) lower (better) preoperative 1 kHz threshold, and (3) shorter duration of hearing loss predicted better postoperative speech recognition, whereas loss of residual hearing, and 250–500 Hz and 2–4 kHz thresholds did not. Interestingly, a lower 1 kHz threshold predicted worse postoperative NCIQ scores in the domain Activity. Linear regression showed that poorer low-frequency hearing and steeper slopes predict worse outcomes, although the negative effect of a steep slope diminishes as low-frequency hearing worsens.

Conclusions: Cochlear implantation in users with ski-slope hearing loss improves speech recognition in quiet and quality of life. Preoperative audiogram characteristics and the duration of hearing loss meaningfully relate to CI outcomes, underscoring the importance of timely referral of patients with ski-slope hearing loss.

Free paper 0472

Predictors of tinnitus relief following cochlear implantation: Analysis of demographic, audiological, and objective electrophysiological factors

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Introduction: Cochlear implantation (CI) is increasingly recognized for its potential to suppress tinnitus in patients with severe-to-profound sensorineural hearing loss. However, variability in treatment outcomes suggests the need for reliable prognostic indicators. This study aimed to evaluate the effectiveness of CI in tinnitus suppression and identify specific demographic, audiological, and objective predictors of therapeutic success.

Material and methods: A prospective cohort of 52 adult recipients of cochlear implants with concomitant tinnitus was analyzed. Tinnitus severity was assessed pre- and postoperatively using the Tinnitus Handicap Inventory (THI) and Visual Analog Scales (VAS) for loudness and annoyance. Predictors of improvement were evaluated using uni- and multivariable regression models. Additionally, Mismatch Negativity (MMN) responses were recorded in a subset of 40 patients to determine if objective electrophysiological measures correlate with subjective tinnitus relief.

Results: Post-implantation, 69.2% of patients experienced a clinically significant reduction in tinnitus severity (≥7-point THI reduction). The median total THI score improved significantly from 48.00 to 30.00 ($p < 0.001$), with concurrent significant decreases in VAS loudness and annoyance scores. Multivariable analysis identified higher baseline THI scores and a history of noise exposure as independent positive predictors of improvement, while longer duration of hearing loss was negatively associated with outcomes. Subgroup analyses revealed that these predictive associations were predominantly driven by male patients and those older than 50 years. Regarding objective measures, an initial correlation between MMN latency and functional THI improvement was observed; however, this significance was lost after controlling for pure-tone average, indicating the relationship was confounded by hearing loss severity.

Conclusions: Cochlear implantation significantly reduces tinnitus burden, particularly in the functional and emotional domains. Patients with higher preoperative distress and a history of noise exposure – especially older males – are more likely to experience substantial relief. While MMN provides insight into auditory processing, it does not currently serve as an independent predictor of tinnitus relief when adjusted for hearing thresholds. These findings assist in preoperative counseling by managing patient expectations based on individual profiles.

Free paper 0454

Preliminary findings on sensory processing and auditory integration in pediatric cochlear implant users: A six-month follow-up study

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Introduction: This study aimed to examine changes in sensory processing profiles before and after cochlear implant surgery and to evaluate auditory integration outcomes in the early postoperative period in pediatric cochlear implant users implanted at an early age. By combining sensory processing measures with auditory performance assessment, the study sought to provide a comprehensive view of early sensory and functional auditory outcomes following cochlear implantation.

Material and methods: A prospective follow-up design was employed. The study included ten children with bilateral profound sensorineural hearing loss who received cochlear implants at approximately one year of age. Only children without additional disabilities were included. Participants were assessed preoperatively and at six months after cochlear implant surgery. Sensory processing was evaluated using the Infant/Toddler Sensory Profile, while auditory integration was assessed using the Meaningful Auditory Integration Scale (MAIS). Sensory Profile subscale and sensory processing pattern scores were calculated using raw scores. Due to the small sample size and non-normal data distribution, pre- and postoperative scores were compared using the Wilcoxon signed-rank test.

Results: No statistically significant differences were observed between preoperative and postoperative scores for sensory processing subscales, including auditory, visual, tactile, vestibular, and oral sensory processing ($p > 0.05$). A trend toward significance was observed in the visual sensory processing subscale. In contrast, a statistically significant increase in MAIS scores was found at six months postoperatively ($p < 0.01$), with all participants demonstrating improved auditory integration.

Conclusions: These preliminary findings suggest that early cochlear implantation is associated with rapid improvements in auditory integration in young children, whereas changes in sensory processing profiles may reflect a more gradual and heterogeneous multisensory reorganization process. Longer follow-up studies with larger samples are warranted to further elucidate sensory processing changes following early cochlear implantation.

Free paper 0300

Preservation of residual hearing after cochlear implantation with the Advanced Bionics HiFocus™ SlimJ electrode array

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Introduction: The outcome of cochlear implantation is influenced by multiple factors, including the type of electrode array used. This study aimed to assess the performance of a specific electrode regarding residual hearing preservation and to examine the impact of patient age and preoperative low-frequency hearing thresholds.

Material and methods: Twenty-three patients underwent unilateral cochlear implantation with the HiFocus™ SlimJ electrode array. Pure-tone audiometry (0.125–8 kHz) was conducted before surgery and at 1, 3, and 6 months postoperatively. Hearing preservation was evaluated using the HEARRING Group formula.

Results: Residual hearing was maintained in all participants. The analysis indicated that preoperative low-frequency hearing thresholds played a more significant role in hearing preservation than patient age.

Conclusions: The HiFocus™ SlimJ electrode array allowed for complete preservation of residual hearing in all implanted patients. Hearing preservation was more strongly associated with preoperative low-frequency hearing levels than with age.

Free paper 0571

Prevalence of inner ear anomalies and normative cochlear parameters among Omani population with sensorineural hearing loss

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Introduction: Inner ear malformations are diverse group of congenital conditions that are a major cause of hearing loss in children. Identifying these anomalies is considered crucial for surgical planning helping to anticipate challenges like CSF gushers, choose the appropriate side, select the correct electrode type and length. In this retrospective study will determine the prevalence of inner ear malformation in our population as it was not studied before. In addition will identify the normal parameter of the cochlea by reviewing HRCT temporal bone and using OTOPLAN software that can help in measurement and surgical planning and best electrode choice.

Objectives: (1) To determine the prevalence of inner ear malformation in sensorineural hearing loss among Omani populations. (2) To identify the normal measurement of cochlea by using OTOPLAN software.

Material and methods: Retrospective collection of patient in the last 10 years seen in cochlear implant clinic at tertiary hospital referred from all regions of Oman. *Period:* from 2015 till 2025. *Inclusion criteria:* All patient with sensorineural hearing loss who underwent HRCT temporal bone for all ages. *Exclusion criteria:* Patient with normal or conductive hearing loss.

Results: Total of 413 patients having Sensorineural hearing loss, 52.3% male, 47.7 female, most patient from Muscat and North Batinah governate 22% and 20.6%. 347 patient had normal inner ear structure and 66 patients with inner ear anomalies with prevalence rate of 16%. 43 patient among 66 had cochlear implantation. Commonest inner ear anomaly is enlarged vestibular aqueduct (20 patients) followed by Mondini syndrome (13 patients).

Free paper 0081

Process management of robotic cochlear implant surgery: Integration and optimization of two robotic assistance systems within the clinical workflow

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Introduction: Robotic cochlear implantation (CI) represents a major advancement in minimally invasive otologic surgery. This project provides the first comprehensive presentation of the clinical workflows developed for two robotic assistance systems: HEARO and OTODRIVE. Both systems were integrated within a structured process-management framework aimed at defining safe, efficient, and standardized procedural pathways.

Material and methods: Process steps from patient admission and indication to surgery were modeled using the Business Process Model and Notation (BPMN 2.0) in ADONIS (BOC Group, Vienna). To analyze responsibilities and interdisciplinary collaboration, a RACI matrix (Responsible, Accountable, Consulted, Informed) was constructed to clarify task ownership and communication pathways. A timeline analysis was conducted to examine process durations, resource demands, and potential bottlenecks. Workflow development followed an iterative, participatory approach involving surgery, audiology, speech therapy, and administrative units.

Results: The HEARO and OTODRIVE process models visualize the full clinical workflow, including interfaces with patients and implant manufacturers. Key procedural components comprise preoperative CT-based planning, eligibility assessment, surgical preparation, and structured postoperative documentation. The models enable systematic assessment of resources, process durations, and interdepartmental interfaces, providing actionable insights for workflow standardization and improvement.

Conclusions: The integration of robotic-assisted CI surgery into clinical practice benefits substantially from comprehensive process modeling. The workflows identify structural opportunities and challenges associated with HEARO and OTODRIVE and support the continuous refinement of robotic CI procedures. Ongoing monitoring can facilitate the detection of optimization potentials and contributes to the sustainable implementation of robotic systems in routine CI care.

Free paper 0598

Protrusion of cochlear implants as a late complication in an 8-year-old patient

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Introduction: Cochlear implantation is a standard therapeutic procedure that significantly improves quality of life in pediatric and adult patients with severe hearing loss. Late implant extrusion due to host tissue reaction is a rare complication. We present the case of an 8-year-old patient who developed bilateral implant protrusion nearly four years after implantation.

Case report: An 8-year-old girl with congenital sensorineural hearing loss underwent bilateral cochlear implantation at the age of four. The primary surgery and postoperative healing were uneventful. In March 2025, she presented with left-sided protrusion of the internal implant component through inflamed skin and necrotic skin changes over the right implant. Bilateral revision surgery was performed, including debridement of necrotic and inflammatory tissue and reinsertion of both implants into newly created subperiosteal pockets. One month later, purulent infection and recurrent protrusion occurred on the left side, followed by similar findings on the right. The left implant was explanted under general anesthesia, and a dummy electrode was inserted to preserve cochlear patency. The right implant was temporarily retained, with the wound healing by secondary intention. Due to suspected allergy, epicutaneous patch testing for implant materials was performed with negative results. Given the high risk of right-sided extrusion, right explantation was indicated, combined with simultaneous left-sided reimplantation using a device from a different manufacturer. Preoperative patch testing for the new implant materials was again negative.

Results: Currently, the patient is status post left-sided reimplantation. The retroauricular wound healed by primary intention, and auditory performance remains comparable to the pre-complication level (February 2025). Right-sided reimplantation is planned.

Conclusions: The etiopathogenesis of the complication remains unclear to date. In addition to a possible allergic reaction, bilateral trauma in the region of the implants must also be considered, however, both the patient and her parents deny any such history.

Free paper 0356

Psychophysical outcomes for variations of Focused Multipolar Stimulation

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Introduction: The SASC (Stimulation and Sound Coding) study forms part of Cochlear's global Nexa Research Program and explores the impact of a range of configurations of focused multipolar stimulation (FMS) on auditory perception.

Objective: To assess the perceptual effects of FMS on psychophysical outcomes in adult CI recipients.

Material and methods: Eighteen adult participants were newly implanted with the research system comprising the Nexa cochlear implant, a modified Nucleus 7 sound processor and investigational fitting software, and participated in a clinical investigation that administered a battery of psychophysical assessments at multiple follow-up intervals within the first year of experience. Several versions of FMS, each with distinct parameter settings, were evaluated. Tests included spectral discrimination, pitch ranking, and F0 discrimination. Data were collected using standardized protocols and analyzed to compare perceptual outcomes across the different FMS configurations.

Results: Preliminary observations suggest that variations in parameter configurations for the FMS stimulation paradigm influence psychophysical outcomes. Some variability was observed across participants and test conditions. Analyses are ongoing, and further data will be presented at the time of the conference.

Conclusions: The perceptual implications of variations in FMS on psychophysical test performance are important to inform optimal configuration of the novel stimulation strategy to shape auditory experience in CI recipients. Continued

investigation will clarify how specific FMS configurations affect perceptual outcomes and inform future approaches to cochlear implant programming and technology development.

Free paper 0735

Quality of life and patient activity following cochlear implantation: A single-center study

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Introduction: Cochlear implantation (CI) is an established and safe surgical method for treating severe to profound sensorineural hearing loss. Since the initiation of the CI program in our department in 2003, over 200 patients have been implanted. This study aimed to evaluate the impact of implantation on the quality of life, professional activity, and social functioning of patients treated at the Department of Laryngology, SPSKM in Katowice.

Material and methods: The study group consisted of 100 adult patients using various Cochlear Ltd implant models (including CI24 and CI500 series). A customized questionnaire developed by the clinical team was distributed to all participants. The survey included closed questions regarding demographic data and technical aspects, as well as open questions concerning subjective feelings and life changes post-surgery. Analysis was conducted on 65 returned questionnaires (45 women, 20 men), with a mean patient age of 60.5 years.

Results: The average duration of implant use was 6.1 years. High compliance was observed, with 65% of patients using their speech processors for more than 12 hours daily. While most patients used newer generation processors like the Nucleus 6 (55%), only 10% utilized wireless accessories such as MiniMic or PhoneClip. Regarding patient activity, 71% reported improved communication with family members, and 76% declared better speech understanding and social contacts. Furthermore, 72% of respondents indicated a significant increase in self-confidence following the procedure.

Conclusions: Cochlear implantation significantly enhances the quality of life and psychosocial well-being of patients. The high level of satisfaction and improved social engagement reported by the participants confirm that CI is a highly effective intervention that is strongly recommended by the patients themselves for all eligible candidates.

Free paper 0445

Quality of life in caregivers of children with cochlear implants and its relationship with auditory performance

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Introduction: Cochlear implantation is an established and effective intervention for children with severe to profound hearing loss, enabling auditory access and supporting speech and language development. Nevertheless, objective audiological outcomes alone may not fully capture the functional, emotional, and social impact of cochlear implantation on families. Caregivers play a pivotal role in consistent device use, auditory stimulation, and rehabilitation processes; therefore, family quality of life represents a key component of long-term outcomes. Evidence exploring the relationship between auditory performance and caregiver-reported quality of life in pediatric cochlear implant users remains limited, particularly in Latin American populations.

Material and methods: An observational, descriptive, cross-sectional study was conducted including caregivers of children with unilateral or bilateral cochlear implants with a minimum post-implant follow-up of 6 to 12 months. Auditory performance was assessed using free-field audiometry with the cochlear implant, focusing on functional hearing thresholds. Family quality of life was evaluated using two validated questionnaires: the Children with Cochlear Implants: Parental Perspectives (CCIPP), a cochlear implant–specific instrument assessing communication, emotional well-being, family relationships, and education; and the Pediatric Quality of Life Inventory Family Impact Module (PedsQL-FIM), a generic measure evaluating family functioning and caregiver burden. Data were collected during routine follow-up visits. Descriptive statistics were used to characterize the sample, and correlation analyses were performed to examine the relationship between auditory performance and quality of life scores.

Results: 50 caregiver–child dyads were included. Auditory performance thresholds demonstrated variability across the cohort. Caregiver-reported quality of life scores varied across domains in both the CCIPP and the PedsQL-FIM. Better auditory performance tended to be associated with higher scores in communication-related and emotional well-being domains. The CCIPP provided greater sensitivity to hearing- and communication-specific outcomes, while the PedsQL-FIM captured broader aspects of family impact.

Conclusions: Auditory performance in children with cochlear implants is associated with caregiver-perceived quality of life. The combined use of audiological measures and both cochlear implant–specific and generic family impact instruments offers a more comprehensive understanding of pediatric cochlear implant outcomes. These findings underscore the importance of incorporating family-centered assessments into routine follow-up and rehabilitation programs.

Free paper 0739

Quality of life outcomes among MED-EL cochlear implant users in the eastern part of Libya: Challenges, progress, and future directions

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Introduction: Severe to profound hearing loss significantly impacts communication, education, employment, and social participation. Cochlear implantation is a well-established intervention for individuals with severe hearing impairment, leading to significant improvements in auditory perception and speech understanding. While clinical and audiological outcomes are commonly used to evaluate implant success, assessing patient-reported quality of life (QoL) is equally important to understand the broader benefits of cochlear implantation. In Libya, particularly in the eastern region, no research has examined how cochlear implant (CI) users experience daily life following implantation.

Aim: This study aims to assess the quality of life of MED-EL CI users in eastern Libya and to identify factors influencing rehabilitation outcomes and social participation.

Material and methods: A mixed-methods design integrating quantitative and qualitative data collection. The quantitative component will utilize the Hearing Loss–Quality of Life (HL-QoL) questionnaire, a validated instrument consisting of 21 items that evaluate the impact of hearing loss on everyday functioning. The questionnaire measures challenges in communication, participation in social activities, interactions with others, educational or occupational performance, and emotional well-being. Responses are rated on a scale from "never" to "always," generating a total score ranging from 19 to 147, reflecting the participant's perceived quality of life. Participants will include adult and pediatric MED-EL CI users with at least 12 months of experience. Data will be collected from patients implanted at the Specialized Surgical Centre (SSC) in Benghazi and other CI centers in eastern Libya. Demographic and clinical variables, including age, gender, implant duration, and daily device usage, will also be recorded. Additionally, semi-structured interviews with selected participants and caregivers will explore experiences related to rehabilitation, device maintenance, and access to audiological services.

Expected outcomes: The study will demonstrate improvements in communication ability, social participation, and educational or occupational engagement among CI users. However, challenges such as limited rehabilitation services, financial constraints, and unequal access to specialized audiological care may influence long-term outcomes.

Conclusions: Evaluating QoL outcomes among CI users in eastern Libya will provide valuable insights for improving audiological services, strengthening rehabilitation programs, and informing healthcare policies to enhance long-term support for individuals with hearing loss.

Free paper 0006

Radiologic and cadaveric confirmation of the stapes to reliably identify the round window

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Introduction: The stapes is anecdotally described as a helpful landmark for identifying the round window during cochlear implant surgery, however minimal objective research exists. We sought to corroborate this relationship utilizing radiologic and cadaveric distance relationships of the stapes to the round window.

Material and methods: Retrospective review of multiplanar computed tomography (CT) image reformats and prepared fixed temporal bone specimens at a tertiary referral center. Patients >18 years of age without prior surgery or otologic disease that underwent high quality CT imaging of the temporal bone were included. Identical criteria were utilized for temporal bone specimen identification. Prediction accuracy of stapes intercrural width to locate the level of the round window following both radiologic and cadaveric assessments was determined.

Results: There were 50 radiologic, and 6 cadaveric ears studied. The stapes intercrural width was an accurate predictor of the round window level in all cases.

Conclusions: This study helps reaffirm and further describe the relationship of the stapes to the round window utilizing the intercrural width. This information can help surgeons gain accurate access to the cochlea when faced with challenging cases where inflammation or fibrosis makes identification difficult.

Free paper 0088

Reading comprehension, speed, and accuracy in children with cochlear implants: A norm-referenced performance analysis

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Introduction: Children with cochlear implants (CwCI) often benefit from improved auditory access through cochlear implantation, which can support the development of verbal production and comprehension skills. However, they may still face challenges in written language acquisition. The aim of the study was to systematically assess reading comprehension

(RC), reading speed (RS), and reading accuracy (RA) in CwCI aged 10;0 to 16;11 years attending mainstream schools, and to compare their performance with age-related normative data.

Material and methods: Data were analyzed retrospectively based on test results from $n = 14$ CwCI. Reading ability was assessed using the Reading Speed and Comprehension Test for grades 5–12 (LGVT 5–12+). Six participants attended a comprehensive school, six a grammar school, and one a secondary school. Results were descriptively compared with normative data for children with normal hearing (T = 50, SD = 10). At the time of testing, the participants had a mean age of 13.66 years (SD = 1.95) and had been fitted with bilateral CIs for an average of 12.06 years (SD = 2.36).

Results: Across all three subtests (RC, RS, RA), mean T-values were within the lower normal range. In RA, the highest score with a mean of 48.17 was observed, although interindividual variability was high (SD = 17.67). Mean scores for RS ($M = 43.79$; SD = 7.98) and RC ($M = 46.86$; SD = 9.30) were slightly lower and showed less variability. At the individual level, 57% of the CwCI scored within the normal range ($T \geq 40$) across all three subtests, 43% achieved below-average values in at least one subtest ($T < 40$). Below-average values occurred most frequently in RS (6 in RC, 11 in RS, 4 in RA).

Conclusions: More than half of the tested CwCI demonstrated reading abilities within the normal range, showing no apparent reading difficulties. However, many children exhibited slight deficits in at least one aspect of reading ability, with greater difficulties in reading speed and comprehension than in accuracy. Overall, our findings suggest that CwCI attending mainstream schools should be assessed in their reading abilities and supported in potentially affected domains to help overcome these difficulties.

Free paper 0476

Real-time intra-operative electrocochleography in bilateral cochlear implantation for auditory neuropathy spectrum disorder: A case report

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Aim: Describe the preoperative decision-making, intraoperative electrocochleography (ECochG) findings, and outcome of bilateral cochlear implantation (CI) in an adolescent boy with auditory neuropathy spectrum disorder (ANSD).

Case report: A 14-year-old was referred for hearing rehabilitation with normal pure tone audiometry but poor speech understanding. A diagnosis of ANSD was made based on acoustic brainstem response (ABR), distortion product otoacoustic emission, and acoustic reflex testing. fsOAE was present with good amplitude in both ears. SDS were poor in aided and unaided tests. Unaided LLR was absent. Imaging revealed no central cause of hearing impairment. Over the next 3 years, his hearing loss progressed. ABR showed absence of peak V with ringing Cochlear Microphonics (CM). *Interventions:* simultaneous bilateral cochlear implantation. *Main outcome measures:* (1) Pre-operative and post-operative audiometric data: PTA, Impedance, Acoustic Reflex; (2) fs-OAE; (3) Intraoperative electrocochleography and post-op ECochG; (4) Intra-op and post-op ECAP; (5) Intraoperative EABR and post-op EABR.

Results: Intraoperative ECochG was done for simultaneous real-time recording of EcochG during electrode insertion (chirp stimulus) and measurement of CM across all electrodes for specific frequencies (tone burst stimulus). An acoustic pure tone complex comprising of 125, 250, 500, 1000, 2000 and 4000 Hz was used to elicit EcochGG and CM responses from various locations in the cochlea. The amplitude of EcochG for each frequency stimulation was measured across all electrodes (apical to basal). Responses were in the 100 uV range across all electrodes, confirming hearing preservation. We also measured OAE as a novel method to assess preservation of hair cells and hence hearing. Post-operative SDS showed improvement at 1 month. The patient cites an improved ability to communicate and increased confidence and averages over 10 hours of device use daily.

Conclusions: To our knowledge, this is the first reported case of bilateral cochlear implantation with simultaneous multi-frequency electrocochleography monitoring performed intraoperatively in a young adult with auditory neuropathy spectrum disorder. The findings demonstrate that intraoperative monitoring of residual hearing during cochlear implantation is feasible. In addition, cochleostomy was not associated with intraoperative loss of residual hearing. This case report supports the evolving role of hearing-preservation strategies in CI.

Free paper 0091

Real-time multi-sensor data fusion and processing pipeline for intraoperative force measurement in cochlear implant surgery

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Introduction: Insertion forces generated during electrode array insertion in cochlear implant (CI) surgery have been associated with intracochlear trauma. However, these forces are often too subtle to be perceived by the surgeon. To enable intraoperative insertion force measurement, our group developed the Forception Tool integrating a force sensor and an inertial measurement unit (IMU). The IMU provides orientation information to correct gravity-related bias in force measurements. While the tool and its data acquisition pipeline are established, the real-time signal processing and data fusion steps required for accurate and reliable force interpretation have not been validated previously.

Material and methods: A real-time C++ processing pipeline was implemented that continuously acquires and timestamps force and IMU data from the tool. Based on an analysis of sensor-specific noise characteristics, low-pass filters are applied to the acquired signals to mitigate noise. The filtered signals

are then fused to generate a gravity-compensated force signal. Filtering performance was evaluated using data from 30 automated linear insertions with the tool, employing the Peak Preservation Ratio (PPR) and Signal-to-Noise Ratio (SNR). PPR quantifies how well the signal peaks are preserved after filtering. To verify the correctness of force–IMU data fusion, 20 controlled drop experiments were conducted in which the tool was suspended vertically and released. This exposed both sensors to the same event, and the onset times of their responses were compared to assess temporal synchronization.

Results: The applied filtering effectively preserved relevant insertion force peaks, achieving a mean PPR of 99.81% ± 0.02% for peaks greater than 10 mN. Additionally, the gravity-compensated force signal after filtering exhibited an overall SNR of 31.62 dB ± 0.81 dB. Controlled drop experiments verified the temporal synchronization between the force and IMU data streams, with a mean time offset of 8 ms ± 4 ms.

Conclusions: The implemented pipeline reliably synchronizes and fuses force and IMU data while reducing noise and preserving relevant force peaks. These results demonstrate the feasibility of accurate real-time intraoperative force measurement during CI surgery. Future work will focus on providing insertion force feedback to the surgeon and integrating the pipeline into the clinical workflow.

Free paper 0019

Real–world evaluation of the AudioKey 3 App: Insights into performance, satisfaction, and cochlear implant use

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Purpose: This study aimed to assess the real-world performance, user satisfaction, and daily usage patterns of MED-EL's AudioKey 3 mobile application for cochlear implant (CI) users. The evaluation also included an analysis of app-related safety, capturing any device-related complications reported through a user survey.

Material and methods: A post-market observational analysis incorporated both in-app survey data ($N = 46$) and anonymized app-log metrics ($N = 11{,}014$) collected from October 14, 2024, to March 31, 2025. Main outcome measures included the frequency of feature use, listening-environment engagement, and streaming activity.

Results: Among surveyed participants, 98% successfully used AudioKey 3 for remote control and status functions ($p < 0.001$). 96% rated their overall satisfaction as very good or good, while 66% provided a good rating via the in-app rating tool ($N = 776$). Mean daily processor wear time was 11.8 hours, with speech-in-noise identified as the most frequently selected listening program (mean = 3.5 h/day). Streaming activity was limited – 59% of devices were never used for streaming, and only 5% showed streaming durations exceeding 3 h/day. The most frequently accessed features were volume control and program switching, while streaming enable/disable remained least used.

Conclusions: The AudioKey 3 app demonstrates strong reliability and ease of use, supporting consistent hearing-device engagement and user satisfaction in real-world conditions. Its role in simplifying daily management of cochlear implants is evident. The limited streaming use observed likely reflects individual listening preferences or external technical factors.

Free paper 0277

Recording of electrically evoked cortical potentials in a child after cochlear implant surgery

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Introduction: Cortical auditory evoked potentials (CAEPs) are the brain's responses to sound stimuli, generated primarily in the cerebral cortex. Based on the latencies of the recorded N1 P1 and N2 P2 potentials, the maturation of the central auditory system in children after cochlear implantation is assessed.

Aim: The aim of this study is to analyze interaural differences in the latencies of cortical auditory potentials in selected patients.

Material and methods: Two boys, aged 7 and 10, were selected. One boy, with profound bilateral hearing loss, received an implant bilaterally (the first implant at age 6, the second at age 7). The other boy, with unilateral deafness, received an implant in his deaf ear at age 8. Auditory responses generated in the auditory cortex were recorded in response to electrical or acoustic stimulation, using electrodes placed on the child's head. Synergia software was used for recording and acquisition of the potentials. Acoustic stimulation was performed using a Natus TIP-300 in-canal earphone. The electrical stimulus was delivered directly through the patient's cochlear implant. Stimulation was performed using Maestro software. Each waveform was obtained based on 30 averages. Electrically evoked auditory cortical potentials were obtained by administering the stimulus to the second electrode of the implant (the region of the cochlea responsible for low frequencies) and the tenth electrode (high frequencies). The stimulus was presented at a comfortable volume level for the patient, assessed based on behavioral observations. The P2 potential latency was determined for the obtained waveforms.

Results: Comparison of the latencies of the auditory cortical potentials in the boy with binaural implantation revealed a difference between the two sides. Responses recorded after stimulation of the newer implant had a longer latency compared to the previously implanted implant. In the latter case, the results of the boy with single-sided deafness were analyzed. Recorded cortical potentials obtained after electrical stimulation of the implanted side showed prolonged latencies compared to responses obtained acoustically from the side with normal hearing.

Conclusions: Assessment of P2 potential latency allows for monitoring the development of the higher levels of the auditory pathway in children after cochlear implantation.

Free paper 0671

Refractory acoustic feedback after cochlear Osia implantation caused by unexpectedly low BI300 stability (ISQ): A case report

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Introduction: The Cochlear Osia system depends on adequate primary and secondary (healed) stability of the BI300 fixture. Persistent acoustic feedback is typically managed by processor troubleshooting and fitting adjustments; however, insufficient implant stability may be an underrecognized cause.

Material and methods: A man in his 70s, previously treated with right canal wall up surgery for cholesteatoma, presented with profound right-sided sensorineural hearing loss and contralateral mixed hearing loss. He was qualified for Osia implantation. BI300/Osia implantation (December 2024) was uncomplicated. The sound processor was activated in January 2025 with good initial benefit. Over subsequent weeks, the patient developed recurrent, bothersome feedback. Processor integrity testing and repeated fitting modifications did not resolve the issue. Revision surgery was undertaken to assess the implant/fixture and to quantify stability using resonance frequency analysis (Osstell).

Results: No macroscopic device damage was identified intraoperatively. The original BI300 showed low stability with an Implant Stability Quotient (ISQ) of 40. Because typical intraoperative ISQ values for bone-anchored hearing implants are usually around the high 50s to high 60s and the expected clinical range for stable implants is commonly reported as approximately 55–80, the measured value was considered markedly reduced. A new BI300 was inserted; stability remained very low (ISQ 32). Due to failure to achieve adequate primary stability, re-implantation of a new Osia transducer was abandoned. The low BI300 stability was considered the most plausible mechanism behind the persistent feedback despite normal processor testing.

Conclusions: When feedback after Osia implantation is persistent and resistant to programming changes, inadequate BI300 stability should be considered. Intraoperative resonance frequency analysis provides an objective assessment that may alter management, including deferring re-implantation if primary stability remains insufficient.

Free paper 0588

Relation between electrical compound action potential measures and speech perception in cochlear implanted children: Audiological and phonological outcomes

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Purpose: To study ECAP measures (threshold and amplitude growth function, AGF) in children CI users and find the relation between these ECAP measures and speech outcomes using audiological and phonological assessment.

Material and methods: Twenty-one children were unilaterally implanted with MED-EL CI, and all subjects were submitted to phonological assessment, basic audiological assessment, speech recognition tests (WRS and BKB-SIN) and MED-EL maestro software measures (IFT, AutoART and AGF measures "thresholds and slopes" across apical, middle and basal electrodes).

Results: This study demonstrated no statistically significant difference between AGF thresholds at apical, middle and basal electrodes and a statistically significant difference between AGF slopes at apical and both middle and basal electrodes. There was no statistically significant correlation between the ECAP threshold and speech perception tests. In contrast, a positive statistically significant correlation was found between the AGF slope of the apical electrode and word recognition score, and a negative statistically significant correlation between AGF slopes at apical, middle and basal electrodes and SNR loss of BKB-SIN. High sensitivity and specificity of AGF slope at apical electrode were found to differentiate between good and poor performers as regards SNR loss of BKB-SIN and language test.

Conclusions: The AGF slope reflects neural survival better than the ECAP threshold. AGF slope at apical electrodes correlated with better CI performance in both phoniatric and audiological measures of speech perception and can be used as an objective tool to predict CI outcome.

Free paper 0528

Remote analysis of auditory performance in cochlear implant users using a new tool: Remote Check

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Introduction: Cochlear implants (CIs) are indicated for individuals with severe-to-profound hearing loss and promote improvements in speech comprehension, well-being, and quality of life. CI outcomes depend on factors such as age, duration of auditory deprivation, and cognitive functions,

and may be assessed in a sound booth or through remote tools such as Remote Check.

Objective: To remotely evaluate the auditory performance of cochlear implant users using the Remote Check tool.

Material and methods: A prospective cross-sectional analytical study was conducted. Thirty-one cochlear implant users, prelingual and postlingual, with at least six months of device use and without cognitive or intellectual impairments associated with hearing loss, participated in the study. Remote Check was accessed through the Nucleus Smart app and managed via the My Cochlear Professional platform. Participants completed the assessment, and data were collected regarding the Digit Triplets Test (DTT), the Aided Threshold Test (ATT), and device usage time.

Results: Comparative analyses indicated that unilateral CI users with prelingual hearing loss showed poorer outcomes compared to postlingual users in the same group, whereas prelingual individuals using bilateral CIs demonstrated better outcomes compared to postlingual participants in the bilateral group. Regarding auditory thresholds, significant asymmetry was observed across different frequencies, varying according to device use. Furthermore, effect size analyses revealed moderate differences in speech-in-noise performance at some frequencies, a large effect at 250 Hz in the left ear, and a large effect for device usage time among users of right-ear implants.

Conclusions: Remote Check is an effective tool that can support the assessment of cochlear implant users' performance with regard to datalogging, aided threshold evaluation, and speech-in-noise tests.

Free paper 0623

Remote Care-based optimization of clinical triage for cochlear implant users: A multicenter prospective study protocol

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Introduction: The growing population of cochlear implant (CI) users is increasing demand for long-term specialist follow-up, straining traditional clinic-based models. Teleaudiology, including Cochlear™ Remote Care (Remote Check and Remote Assist), may optimize post-implant management through remote monitoring, selected remote adjustments, and data-driven triage, but is not yet implemented at scale or routinely reimbursed in many countries, including Poland. This protocol evaluates a structured hybrid model and provides an implementation framework.

Material and methods: This prospective, multicenter study will enroll pediatric (≥10 years) and adult (≥18 years) CI users implanted with the Cochlear Nucleus system and followed over 12 months within a hybrid care model. Scheduled in-clinic visits will be complemented by remote follow-ups using Remote Check and Remote Assist within the Nucleus Smart App. Audiological outcomes will include in-clinic soundfield puretone audiometry, and athome appbased aided audiogram and digit-in-noise (Digit Triplet Test) testing. Device telemetry (including electrode impedance) and patient-reported outcome measures (SSQ, APHAB) will be collected remotely and in clinic. The primary objective is to evaluate the clinical validity, operational efficiency, and economic impact of Remote Care, with emphasis on its ability to support triage and substitution, deferral, or escalation of routine in-person visits. Secondary analyses will address clinical noninferiority, safety, clinician time utilization, patient-related costs, and user acceptance.

Results: We hypothesize that remote assessments will show high agreement with in-clinic measurements, supporting the reliability of home-based monitoring. Audiological performance and subjective hearing outcomes are expected to be comparable between hybrid and conventional follow-up pathways. Remote Care is expected to reduce in-clinic appointment time and safely limit unnecessary face-to-face visits through asynchronous, data-driven triage while maintaining high patient and clinician satisfaction.

Conclusions: This study is designed to determine whether Remote Care represents a safe, clinically equivalent, and resourceefficient model for post-implant follow-up in CI users. The outcomes are intended to inform standardized workflows and support broader adoption and reimbursement of tele-audiology services at national and international levels.

Free paper 0313

Repercussions of otopathological findings in unilateral hearing loss for cochlear implants

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Introduction: The impact of single-sided deafness was often underestimated, as it was believed that the normal contralateral ear would compensate for its deficits. However, a particularly increased effort is required to compensate it in complex listening environments, leading to reduced performance and increased hearing handicap. Otopathology is the gold standard for evaluating intracochlear pathology, providing sensitive and specific identification of pathophysiological mechanisms. Therefore, we aim to describe histopathological findings of severe/profound unilateral hearing loss and to discuss the implications of these findings for auditory rehabilitation through cochlear implantation.

Material and methods: This study included 78 ears from 39 human subjects with a diagnosis of severe to profound unilateral hearing loss from the Temporal Bone collection of the Otopathology laboratory of the Massachusetts Eye and Ear Infirmary. Etiologies of hearing loss included sudden sensorineural hearing loss (SSNHL), Ménière's disease (MD), labyrinthitis, chronic otitis media, and otosclerosis. Each specimen was prepared with standard histologic techniques. The slides were digitalized and evaluated in their histopathological aspects including spiral ganglion neuron (SGN) quantification, allowing comparison to the contralateral unaffected ear.

Results: Acute processes including SSNHL, labyrinthitis and hearing loss following surgery were all associated with intracochlear damage. This may point to consideration of earlier intervention to minimize this variation. The degree of SGN degeneration was more variable and not always temporally related to loss of hearing, precluding generalizable implications for cochlear implantation. The degree of SGN loss in MD was moderate and showed no temporal relation indicating more favorable outcomes for delayed implantation in MD.

Conclusions: The multiple causes of unilateral hearing loss have different histopathological implications in the inner ear, which may reflect in different outcomes for auditory rehabilitation.

Free paper 0117

Results of a comparison between dissyllabic and monosyllabic lists and their consequences in clinical audiometry analysis of 3 populations (NH, HFHL, CI)

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Introduction: Audiologists at the Centre d'Audiophonologie Brussels, have found that speech audiometry using dissyllabic lists can rapidly lead to a ceiling effect. This distorted the results of 'star patients' who, in reality, heard less well than the dissyllabic lists suggested.

Aim: The aim of this study was to determine whether the results of speech audiometry differed according to intensity and language material, and to establish whether the different ratings between dissyllabic words and monosyllabic words, mental supplementation, and the design of the 2 types of lists influenced the results according to group.

Material and methods: Three groups ($n = 68$): normal hearing (NH, $n = 29$), high frequency hearing loss (HFHL, $n = 13$), hearing with a cochlear implant (CI, $n = 26$) were subjected to: tonal audiometry, speech audiometry with the mono and dissyllabic lists. Results were compared at 4 intensities (40-, 55-, 70- and 80-dB SPL) within each group and between the 3 groups.

Results: The inter-group comparison showed a significant difference between the NH and CI at all intensities, between the NH and HFHL groups at 40- and 55-dB SPL; at intensities of 70- and 80-dB SPL between the HFHL and CI groups. Intra-group comparison shows a significant difference between the two language materials in the NH group at 40 dB SPL, in the HFHL group at 55- and 70-dB SPL, and in the CI group at 40- and 55-dB SPL.

Conclusions: NHs reached a maximum for both list types. HFHLs achieve maximum intelligibility at high intensities, and CIs parallel NHs at 55 dB SPL and above.

Free paper 0575

Results of bilateral cochlear implantation in Norrie disease

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Introduction: Norrie disease (ND) is a rare X-linked disorder caused by a mutation in the NDP gene, which encodes a protein that plays a role in developing the vasculature of the eye and ear. Characteristic symptoms include: abnormal retinal development, congenital blindness, and sensorineural hearing loss that begins in childhood and progresses to profound deafness before middle age. Other symptoms may include developmental delay, intellectual disability, and behavioral disorders.

Material and methods: This retrospective case study describes the effects of treating hearing loss with cochlear implants in a patient with Norrie disease.

Case report: A 20-year-old patient with congenital blindness came to the Institute of Physiology and Pathology of Hearing. Since the age of 7, he had experienced progressive hearing loss and tinnitus, and he had used hearing aids since the age of 14. A pure tone audiometry test at age 20 revealed profound sensorineural hearing loss in the right ear and moderate hearing loss in the left ear. An MRI scan of the head revealed atrophy of the eye, an active remodeling process, and inflammatory and degenerative changes in the cochlea, with a high probability of fibrous obliteration, and also segmental cerebellar atrophy. At age 22, a MED-EL cochlear implant was placed in the right ear. A postoperative CT scan of the temporal bones showed the tip of the cochlear implant electrode in the 460-degree position, microphthalmia with calcifications in the eyeballs, and widened cerebellar sulci. Due to progressive hearing loss in the left ear, a second MED-EL cochlear implant was placed in the left ear at age 35.

Results: In a free-field audiometry test twelve years after cochlear implantation in the right ear (the left ear closed), the patient achieved an average score of 34.17 dB. Six months after cochlear implantation in the left ear he achieved an average score of 43.33 dB for frequencies ranging from 0.25 to 6 kHz (the right ear closed).

Conclusions: Norrie's disease leads to devastating dual sensory deprivation. Cochlear implantation is the primary method for restoring hearing, which is often lost, in patients with ND.

Free paper 0281

Results of cochlear implantation in patients with congenital rubella

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Introduction: Congenital rubella syndrome (CRS) is an infection caused by the rubella virus transmitted to the fetus during pregnancy, which can cause congenital hearing loss. A cochlear implant can be an effective therapy in patients with severe to profound bilateral hearing loss. The aim of this study was to evaluate the benefits of cochlear implantation in patients with profound hearing loss caused by congenital rubella syndrome.

Material and methods: In total, 38 patients with profound hearing loss caused by intrauterine rubella virus infection were considered for cochlear implantation. Patients ranged in age from 8 to 72 years on the day of surgery, with a mean age of 27 years and a median of 25 years (SD = 13.2). Preoperatively, all patients underwent pure-tone audiometry, and free-field speech audiometry was conducted in a quiet environment with the patient wearing a fitted hearing aid. Postoperatively, patients underwent pure-tone audiometry to assess residual hearing, and free-field speech audiometry was conducted when the patients had an active implant.

Results: The average preoperative hearing threshold (averaged across the seven frequencies from 0.125 to 8 kHz) was 99.2 dB HL (SD = 6.79), while the average postoperative hearing threshold was 103.4 dB HL (SD = 5.74). Twelve months after the operation, patients achieved a WRS in quiet scores ranging from 10% to 90%, with an average of 59.1% and a median of 70% (SD = 25.8).

Conclusions: Rubella during pregnancy can lead to severe congenital defects, with sensorineural hearing loss being the most common. Cochlear implants appear to be an effective treatment for profound hearing loss caused by congenital rubella syndrome.

Free paper 0201

Retrospective multicentric evaluation of the MI-SI-R technique for bone conduction hearing implants (OSIA)

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Introduction: Active bone conduction hearing implants are widely used for mixed (MHL) and conductive hearing loss (CHL). Conventional transcutaneous systems rely on anchoring and bone bed drilling to ensure stability and transmission efficiency. However, these requirements increase surgical invasiveness and may compromise long-term preservation of the implantation site, with a far posterosuperior position of the processor. The MI-SI-R (Mini-Invasive Sub-Periosteal Implant – Reverse orientation) technique is an anchor-free, drill-free and endoscope-assisted approach designed to minimize surgical morbidity, preserve periosteal integrity, allow early fitting, and maintain the possibility of future re-implantation at the same anatomical site.

Material and methods: This international multicentric retrospective study reports preliminary results from an ongoing pooled analysis. At the time of submission, 20 MI-SI-R implantations had been analyzed, including 15 adults with mixed hearing loss and 5 children with conductive hearing loss. In parallel, a comparative anchored reference group is being consolidated and is expected to include approximately 20 patients (around 10 adults with MHL and 10 pediatric cases), yielding an anticipated total study population of approximately 40 patients. Audiological assessment included air- and bone-conduction thresholds, aided pure-tone averages, speech reception thresholds, and calculation of overclosure (aided PTA minus bone PTA). Early fitting was targeted around postoperative day 15, audiological evaluation was performed at 3–4 months, with a minimum clinical follow-up of 6 months for the more recent one.

Results: In the MI-SI-R cohort, consistent audiological benefit was observed in adults with MHL, with overclosure values comparable or better to those reported in anchored adult reference cases. Pediatric patients demonstrated good tolerance and stable early audiological outcomes. Early fitting was feasible in the majority of cases. The reverse position of the OSI achieves an excellent retroauricular position of the external processor. No major surgical complications were observed, and preservation of the implantation site was consistently achieved across centers.

Free paper 0645

Review of 91 pediatric patients (163 ears) at the Centre for Children with Hearing Loss, NUDCH

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Objective: To evaluate hearing outcomes in pediatric patients who received cochlear implants in our Implant Center, and to determine the mean age at implantation for children with prelingual deafness.

Material and methods: We performed a retrospective observational study. Inclusion criteria were: patients had surgery, device activation and fitting at our center and completed at least one year of follow-up. 91 pediatric patients met criteria, receiving a total of 163 cochlear implants (lateral-wall and perimodiolar electrodes). The primary outcome was hearing thresholds at one year post-implantation, measured by open-field Visual Reinforcement Audiometry (VRA) at 500 Hz, 1 kHz, 2 kHz, and 4 kHz. Secondary data collected included type and side of implantation, documented etiology of hearing loss and age at implantation.

Results: VRA results one-year after implantation showed mean thresholds of 32.6 dB 31.9 dB, 32.2 dB, and 34.1 dB at 500 Hz, 1 kHz, 2 kHz, and 4 kHz respectively, with median thresholds of 30 dB for the first three frequencies and 35 dB for 4 kHz. The median age at implantation for all cases was 26 months (oldest was 17 years old). For the patients with prelingual hearing loss the median age was 19 months (Q1 = 16, Q3 = 26.5, IQR = 10.5). Of the 163 implanted ears, 76.0% were bilateral, 12.3% sequential, and 11.6% unilateral implantations. Of the unilateral implantations slightly more frequent was left ear (52.7%). The most common etiology was *GJB2* mutations (48.3%), followed by unknown causes (44.1%), CMV (4.3%), and meningitis (3.2%).

Conclusions: Our pediatric cochlear implant program achieved favorable audiometric outcomes. Most patients received bilateral implants, and *GJB2* mutations were the most frequently identified etiology. These findings support the effectiveness of cochlear implantation in the pediatric population. However, the mean age at implantation for children with prelingual hearing loss was high and should be reduced.

Free paper 0652

Round window anatomy and its implications in cochlear implant surgeries

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Introduction: The round window (RW) represents the most physiological portal to the scala tympani during cochlear implantation (CI). With increasing emphasis on hearing preservation and atraumatic electrode insertion, detailed knowledge

of round window microanatomy and its variations has become crucial for optimizing surgical outcomes. Anatomy: The RW is a small, oval-shaped opening (approximately 1.5–2 mm in diameter) located in the medial wall of the middle ear, leading to the scala tympani of the cochlea. It is covered by the round window membrane (RWM).

Material and methods: A comprehensive review of surgical anatomy, cadaveric studies, radiological data, and intraoperative findings was performed to analyze round window morphology, niche variations, orientation relative to the facial recess, and implications for electrode insertion trajectory. High-resolution CT temporal bone correlations were included to assess preoperative predictability of anatomical variations. Surgical Considerations: (1) Visualization: Adequate visualization of the RW is crucial, often requiring removal of the round window niche or adjacent bone. (2) RW membrane: The RWM may need to be incised or partially removed to facilitate electrode insertion. (3) Angle of insertion: The surgeon must carefully determine optimal angle for electrode insertion to avoid damaging the RW or surrounding structures.

Results: The round window niche is a three-dimensional bony recess formed by superior, anterior, and posterior pillars that may obscure direct visualization of the round window membrane (RWM). Variations in niche overhang, membrane orientation, facial recess width, and position relative to the basal turn significantly influence surgical access. Inadequate exposure may result in improper insertion angle, increased risk of scalar translocation, intracochlear trauma, or incomplete electrode placement. Radiological assessment aids in identifying high jugular bulb, narrow facial recess, anteriorly placed RW, or ossification. Round window membrane insertion, when properly aligned with the scala tympani axis, is associated with improved hearing preservation and reduced intracochlear trauma compared to cochleostomy approaches.

Conclusions: A precise understanding of round window anatomy, its spatial orientation, and anatomical variations is essential for safe and atraumatic cochlear implant surgery. Preoperative imaging combined with meticulous intraoperative niche drilling enhances visualization, optimizes electrode trajectory, and improves functional outcomes.

Free paper 0639

Shape of the cochlear basal turn and electrode selection

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Introduction: Cochlear implantation (CI) in recent times has reached a point that every fine geometrical detail of the inner ear has a role to play in the proper placement of the CI electrode array with a minimal degree of intracochlear trauma. Variations in the vertical trajectory of the cochlear duct from base to apex have been classified. The authors, to the best of their knowledge, are unaware of any prior studies that report specifically on the shape of the cochlear basal turn by measuring the cochlear parameters and its implications on the *electrode-to-modiolus* proximity with electrode array types. The objective of this study was to determine the shape of cochlear basal turn through basic cochlear parameters measurement. The secondary aim was to overlay an image of the precurved electrode array on top of the three-dimensional (3D) image of the cochlea to determine which shape of the cochlear basal turn gives optimal electrode-to-modiolus proximity.

Material and methods: Computed tomography (CT) preoperative image-data sets of 117 ears were made available for the measurements of cochlear parameters retrospectively. Three-dimensional slicer was used in the visualization and measurement of cochlear parameters from both 3D and 2D (2-dimensional) images of the inner ear. Cochlear parameters including basal turn diameter (A), width of the basal turn (B), and cochlear height (H) were measured from the appropriate planes. B/A ratio was made to investigate which ratios correspond to round and elliptical shape of the cochlear basal turn.

Results: The cochlear size as measured by A value ranged between 7.4 mm and 10 mm.The ratio between the B and A values anything above or below 0.75 could be an indicator for a more round- or elliptical-shaped cochlear basal turn, respectively. One-sized/shaped commercially available precurved electrode array would not offer a tight electrode-to-modiolus in the cochlea that has an elliptical-shaped basal turn as identified by the B/A ratio of <0.75.

Conclusions: Accurate measurement of cochlear parameters adds value to the overall understanding of the cochlear geometry before a cochlear implantation procedure. The shape of cochlear basal turn could have clinical implications when comes to electrode-to-modiolus.

Free paper 0110

Simultaneous intraoperative measurement of eCAP and eABR: A feasible approach in cochlear implant surgery

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Introduction: In cochlear implant (CI) surgery, intraoperative measurements of electrically evoked auditory brainstem responses (eABRs) are often limited by short surgical time constraints. Consequently, the electrically evoked compound action potentials (eCAP) are typically recorded, as it can be obtained rapidly via the electrode array and reflect spiral ganglion cell function as well as the electrode-nerve interface. However, eABRs provide important complementary information, particularly in cases of intraoperative complications or in pediatric patients, where subjective assessment is challenging. The aim of this study was to develop and evaluate a measurement setup enabling simultaneous intraoperative recording of eCAP and eABR.

Material and methods: Simultaneous eCAP and eABR recordings were performed during CI implantation using the

FLEXSOFT electrode array (MED-EL) at apical contacts (E2–E3). Twenty-one stimulation levels (0–25 qu; 500 repetitions per level) and an AutoART control measurement up to 40 qu were applied. The N1–P2 complex (ej1) of the eCAP and the ej5 component of the eABR were analyzed. Amplitude growth functions (AGFs) were used to estimate thresholds, which were subsequently correlated.

Results: Seventeen implanted ears have been included in this ongoing study. eCAP responses were successfully derived in 58% of cases, AutoART responses in 88%, and eABR responses in 76%. Threshold analyses revealed a moderate association between ART and AutoART measurements ($R = 0.54$, $p = 0.14$). A similar trend was observed between ej1 and ej5 thresholds ($R = 0.70$, $p = 0.08$), while the correlation between AutoART and eABR thresholds reached statistical significance ($R = 0.70$, $p = 0.01$).

Conclusions: Both eCAP and eABR responses could be reliably recorded intraoperatively, and corresponding AGFs were successfully derived. In some cases, no ART threshold could be determined despite a measurable AutoART threshold, likely due to the limited stimulation range of the simultaneous measurement protocol. Conversely, in two cases, eABRs were absent despite detectable eCAPs. These patients additionally exhibited delayed postoperative speech comprehension, suggesting a possible central auditory processing deficit. With a prevalence of 12% in this cohort, these findings highlight the clinical relevance of intraoperative eABR recordings.

Free paper 0594

Simultaneous one-stage surgical placement of Bonebridge and epithesis in children with aural atresia

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Children affected by aural atresia require early auditory rehabilitation and often seek satisfactory aesthetic reconstruction of the external ear. Conventional reconstructive approaches are frequently complex, involve several surgical stages, and may yield limited functional or cosmetic outcomes. Bone conduction hearing implants combined with auricular epitheses represent a less invasive alternative. This study describes the clinical and audiological outcomes of a single-stage surgical strategy integrating both interventions. Five pediatric patients with congenital aural atresia (aged 8–13 years) underwent simultaneous implantation of an active bone conduction device and placement of an auricular epithesis during the same surgical session. Preoperative planning was performed using a customized three-dimensional printed surgical mask to define the optimal position of both implants and to avoid spatial conflicts. Audiological assessment was conducted three months after device activation and included unaided and aided sound-field thresholds and speech recognition testing. Safety outcomes and patient satisfaction with the aesthetic result were also evaluated. Mean sound-field pure-tone average across four frequencies improved from 71.25 ± 8.2 dB HL in the unaided condition to 40.5 ± 8.6 dB HL with the device, corresponding to a mean functional gain of 30.75 ± 6.1 dB. Mean word recognition scores increased from 2 ± 4.5% without amplification to 91 ± 20.12% in the aided condition. No perioperative or postoperative complications were observed. All participants reported high satisfaction with the cosmetic appearance of the epithesis. Average daily use of the hearing device was 5.75 ± 4.9 hours, and the epithesis was worn throughout waking hours. A single-stage approach combining Bonebridge implantation and auricular epithesis placement, supported by three-dimensional preoperative planning, appears to be a safe and effective option for simultaneous functional and aesthetic rehabilitation in pediatric patients with aural atresia.

Free paper 0064

SingWithMED-EL: An innovative method for the auditory and speech development of children with CI, created by Svetlana Burnos

Modern cochlear implants provide children with profound hearing loss access to sound and speech, yet achieving clear and expressive oral communication requires refined auditory skills. Children with CIs often face challenges in auditory attention, memory, slow speech processing – especially in noise – and in perceiving speech melody and controlling their own voice. The SingWithMED-EL project addresses these needs through a unique, music-based methodology that develops listening and speech skills via singing. This international initiative makes musical rehabilitation accessible globally through online distance learning.

The core of the project is a structured 14-week online course that combines live group sessions with guided independent practice. Lessons utilize original song materials to systematically develop auditory memory and attention, phonological awareness, intonation-rhythmic analysis of speech, articulation, speech breathing, and voice control. A key technical feature ensures that during group sessions, each child hears only the teacher's voice and their own, simulating the focused environment of an individual lesson. The course culminates in the collaborative creation of a professional music video, serving as both a motivational goal and a celebratory achievement.

Results demonstrate the method's effectiveness: over five hundred children with CIs from varied language backgrounds have successfully finished the program. Participants show marked improvement in sound perception, vocal flexibility, expressiveness, and smoother, more nuanced speech. Beyond technical progress, children gain confidence, experience joy in communication, and engage in meaningful creative expression. The resulting music videos inspire other families and visibly showcase the children's capabilities.

In conclusion, SingWithMED-EL represents a modern, effective solution for the distance rehabilitation of children with CI. By integrating music and singing, it not only advances auditory and speech development but also fosters confidence, creativity, and an overall improved quality of life, paving the way toward richer communication with the world.

Free paper 0021

Solutions to improve hearing in children in remote areas

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In developing countries, nearly 70% of deaf children are born in low-income families with family marriages and genetic talents. Some of them come late to the cochlear implant center and have difficulty in rehabilitation. There are various solutions to help these children, including: 1-raising awareness among families, 2-speeding up newborn hearing screening, 3-providing free or low-cost prostheses, 4-remote hearing rehabilitation, 5-financing from companies that sell prostheses, 6- financing from Charities or insurances.

Free paper 0100

Sound localization performance in individuals with bilateral cochlear implants: Clinical implications and subjective outcomes

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Introduction: Sound localization is essential for everyday orientation and communication. In individuals with bilateral cochlear implants (biCI), sound localization abilities frequently remain compromised despite substantial technological progress, largely because current CI systems still provide only limited transmission of interaural time and level differences (ITDs, ILDs). The present study systematically examines the sound localization performance of biCI users using the extended "Kindertisch- Test" (ERKI) and investigates its association with duration of bilateral CI experience and subjective self-assessment.

Material and methods: Sound localization performance was assessed using the ERKI with a bisyllabic speech stimulus ("Halo"). The instruction phase consisted of 13 stimuli with a 15° angular resolution, followed by the main measurement with 73 stimuli at a 5° resolution. Subjective localization ability was evaluated using a questionnaire. Additionally, Ear-specific speech recognition was measured using the Freiburg Monosyllabic Test (FBE) at 65 dB SPL.

Results: A total of 20 biCI users (♀ = 14, ♂ = 6; mean age = 45.60 years, SD = 19.74) were included. FBE scores were similar between the right (M = 71.25%, SD = 15.97) and left ear (M = 70.50%, SD = 23.67). Average localization performance (percentage of stimuli within the functional reference range) was 42.10% (SD = 12.01), substantially below reference data from normal-hearing individuals (M = 84.00%, SD = 13.90). No significant association was observed between sound localization performance and duration of CI use (p = 0.959; M = 8.38 years, SD = 5.82). Likewise, no significant correlation was found between sound localization performance and subjective self-assessment (p = 0.973; M = 56.13%, SD = 15.74).

Conclusions: The findings demonstrate substantial limitations in sound localization abilities among biCI users. Furthermore, neither duration of implantation nor subjective self-assessment is associated with the objective performance. Clinically, the ERKI, may serve as a valuable tool to (1) provide patients with objective feedback that may recalibrate overly pessimistic self-assessments and (2) identify potential interaural asymmetries that may need targeted clinical intervention.

Free paper 0028

Spatial relationship between electrode positioning and lateral wall proximity: Implications for ECAP

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Introduction: Precise electrode positioning helps achieve optimal cochlear implant outcomes. However, the relationship between electrode-to-lateral wall distance and neural response still requires further investigation.

Objectives: This study aimed to determine whether electrode proximity to the lateral wall influences electrically evoked compound action potential (ECAP).

Material and methods: A retrospective cohort of 44 ears implanted with lateral wall electrodes was analyzed. High-resolution computed tomography scans were processed using OTOPLAN to measure electrode-to-lateral wall distances. ECAPs were recorded postoperatively. The correlations between distance and ECAPs were studied at the overall, channel-specific, and regional levels.

Results: Electrode distances ranged from 1.91 to 3.61 mm, while ECAPs ranged from 9.93 to 16.98 μV. A significant positive correlation was observed across all 174 electrode–ear pairs (r = +0.58, p < 0.001), indicating that greater electrode-to-lateral wall distance is associated with higher ECAP thresholds. Channel-level analysis demonstrated a stronger relationship (r = +0.76, p = 0.004), while individual ear correlations averaged r = +0.41. Regional analysis identified the middle cochlear region as a primary contributor to this association (r = +0.34).

Conclusions: Bigger electrode-to-lateral wall distances were associated with higher ECAP thresholds, with the middle cochlear region showing the strongest relationship. These findings highlight the impact of spatial positioning on neural responsiveness, suggesting that additional factors, such as the cochlear region, neural survival, insertion characteristics, and stimulation dynamics, also contribute to ECAP variability. Despite differences in patient anatomy, electrode arrays showed consistent positioning across cochlear regions, supporting the stability of lateral wall placement and its importance in achieving efficient neural activation.

Free paper 0386

Speech-in-noise performance in adult cochlear implant users and normal-hearing listeners: a comparison of the HeBio and Matrix Sentence Tests

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Introduction: Advances in cochlear implant (CI) technology have improved speech perception, increasing the need for sensitive speech-in-noise measures that reflect real-world listening, capture performance differences, and avoid ceiling effects. Sentence tests differ in semantic predictability, and competing noise ranges from energetic to informational masking, both affecting speech-in-noise sensitivity. This study aimed to evaluate speech-in-noise performance in adult CI users across different sentence tests and noise conditions, and to compare their performance with that of normal-hearing (NH) listeners.

Material and methods: 40 adult CI users (age range 19–77, $M = 52$) and 69 NH adults (age range 20–80, $M = 46$) participated in the study. All participants completed two sentence-in-noise tests: a semantically meaningful sentence test (HeBio) that reflects real-life listening conditions, and a semantically unpredictable sentence test with identical syntactic structure (Matrix). Each test was administered under two competing noise conditions: speech-shaped noise and four-talker babble noise. Adaptive procedure was used to estimate the signal-to-noise ratio required for 50% word recognition (SNR50).

Results: Significant main effects were found for group, test type, and noise condition. CI users demonstrated higher SNR50 thresholds than NH listeners across all conditions, with a mean difference of ~13 dB, which was comparable across sentence types. Across groups, SNR50 thresholds were significantly lower for the Matrix test than for the HeBio test, and lower in speech-shaped noise than in four-talker babble noise. Noise type significantly affected performance in both groups, with a larger effect in NH listeners. Noise-related differences were more pronounced for HeBio sentences in NH listeners, whereas CI users showed no significant noise-related difference in HeBio sentences. In CI users, age was not significantly associated with speech-in-noise performance.

Conclusions: Adult CI users require more favorable signal-to-noise ratios than NH listeners to achieve comparable speech understanding in noise. HeBio sentences, particularly in four-talker babble, impose greater listening demands than Matrix sentences and speech-shaped noise, providing a sensitive, clinically feasible tool that captures performance differences without ceiling effects. These findings support the inclusion of HeBio sentences in clinical evaluation to guide counseling, follow-up, rehabilitation planning, and outcome assessment under listening conditions that better reflect everyday communication.

Free paper 0135

Stability, survival and long-term outcomes of 3 mm bone-anchored hearing implants: Combined clinical and preclinical evidence

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Introduction: Evidence of the stability and clinical performance of 3 mm bone-anchored hearing implants remains limited. This report presents findings from two complementary studies (i) a preclinical study evaluating the influence of implant length, bone density and peri-implant bone defects on implant stability and (ii) a clinical study comparing the long-term outcome and survival of 3 mm versus 4 mm implants in adult patients.

Material and methods: *Preclinical study:* Ponto BHX (3 and 4 mm, Oticon Medical) were placed into polyurethane foam blocks of varying densities, fully seated and in osteotomies with unilateral and circumferential peri-implant bone defects of different sizes. Stability was measured using maximum insertion torque, ISQ, ASIST, and pullout force. *Clinical study:* A retrospective, single-centre study involved a review of electronic medical records of 234 adults and 240 implants; 4 mm ($n = 120$) and 3 mm ($n = 120$) implants, all wide-diameter of 4.5 mm were included. Longterm outcomes such as implant survival, time to sound processor loading, and post-operative complication rates were compared between implant lengths.

Results: *Preclinical study:* Increased bone density enhanced stability and insertion torque for both implant lengths whereas greater bone defect severity reduced implant stability. Irrespective of bone density, the 3 mm implant had equal or better stability and insertion torque than the 4 mm implant. *Clinical study:* At 3 months, 238 of 240 implants (99%) remained in situ. At the final follow-up (after a mean observation period of 43 ± 40 months) 232 implants (97%) were still in place. Implant losses occurred due to trauma, spontaneous failures, or elective removal. Survival rates or reasons for implant loss did not differ significantly between implant lengths.

Conclusions: Both 3 mm and 4 mm BAHS implants offered comparable long-term survival in an adult population. Preclinical data confirm mechanical stability of 3 mm implants, supporting their safe and reliable use beyond traditional indications and enabling greater flexibility in clinical practice.

Free paper 0217

State of the art of cochlear implants in adults: A review of technological evolution

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Introduction: Cochlear implants (CIs) represent one of the most relevant technological interventions for the treatment of severe to profound sensorineural hearing loss in adults, as they are capable of restoring auditory perception through direct electrical stimulation of the auditory nerve. From the first single-channel devices to modern multichannel systems, CI technology has evolved continuously, with improvements in electrode design, sound-processing strategies, external interfaces, and the potential for digital integration with mobile applications and artificial intelligence. This study aimed to examine how technological innovations in the field of cochlear implants contribute to improved auditory performance as well as enhanced quality of life for users.

Material and methods: This systematic review explored scientific literature published over the past two decades on the technological evolution of cochlear implants in adults. Sources included retrospective clinical studies, systematic reviews, and reports of advances in cochlear implant hardware and software. The analysis focused on progress in the technical characteristics of devices, speech perception outcomes, and functional experiences reported by adult users. The review was based on indexed scientific databases and peer-reviewed literature, with inclusion criteria limited to studies that explicitly addressed CI technology and outcomes in adults.

Results: The findings indicate that technological updates in cochlear implants over time are associated with significant improvements in speech perception in both quiet and noisy environments, particularly with the development of electrodes with a higher number of channels and advanced sound-coding strategies. Studies show that adults implanted in more recent technological eras demonstrate better auditory performance outcomes compared with groups implanted during earlier phases of CI technology. In addition, the use of digital support tools and connectivity with smart devices has strengthened monitoring and post-implantation auditory rehabilitation.

Conclusions: The technological evolution of cochlear implants in adults has driven significant clinical and functional gains, reflected in improved speech perception and quality of life. Current trends point toward increasingly digitally integrated devices with more sophisticated signal processing, a key factor for the next generation of implants. Future studies should continue to compare outcomes across different generations of technology to clarify the impact of these innovations on specific subpopulations of adults with hearing loss.

Free paper 0574

Stimulation thresholds and spread of excitation in cochlear implant users: Insights from ECAP measurements

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Background: Cochlear implants (CIs) restore hearing by electrically stimulating the auditory nerve. Two critical parameters affecting auditory perception are the stimulation threshold – the minimum current required to elicit a perceptible sound – and the spread of excitation (SOE) – the extent of neural activation around each electrode. Understanding these parameters is essential for optimizing device programming and improving speech perception outcomes.

Objective: To evaluate stimulation thresholds and the spread of excitation across electrodes in post-lingually deafened CI recipients using Electrically Evoked Compound Action Potential (ECAP) measurements. Methods: A cohort of CI users underwent post-operative ECAP testing. Thresholds (T-levels) were recorded for each electrode, and SOE was assessed using the forward-masking paradigm. ECAP amplitudes were plotted against masker electrode positions to determine the width and symmetry of neural activation. Comparisons were made between normal neural responses, focused stimulation modes, and sites with reduced neural survival.

Results: Stimulation thresholds varied across electrodes and participants, reflecting individual cochlear anatomy and neural survival. Narrow SOE curves indicated focused excitation and were associated with electrodes near the modiolus, whereas broader curves suggested overlapping activation and potential reduction in frequency resolution. Focused stimulation modes reduced spread and improved selectivity in electrodes with otherwise wide excitation patterns. Electrodes with low ECAP amplitudes or absent responses were identified for potential deactivation.

Conclusions: ECAP-based evaluation of stimulation thresholds and SOE provides objective insights into the spatial selectivity and neural responsiveness of cochlear implant electrodes. These findings can guide electrode-specific mapping strategies, optimize speech perception, and improve overall CI outcomes.

Free paper 0655

Stream segregation in cochlear implant listeners

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When listening to a sequence of tones which alternate between low (L) and high (H) frequency, those with typical hearing (TH), are more likely to perceive the two subsets as segregated perceptual streams when: (1) the frequency

separation (ΔF) between L and H is increased and (2) the inter-stimulus interval (ISI) between tones is decreased. Although cochlear implant (CI) listeners hear greater segregation as ΔF is increased, there is currently no evidence that ISI affects segregation judgments.

We asked 12 CI listeners to detect a temporal delay imposed on the H tone of LHL triplet. Performance was measured in an adaptive procedure where the size of the delay was adjusted – as stream segregation should make the task more difficult, so thresholds were expected to rise as ΔF increased. We also measured performance when the LHL triplet was preceded by a precursor sequence of five L tones. Previous TH studies have shown that such a precursor should further promote the segregation of the H tone, but only when there is an ΔF between subsets. The experiment tested three ΔFs (H frequencies corresponding to +0, +3, or +5 electrodes from L) and three presentation rates (ISIs of 50, 100, or 200 ms).

CI listeners performed more poorly than TH at the shortest ISI, where ceiling effects obscured stream segregation effects. However, CI listeners demonstrated clear stream segregation effects when the ISI was 100 ms, and these effects diminished when the ISI was increased to 200 ms. These findings suggest CI listeners may experience stream segregation at slower presentation rates than TH. We speculate that this may reflect increased neural adaptation from CI stimulation.

From results at 100 ms ISI, we quantified individual stream segregation effects by calculating a ratio between thresholds in the presence or absence of the precursor. This ratio shows a strong negative correlation with speech-on-speech segregation – those who showed a greater effect of stream segregation on delay detection thresholds achieved lower signal-to-noise ratios (SNRs) when following a target speaker in the presence of a co-occurring irrelevant speaker (measured using a version of the coordinate response measure task).

Free paper 0485

Study protocol on how technology, social factors, and perceived disability level influence functioning after cochlear implantation in children with congenital deafness

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Introduction: Cochlear implantation (CI) has become the primary intervention for children with severe-to-profound congenital hearing loss, offering substantial improvements in auditory perception and communication. However, despite technological advances and earlier implantation, outcomes remain highly variable: some children achieve near-normal language and social functioning, while others continue to face significant challenges. This variability underscores the need for a comprehensive, multidisciplinary perspective that integrates medical, technological, social, and personal factors.

Material and methods: The project investigates how technology (CIs), social factors (family support, school integration, peer relationships), and perceived disability (both by the child and their environment) influence activity and social participation. The research adopts a 360-degree methodology, collecting data through in-depth individual interviews, focus groups, and computer-assisted web interviews (CAWI) with implanted children, their parents, siblings, teachers, and schoolmates. A mixed-methods design is used, combining quantitative surveys and qualitative approaches (targeting children aged 7–18, bilaterally implanted, using at least one implant for a minimum of five years, with no additional disorders or disabilities), with data analyzed using both classical and AI-supported techniques.

Results: Findings will inform the development of practical recommendations for families, schools, and public institutions, supporting the full inclusion of children with CIs in social, educational, and cultural life.

Conclusions: By integrating expertise from medicine, audiology, biomedical engineering, and sociology, this research advances interdisciplinary understanding and supports the creation of individualized, needs-based rehabilitation strategies.

Free paper 0408

Sudden changes in impedance in patients with CI

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Introduction: This study examines sudden impedance fluctuations in patients with cochlear implants (CI) implanted at Motol University Hospital, the largest implantation center in the Czech Republic, between 2018 and 2025, from three manufacturers: Advanced Bionics, Cochlear, and MED-EL. Cochlear implantation is an effective hearing rehabilitation in patients with moderate to severe hearing loss. Upon initial activation, impedances are measured to reflect the stable function of the implant, confirm the integrity of the electrode contacts, including short circuits or interruptions, and provide information about the local environment. Sudden changes, irregular or across the entire spectrum, may indicate problems with individual electrodes or changes in cochlea status. These fluctuations can affect listening quality or be associated with balance disorders. Values exceeding an average of 7–8 kΩ are considered elevated impedances, and in severe cases up to 10–12 kΩ. Impedances are therefore an important indicator for fitting technicians and physicians.

Material and methods: During the monitored period, the proportion of adult patients with impedance fluctuations was 2.2% (54.5% women and 45.5% men). There is currently no clear standardized procedure for preventing increased impedance. In most cases, a similar procedure is used, patients are given corticosteroids (usually for 10 days) and the processor adjustments, most often by increasing the pulse width. Followed by a control measurement; if the values are normal, the adjustment interval is extended.

Results: All patients experienced clinically apparent fluctuations. Symptoms included hearing deterioration with vertigo (6 patients), pressure under the implant (1), headaches (2), and migraine attacks (1); only one patient reported no subjective difficulties. In severe cases, temporary or permanent electrode deactivation was necessary. Impedance increases usually affected the entire array; rarely, they were localized to basal or apical regions. Clear categorization was not possible.

Conclusions: Impedance fluctuations in cochlear implants are insufficiently described in the literature, and available clinical evidence is limited. Nevertheless, this is an important clinical phenomenon that can influence hearing rehabilitation and have an impact on further clinical decision-making, including bilateral implantation.

Free paper 0604

Summary of 10 years of the Stimulation of Polymodal Sensory Perception by Skarzynski (SPPS-S®) based on the results of over 4 thousand patients

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Introduction: In 2014, the Skarzynski Method of Polymodal Sensory Perception Stimulation (SPPS-S®) was introduced to the market. It is a form of auditory stimulation applied in various groups of disorders that coexist with central auditory processing disorders. The solutions used in SPPS-S® offer a multifaceted therapy by simultaneously engaging different senses (hearing, vision, and touch), their integration, and coordination, combined with psychological training. Patients can undergo SPPS-S® therapy either at a rehabilitation center (in person) or at home (remotely). The device used for therapy is the only one on the Polish market that has a medical device conformity certificate, and this solution has been awarded and recognized with numerous accolades both in Poland and abroad.

Objective: The aim of this work is to present the method of Polymodal Sensory Perception Stimulation by Skarzynski (SPPS-S®) and the results of patients who, over the course of 10 years since the method's introduction to the Polish market, have utilized this rehabilitation method.

Material and methods: The analysis is based on the results of 4 372 patients who have undergone SPPS-S® therapy since 2014.

Results: The patients' results confirm a statistically significant effect of the therapy in all analyzed tests assessing central auditory processing.

Conclusions: Based on the analysis of the patients' results, it has been demonstrated that SPPS-S® therapy is an effective form of treatment for patients with central auditory processing disorders. The method's principles, which utilize cutting-edge telemedicine solutions and medical device conformity certification, ensure high safety in its application.

Free paper 0481

Surgical and anatomical challenges during auditory brainstem implantation: A 10-year experience

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Introduction: The auditory brainstem implant (ABI) is a neuroprosthetic for managing profound hearing loss in patients unsuitable for cochlear implantation due to anatomical constraints. Understanding intraoperative challenges is essential to improve surgical safety and outcomes.

Objective: To analyse intraoperative challenges during ABI surgery in 53 patients operated between 2014 and 2024.

Material and methods: A retrospective review of 53 consecutive ABI procedures was conducted. Intraoperative challenges were categorized into venous or dural bleeding, anatomical distortion, flocculus and choroid plexus variations, difficulty identifying the lateral recess and foramen of Luschka, cerebrospinal fluid (CSF)-related issues, and electrode placement feasibility.

Results: Seventeen procedures (32%) were completed without significant challenges. Venous and dural bleeding occurred in 13 cases (24.5%), involving large dural venous lakes, emissary veins, sigmoid sinuses, transverse sinuses and sinodural junctions, occasionally causing significant blood loss requiring hemostatic interventions. Floccular hypertrophy (Grades II–IV), obscuring the VII–VIII nerve complex and lateral recess was observed in 13 cases (24.5%). Hypertrophied and prolapsing choroid plexus necessitating coagulation to access the foramen of Luschka occurred in 12 cases (22.6%). Difficulty identifying the lateral recess or foramen of Luschka due to stenosis or anatomical distortion was seen in 10 cases (18.9%). Intraoperative EABR non-responsiveness contributed to electrode placement difficulty in 2 cases (3.8%). CSF-related complications including electrode instability and transient bradycardia from rapid CSF egress, were also noted in 2 cases (3.8%). ABI implantation was abandoned in 2 cases (3.8%) due to severe congenital distortion. Despite these challenges, the majority of surgeries were completed successfully with satisfactory outcomes.

Conclusions: ABI requires meticulous preoperative planning, precise microsurgical technique, and intraoperative adaptability. Anticipating anatomical and surgical challenges, maintaining flexible strategies and careful microsurgical execution are critical to optimizing outcomes in ABI candidates.

Free paper 0697

Systematic differences between CT and MRI T2-weighted cochlear measurements: Impact of imaging modality on preoperative planning and linear correction models

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Introduction: High-resolution computed tomography (CT) and magnetic resonance imaging (MRI) T2-weighted sequences are both accepted for preoperative cochlear measurements, yet visualize fundamentally different anatomical structures. CT captures the hyperdense bony lateral wall while MRI visualizes perilymphatic fluid at the organ of Corti level, creating an inherent anatomical offset of 0.5–1.0 mm. With increasing adoption of radiation-free MRI protocols in pediatric populations, quantifying systematic measurement differences and developing correction models is essential for integrating MRI data into CT-derived clinical frameworks.

Material and methods: Automated analysis using the Nautilus platform extracted four standardized cochlear measurements from 650 paired CT and MRI cases: A-value (basal diameter), B-value (basal width), H-value (cochlear height), and cochlear duct length (CDL). Bland-Altman analysis quantified systematic bias and 95% limits of agreement. Linear regression models were developed for cross-modality conversion. Manual validation was performed on 40 ears by expert raters.

Results: Correlation strength varied substantially across measurements: B-value demonstrated the strongest agreement ($r = 0.705$, $R^2 = 0.497$, MAE = 0.188 mm), while A-value showed moderate correlation ($r = 0.552$, $R^2 = 0.305$). Systematic offsets were largest for measurements dependent on clear bony boundary visualization: A-value showed CT systematically 0.738 mm larger than MRI (95% LoA: 0.01–1.46 mm), while CDL showed MRI 1.018 mm larger than CT (95% LoA: –2.34 to 0.31 mm). In contrast, B-value (–0.142 mm) and H-value (–0.118 mm) demonstrated excellent agreement with narrow limits. Linear regression models explained 25–50% of variance. Manual validation confirmed automated findings with comparable regression slopes.

Conclusions: Measurement-specific differences reflect anatomical visualization boundaries and CT's superior spatial resolution for cortical bone rather than measurement error. B-value demonstrates clinical equivalence between modalities, while A-value and CDL require linear correction models when cross-modality comparisons are necessary. Simple regression transformations enable integration of MRI measurements into CT-derived electrode selection algorithms with quantified uncertainty, supporting radiation-free pediatric imaging protocols while maintaining clinical decision-making accuracy.

Free paper 0222

Technology affinity, knowledge and expectations regarding the robotic CI: Assistance systems HEARO® and OTODRIVE®. A multicenter case-control study

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Introduction: Robotic cochlear implant (CI) – assistance systems offer potential advantages over conventional surgical procedures. Besides technical benefits, the acceptance and successful implementation of robotic cochlear implant surgery may be strongly influenced by patients' technology affinity, prior experiences with digital health technologies, and their motivation to adopt innovative surgical procedures. Building on the HEAROtechAffin project, which demonstrated high technology affinity and acceptance of the HEARO® system among patients, this study extends the evaluation across Europe and additionally investigates the OTODRIVE® system.

Material and methods: In this multicenter study, patients and surgeons from various European reference centers will be surveyed using structured questionnaires. Technology affinity, usability and user experience will be measured using the Affinity for Technology Interaction (ATI) Scale, the System Usability Scale (SUS), and the User Experience Questionnaire (UEQ). Supplementary items assess knowledge and expectations regarding the robotic systems HEARO® and OTODRIVE® compared with conventional CI surgery.

Results: It is anticipated that patients and surgeons with higher technology affinity will show greater acceptance of and more favorable evaluations of robotic CI assistance systems. Furthermore, the study aims to identify differences in process and care pathways between robotic and conventional CI procedures. Particularly concerning preoperative education, perioperative time and personnel planning, and postoperative follow-up.

Conclusions: This study will provide a comprehensive understanding of how robotic CI assistance systems are perceived by patients and surgeons. Based on these insights, targeted strategies can be developed to improve patient education, counseling, and acceptance. In the long term, the project shall support the establishment and further development of robotic assistance systems in CI care for patients with hearing loss.

Free paper 0684

Telemedicine-based preoperative assessment for humanitarian cochlear implant surgery

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Telemedicine may facilitate multidisciplinary cochlear implant (CI) candidate evaluation in settings where access to specialized otologic and audiologic care is limited. This study evaluated an online, multidisciplinary preoperative workflow for CI candidate selection and surgical planning during a high-volume humanitarian campaign supported by the King Salman Humanitarian Aid and Relief Centre (KSrelief). In this descriptive study, 142 children with severe-to-profound hearing loss underwent online review by a committee of otologists, audiologists, and speech-language pathologists, based on audiologic data, caregiver-submitted speech and communication videos, and high-resolution CT/MRI imaging. The primary outcome was the adequacy of online assessment for preoperative planning and case preparedness. Online assessments provided sufficient information for surgical planning in 95% of candidates. Cochlear implantation was completed over three consecutive operative days (30 cases on day 1, 66 on day 2, and 46 on day 3). Preoperative online imaging review enabled early recognition of anatomical complexity and supported efficient resource preparation (including electrode availability and surgical planning), facilitating successful implantation of all scheduled children. A small proportion of cases required intraoperative electrode plan adjustment. Postoperative radiography confirmed correct array placement in all but one case, and surgical complications were infrequent and manageable. A structured online multidisciplinary preoperative workflow can support efficient surgical planning and coordinated high-volume CI delivery in humanitarian settings.

Free paper 0718

The case of decompansated bilateral vestibular hypofunction at the patient after CI, traffic accident and meningitis

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Introduction: Bilateral vestibular hypofunction (VH) is characterized by a pronounced decrease in the function of the vestibular receptors of both labyrinths. Such patients suffer from impaired balance, which worsens in the dark or on a soft, uneven surface, and decreased clarity of vision when moving the head.

Objective: The purpose of our study is a 14-year-old child with severe instability and unsteadiness when walking after meningitis, caraccident and cochlear implantation.

Material and methods: The patient, born in 2010, complained of instability and pronounced swaying when walking. From the medical history, 6 months ago he suffered from bacterial meningitis – with severe headaches, persistent fever and coma for 1 week. After the disease, the child developed bilateral sensorineural deafness.A month after being discharged from the hospital, the boy gets into an accident. Only a year later the boy underwent a CI.

Results: The child came to the appointment with the support of his parents. General condition is satisfactory. Romberg's pose is unstable, the torso is deviated in different directions, Romberg's sensitized test is unstable, the Fukuda test is performed slowly, the torso is deviated in different directions. Spontaneous nystagmus – absent, Head Shaking Test – nystagmus absent. There is no pathological nystagmus on the Dix-Hallpike Test. V-HIT – THIEF subdued. LARP 0.20/0.23, RALP 0.23/0.12, lateral channels 0.16/0.26. Severe bilateral hypofunction of the vestibular apparatus. Halmagi test – corrective saccade to the right and left.

Conclusions: These three undesirable pathogenetic factors caused severe bilateral hypofunction in this patient, which is difficult to compensate. Due to the risk of cochlear ossification following meningitis, CI could not be postponed. A triple trigger in the pathogenesis of CH: meningitis, a traffic accident and the post-CI condition led to a condition in the patient that made it difficult even to ride a bicycle. The patient has to undergo not only a course of auditory-speech, but also full-fledged vestibular rehabilitation.

Free paper 0695

The clinical and personal case for Anatomy-Based Fitting (ABF) in cochlear implantation

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Introduction: For decades, the clinical gold standard for cochlear implantation (CI) rehabilitation has relied heavily on 'neural plasticity', the brains ability to resolve the perceptual gap between mismatched electrical stimulation and biological tonotopic maps. This is true and it works. However, this paper questions when precision is possible through ABF why is this not confirmed as the 'new standard'. We examine the shift from a 'plasticity' model to a 'precision' model through the unique dual lens of an audiologist who transitioned from hearing aids into a bimodal CI user. Clinician to patient crossover provided a unique clinical trial environment ($n = 1$). During switch-on, the CI was programmed with FS4 coding startegy using a conventional mapping method. This map was experienced for 30minutes before subsequently being adjusted using ABF information. By utilizing post-operative imaging and specialized software (OTOPLAN), the exact physical coordinates of the FLEX28 electrode array were identified relative to the patients unique cochlear duct length. The map was then realigned to match the actual anatomical resting place of each electrode contact. Transition from conventional map to ABF map resulted in an instantaneous qualitative shift in sound perception. The mechanical and tinny sound strongly present in the original map was replaced by natural resonance and a richer soundscape. Most notable was the immediate reduction of 'load' and effort required, it was almost relief in hearing. This suggests when the frequency-place map respects individual anatomy the brain is liberated from the 'heavy lifting' of realignment leading to faster route to adaptation and a higher ceiling for sound quality.

Conclusions: External hardware and features of the processors are transient, the electrode to nerve interface us lifelong and therefore key when choosing from current device options. ABF represents a revolution in the CI field by honoring both the surgical craft and the patients neurological resources. By choosing 'exact' anatomical alignment clinicians can provide a more seamless transition from surgery to switch on. This paper argues that for new CI recipients especially, ABF should no longer be considered an elective refinement, but as a clinical necessity for optimising patient outcomes and long term satisfaction.

Free paper 0656

The clinical effect of steroid therapy on preserving residual hearing after cochlear implantation with the Advanced Bionics HiRes Ultra 3D cochlear implant system

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Objective: The main aim of this study was to assess the clinical effectiveness of two different schemes of administration of steroids (1) dexamethasone administered intravenously in comparison with (2) combination of steroid treatments: orally administered prednisone and intravenously administered dexamethasone) in comparison with a control group (no steroid administration) on hearing preservation (HP) in patients who underwent an Advanced Bionics cochlear implantation.

Material and methods: Thirty-five adult patients met the inclusion criteria. All patients were randomly divided into three subgroups depending on the scheme of steroid administration: (1) the first subgroup with only intravenously administered dexamethasone (0.1 mg per kg body weight twice a day for three days), (2) the second subgroup with a combination of methods of administration of steroids (intravenous and oral steroid therapy (dexamethasone, 0.1 mg/kg body weight twice a day plus prednisone, 1 mg/kg weight once

a day for three days before surgery and after administration of dexamethasone – 4th, 5th, 6th day – and after this time the dose of prednisone was reduced)) and (3) the third subgroup without steroid therapy (control group). The results were measured by pure tone audiometry (PTA) in three periods: (1) before implantation, (2) during activation of the processor (one month after implantation), and (3) 12 months after activation. Patients' hearing thresholds before implantation were on average 82 dB HL, 77 dB HL, and 88 dB HL, respectively.

Results: The majority of the patients from the first subgroup had hearing preserved partially (77.8%). A similar result was observed in the second study group (oral + i.v.) (partial hearing preservation was found in 61.5% of the participants). The opposite was true in the control group; a plurality of control patients (38.5%) had no measurable hearing 12 months after the activation of the processor.

Conclusions: Pharmacological treatment consisting of the administration of steroids in patients who had undergone cochlear implantation with the Advanced Bionics HiRes Ultra 3D cochlear implant system may be beneficial for preserving residual hearing in patients.

Free paper 0658

The clinical effects of steroids therapy in the preserving residual hearing after cochlear implantation with the OTICON Neuro Zti EVO

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Introduction: A prospective clinical study was conducted to investigate whether two different pharmacotherapy strategies of steroid administration impact hearing preservation in adult patients who underwent cochlear implantation with the Oticon Medical Neuro cochlear implant system.

Material and methods: Twenty nine adult participants were included. Pure tone audiometry was performed before implantation, during processor activation and 12 months after activation. There were three treatment groups: (1) intravenous steroid therapy (standard steroid therapy with dexamethasone administrated intravenously at the dose 0.1 mg/kg body mass twice a day); (2) combined oral and intravenous steroid therapy (extended steroid therapy with dexamethasone administrated intravenously at the dose 0.1 mg/kg b.m. twice a day and prednisone (orally) at the dose 1 mg/kg body mass/24 h), and (3) no steroid therapy (a control group). Patients' hearing thresholds before implantation were on average 103 dB HL, 89 dB HL, and 93 dB HL, respectively.

Results: Deterioration of hearing thresholds was observed in all three patients' groups. Twelve months after surgery, the patients with and without steroid therapy had similar hearing thresholds.

Conclusions: The steroid regimen used in this study did not play a significant role in patients with non-functional residual hearing, who underwent cochlear implantation with the Oticon Medical Neuro cochlear implant system.

Free paper 0424

The effect of changing stimulation pulse shape from biphasic to triphasic on speech perception in adult cochlear implant users without facial nerve stimulation

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Introduction: Stimulation pulse shape is an important parameter in cochlear implants (CIs) and may affect loudness perception, comfort levels, and speech understanding. Triphasic pulse stimulation is used clinically primarily as a strategy to reduce facial nerve stimulation (FNS). However, data on its perceptual effects and auditory outcomes in CI users without FNS remain limited.

Objective: To evaluate the effect of changing the stimulation pulse shape from biphasic to triphasic on subjective loudness perception, most comfortable level (MCL), and speech perception outcomes in adult CI users without FNS.

Material and methods: Eighteen adult CI users without FNS were enrolled (10 females, 8 males; mean age: 53 years). For each participant, loudness scaling was performed separately for each active electrode to determine MCL under two stimulation conditions: biphasic and triphasic pulse shapes. Based on the obtained data, two clinical maps were created corresponding to each stimulation mode. Participants were subsequently asked to report their subjective overall loudness perception for both maps. Speech perception was assessed using a monosyllabic word test in quiet (presentation level 65 dB SPL) and in noise (SNR +10 dB) for both maps.

Results: Subjective loudness perception was comparable between both maps (mean rating: biphasic stimulation = 26.9; triphasic stimulation = 27.2). The mean MCL was 20.7 [qu] for biphasic stimulation and 25.9 [qu] for triphasic stimulation. Speech perception outcomes were highly similar in both conditions. In quiet, the mean word recognition score was

75.6% for biphasic stimulation and 77.9% for triphasic stimulation. In noise (SNR +10 dB), the mean score was 57.5% for biphasic stimulation and 55.6% for triphasic stimulation, with no clinically meaningful differences between the two maps.

Conclusions: In adult CI users without FNS, implementation of triphasic stimulation following appropriate map fitting does not result in significant changes in subjective loudness perception and provides comparable speech perception performance in quiet and in noise relative to biphasic stimulation. These findings support the feasibility of applying triphasic stimulation without compromising auditory outcomes also in patients without FNS.

Free paper 0116

The effect of choral singing training on speech perception in noise: A study on a group of deaf hearing aid and/or cochlear implant patients

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Introduction: It is a fact that deaf patients with conventional hearing aids and/or cochlear implants perform well overall when it comes to understanding speech in quiet. This is not the case for speech comprehension in noise and music appreciation and perception. This study, in patients with hearing loss, evaluates the effectiveness of group choral singing training on speech comprehension in noise. It also explores their singing voice with and without a hearing aid.

Material and methods: Six one-and-a-half-hour sessions of choral singing training were offered to an experimental group of six subjects with conventional hearing aids and/or cochlear implants. Two control groups, deaf and normal-hearing, were recruited to objectivize results (music perception, speech comprehension in noise) between pre- and post-test.

Results: No significant difference ($p > 0.05$) was found between the experimental group and the deaf control group between pre- and post-test. Qualitatively, however, participants in the experimental group reported a positive change in their musical habits and a positive effect of group training.

Conclusions: Although this study does not allow us to conclude on the effectiveness of a choral singing intervention in the sample studied, qualitative contributions in terms of self-confidence and perception of sounds and voices are reported. Some participants showed a positive evolution in their musical habits. This research also explored the singing voice of patients with hearing loss, and highlighted qualitative improvements in their singing. Musical interventions with the deaf population look promising as a pleasant way of targeting one of their central difficulties.

Free paper 0348

The effect of cochlear implantation on patients with schizophrenia accompanied by severe hearing loss and auditory hallucinations: A three-case report

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Introduction: The use of cochlear implants for patients with schizophrenia accompanied by severe hearing loss and auditory hallucinations has not been widely reported. This study analyzed the impact on speech perception and hallucinations in three patients from Kobe University Hospital who received cochlear implants.

Case reports: *Case 1:* A 32-year-old male with a hereditary hearing loss caused by an ATCG mutation and diagnosed with schizophrenia at age 22 experienced progressive hearing loss. Despite using hearing aids, his condition worsened. After receiving a cochlear implant in his right ear, his speech perception improved significantly, and his Auditory Hallucination Handicap Inventory (AHHI) score dropped from 54 to 0. His progress was notable, and his schizophrenia symptoms were stable enough to be manageable and allow him to work. *Case 2:* A 62-year-old male with a right vestibular schwannoma and left hearing loss of unknown etiology who was diagnosed with schizophrenia at age 21. He experienced progressive bilateral hearing loss, which resulted in deafness following tumor resection. A left cochlear implant notably improved his speech perception, also reducing hallucinations. His AhHI score reached 0, though hallucinations persisted without aids. *Case 3:* A 78-year-old male with bilateral cochlear otosclerosis experienced progressive hearing loss beginning at age 21, ultimately ceasing the use of hearing aids by age 68. He was diagnosed with schizophrenia later in life and experienced untreated verbal hallucinations. After receiving a right cochlear implant, his speech perception improved slightly, but his AhHI score remained nearly unchanged due to long-term schizophrenia, possible cognitive decline, and the duration of his hearing loss.

Results: In cases 1 and 2, cochlear implantation improved speech perception and reduced hallucinations. These improvements were attributed to adequate primary sensory input and stable schizophrenia symptoms, which enabled social engagement. Case 3 experienced fewer benefits, likely due to prolonged untreated hallucinations and cognitive decline.

Conclusions: Overall, early intervention and stable management of schizophrenia symptoms that allow for social participation are critical. Cochlear implantation may offer potential benefits for individuals with schizophrenia accompanied by severe hearing loss by providing auditory input and mitigating auditory hallucinations, without worsening psychiatric symptoms.

Free paper 0319

The effects of noise, reverberation and cochlear implant speech processing on digits-in-noise recognition

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Introduction: Cochlear implant (CI) users often achieve good speech recognition in quiet, but experience substantial difficulties in everyday listening situations involving background noise and reverberation. While the effects of noise on speech recognition in CI users have been studied extensively, less is known about the effects of reverberation. In the present study, we investigated the individual and combined effects of noise and reverberation on speech recognition.

Material and methods: Speech recognition thresholds (SRTs) for the digits-in-noise (DIN) test were measured in 24 normal-hearing listeners in four conditions: (1) noise only, (2) reverberation only, (3) noise and reverberation adjusted to yield an equal effect, and (4) reverberation with a fixed reverberation time (T60) of 1 s combined with varying noise levels. All conditions were presented in three formats: unprocessed, low-pass filtered, and vocoded (CI speech processing).

Results and Conclusions: The effects of noise and reverberation on DIN test results were well described by a modified version of the Speech Transmission Index (STI). Reverberation has a large detrimental effect on speech recognition. For CI users with poor DIN SRTs, even modest amounts of reverberation severely reduce speech recognition.

Free paper 0525

The first unified behavioral and CAEP platform for automated diagnosis and personalized therapy of central auditory processing disorder

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Introduction: Central Auditory Processing Disorder (CAPD) diagnosis remains challenging due to the complexity of the auditory pathway. This project, titled "System Supporting the Diagnosis and Therapy of Auditory Processing Disorder using EEG Technology and Artificial Intelligence Methods," is conducted by Center of Hearing and Speech Ltd under a grant agreement with the Polish Agency for Enterprise Development (PARP), funded by the European Funds for a Modern Economy (FENG) program. The project aims to develop an advanced, platform for automated assessment and personalized rehabilitation of CAPD using both behavioural tests and Cortical Auditory Evoked Potentials (CAEP).

Material and methods: The platform allows to integrate the results of CAEP acquisition, clinical CAPD evaluation, and self-report auditory processing questionnaires. CAEP will be acquired using both active and passive versions of the oddball paradigm, and a dichotic auditory stimulation paradigm. These protocols are designed to capture key CAEPs associated with central auditory processing, specifically the N1 and P2 Mismatch Negativity (MMN), and the P3. Using the ANT Neuro system, the research plan involves optimizing EEG parameters and implementing advanced signal processing for automated component extraction and AI-driven analysis.

Results: Preliminary milestones include the successful development of a diagnostic workstation. The resulting platform fully automates the processing of acoustically stimulated potentials, providing precise metrics of cortical activity. By synthesizing electrophysiological data with behavioral tests, the system generates comprehensive patient profiles and diagnostic decisions. Furthermore, it enables the creation of personalized therapy programs.

Conclusions: This integrated platform shifts the paradigm of auditory care from manual interpretation to an objective, data-driven approach. By automating the link between diagnosis and therapy, the tool reduces human error and enhances care for patients with communication difficulties. Pilot results suggest that a platform integrating CAEP analysis, AI, and behavioral data is a promising tool for enhancing CAPD diagnostics.

Free paper 0483

The Hearing Aid Effect in the 2020s: Where do we stand?

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Introduction: The 'hearing aid effect' is a negative perception toward individuals using hearing assistive devices (HADs), which is a primary reason for parents and children refusing to use them. We aimed to determine the current perception toward individuals using HADs and the associated factors.

Material and methods: A 30-item photo-based survey was conducted to analyze the participants' perception toward individuals using HADs as compared to healthy (H) individuals and individuals with disabilities (D). The survey was validated with an intrarater reliability of 86%. A cross-sectional study was conducted by approaching individuals who visited one of the largest shopping centers in a metropolitan city to participate in the survey. Demographic information, including age, gender, and educational background, was collected.

Results: A total of 517 participants completed the survey. Nearly two-thirds of the participants (59.7%) did not consider individuals using HADs as those who needed assistance as compared to H individuals. Interestingly, Generation X and Z participants had a significantly better perception toward individuals using HADs (63.1% and 59%, respectively) as compared to participants of the Baby Boomers generation (54.3%). The majority of participants who considered HD use a handicap compared to healthy individuals (79.9%) did not have a family member that used a HAD.

Conclusions: The stigma of wearing a HAD is significantly reducing with time, and the younger generations are not considering it as a disability. This is an important point that can be highlighted while counseling parents and young adults who are candidates for HAD use.

Free paper 0367

The impact of auditory deprivation and cortical reorganization on speech perception after cochlear implantation in adults with prelingually unilateral and bilateral deafness

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Introduction: Auditory duration of deprivation is a key factor influencing speech perception outcomes after cochlear implantation (CI). Prolonged deprivation has been linked to cortical reorganization that may influence postoperative rehabilitation. However, the magnitude of this effect and whether outcomes decline gradually or demonstrate a threshold effect remain unclear. This is particularly true for prelingually both bilateral and single-sided deafened patients, for whom data on late cochlear implantation outcomes remain limited. Understanding the clinical impact of deprivation duration on speech perception remains essential for patient counseling and outcome prediction.

Objective: This ongoing study investigates speech perception outcomes after cochlear implantation in two patient groups: (1) patients with prelingually single-sided deafness (SSD) and (2) adults with prelingually bilateral deafness implanted late. The study aims to examine cochlear-implanted patients and their relationship to duration of deprivation with particular interest for patients with prelingual bilateral deafness and prelingual single-sided deafness who receive cochlear implants in adulthood, populations for whom outcome data remain limited.

Material and methods: Approximately 10 adults with prelingually single-sided deafness and additionally, a small cohort of patients with congenital bilateral deafness who underwent unilateral cochlear implantation later in life was investigated. Postoperative speech perception was assessed using standardized speech perception tests and analyzed in relation to duration of deprivation. Duration of deprivation will be analyzed as a continuous variable to assess whether outcomes decline gradually or demonstrate a threshold effect.

Results: Data collection and analysis are ongoing, and no definitive outcome patterns can yet be identified.

Conclusions: This study seeks to improve understanding of cochlear implant outcomes across different deprivation patterns. Comparative analysis of prelingual single-sided deafness and prelingual bilateral deafness may help clarify the role of cortical reorganization. These populations represent unique models for understanding the limits of cortical plasticity and the potential for auditory rehabilitation after prolonged or lifelong auditory deprivation.

Free paper 0310

The impact of auditory deprivation on the effectiveness of cochlear implants

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Introduction: Auditory deprivation, defined as prolonged lack of auditory stimulation, is a key factor influencing cochlear implant outcomes. Numerous studies indicate that both the duration and onset of auditory deprivation significantly affect central auditory system plasticity, speech perception, and overall benefits from implantation. This review aims to summarize the current knowledge on the impact of auditory deprivation on auditory performance in cochlear implant users.

Material and methods: A narrative literature review was conducted using databases including PubMed and Google Scholar. Peer-reviewed studies involving cochlear implant users with varying durations and onset of auditory deprivation were analyzed. Both pediatric and adult populations with prelingual and postlingual hearing loss were included. Studies assessing speech perception, neuroimaging and electrophysiological methods were considered. No publication date restrictions were applied.

Results: The literature consistently shows that shorter periods of auditory deprivation are associated with better speech perception, faster adaptation to cochlear implant stimulation, and higher overall auditory functioning. Prolonged auditory deprivation correlates with poorer speech understanding and limited implant benefits. Neurophysiological studies reveal cortical reorganization and cross-modal plasticity under conditions of extended auditory deprivation, which may constrain the processing of acoustic stimuli post-implantation. Early implantation, especially in children, is strongly linked to language development.

Conclusions: Current evidence confirms that auditory deprivation significantly impacts cochlear implant efficacy. Early auditory intervention and appropriate timing of implantation are critical for maximizing rehabilitative outcomes.

Understanding the mechanisms and consequences of auditory deprivation can inform clinical decision-making and support the development of individualized rehabilitation strategies for cochlear implant users.

Free paper 0700

The impact of extended ABR testing on the precision of hearing aid fitting in children

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Introduction: Auditory Brainstem Response (ABR) testing is an objective method used to diagnose hearing loss and to determine its type and degree, particularly in newborns and young children. The most commonly used stimulus in this test is the click stimulus, which is assumed to reflect hearing thresholds in the 2–4 kHz frequency range. However, ABR can also be performed using frequency-specific tone bursts (500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz) or a chirp stimulus.

Aim: Comparison of the initial fitting gain of hearing aids using the DSLv5 method between an audiogram reconstructed on the basis of ABR test results using a Click stimulus (or 2000 and 4000 Hz tones), and an audiogram reconstructed on the basis of 500, 1000, 2000 and 4000 Hz obtained in the ABR test. Reference of the described conditions to different technological levels of hearing aids.

Material and methods: The results of ABR tests of 30 paediatric patients who underwent ABR testing using 500, 1000, 2000, 4000 Hz tones and/or a Click stimulus were used for comparison. Next, fitting was simulated in the Oticon hearing aid software (GENIE 2 ver. 2025.2) based on two scenarios: using hearing thresholds obtained in ABR for a Click stimulus (alternatively for 2000 and 4000 Hz tones), and then using the hearing thresholds obtained in ABR for 500, 1000, 2000 and 4000 Hz tones. The simulation described above was repeated for three different technological levels of paediatric hearing aids to take into account the impact of the different number of processing channels in hearing aids.

Results: The number of frequencies assessed during ABR testing influenced the resulting amplification characteristics of the hearing aids. Additionally, the number of signal processing channels available in the hearing aids affected the amplification characteristics.

Conclusions: In cases of suspected hearing loss, it is recommended to extend ABR testing to include frequency-specific tone bursts at 500, 1000, 2000, and 4000 Hz in order to improve the accuracy of paediatric hearing aid fitting.

Free paper 0541

The impact of patient factors on objective cochlear implant verification using Acoustic Cortical Auditory-Evoked Potentials

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Introduction: The cochlear implant (CI) is an advanced auditory prosthesis designed to provide access to sound by directly stimulating the auditory nerve, bypassing damaged structures in the cochlea. CIs are the standard-of-care intervention for individuals with severe-to-profound sensorineural hearing loss who exhibit limited speech perception abilities and derive insufficient benefit from hearing aids. However, variability in outcomes remains high among CI users. Our previous research demonstrated that the existing subjective methodology of CI programming does not consistently produce optimal stimulation for speech perception, thereby limiting the potential for CI users to derive the maximum device benefit to achieve their peak potential. We demonstrated the benefit of utilising the objective method of measuring auditory-evoked cortical responses to speech stimuli as a reliable tool to guide and verify CI programming and, in turn, significantly improve speech perception performance.

Objectives: The present study was designed to investigate the impact of patient- and device-specific factors on the application of acoustically-evoked cortical auditory-evoked potential (aCAEP) measures as an objective clinical tool to verify CI mapping in adult CI users with bilateral deafness (BD).

Material and methods: aCAEP responses were elicited using binaural peripheral auditory stimulation for four speech tokens (/m/, /g/, /t/ and /s/) and recorded by HearLab software in adult BD CI users. Participants were classified into groups according to subjective or objective CI mapping procedures to elicit present aCAEP responses to all four speech tokens. The impact of patient and device-specific factors on the presence of aCAEP responses and speech perception was investigated between participant groups.

Results and Conclusions: The cohort of adult CI users ($n = 132$) that participated in this study demonstrated no significant correlation between patient and device-specific factors and the presence of aCAEP responses or speech perception scores. This study reinforces that aCAEP measures offer an objective, non-invasive approach to verify CI mapping, irrespective of patient or device factors. These findings further our understanding of the importance of personalised CI rehabilitation through CI mapping to minimise the degree of speech perception variation post-CI and allow all CI users to achieve maximum device benefit.

Free paper 0609

The importance of school-age hearing screening compared to newborn hearing screening programs

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Introduction: Universal newborn hearing screening programs are an important element of early diagnosis of congenital hearing disorders. However, they do not eliminate the risk of late-onset hearing loss, progressive hearing impairments, or problems related to central auditory processing, which may not become apparent until preschool or school age. Therefore, screening of school-aged children is an important complement to newborn programs, enabling the identification of disorders not apparent early in life.

Purpose: The aim of the study was to assess the importance of hearing screening in school-aged children as a supplement to newborn screening programs and to determine the scale of hearing impairments and central auditory processing processes requiring further diagnosis and intervention.

Material and methods: The study included 33,134 students in grades 1 and 8 of primary schools in Warsaw. The procedure included assessing air conduction hearing thresholds at frequencies of 0.5–8 kHz. Students with normal audiometry results were additionally tested for central auditory processing (freqency pattern test, duration pattern test, and dichotic digit test).

Results: Abnormal audiometric screening results were found in 10.6% of the students, of whom 68.4% had unilateral hearing loss. In the group of children with normal hearing thresholds, 8.8% had central auditory processing disorders. Overall, abnormalities requiring further diagnostics were noted in 18.5% of the population. The results indicate that a significant proportion of hearing disorders are not revealed or diagnosed until school age, despite children being included in a neonatal screening program.

Conclusions: Hearing screening at school age is a necessary supplement to newborn screening programs. It allows for the identification of late-onset, progressive, and central auditory processing disorders, which can significantly impact a child's language development and academic functioning. Systematic implementation of screening tests in the school environment increases the effectiveness of early diagnostic and therapeutic intervention and reduces the risk of long-term health and social consequences.

Free paper 0436

The influence of frequency-to-place mismatch on hearing performance, sound quality, and patient satisfaction in SSD CI recipients by comparing default and anatomical frequency mapping

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Introduction: When the CI is activated, a standard allocation of auditory frequencies is applied in an arbitrary and identical manner for each patient. The tablet-based software OTOPLAN® provides an intuitive and quick way to assess the temporal bone anatomy and helps to plan personalized cochlear implantation to achieve the best results for each patient.

Objective: The purpose of the study is to compare the originally applied frequency allocation of the cochlear implant electrodes assigned by default at the time of activation with the a more recent frequency allocation that is anatomy-based by a software called OTOPLAN®.

Material and methods: Post-activation, high-resolution cone beam CT scans were analyzed using OTOPLAN® (Version V4) to define anatomical frequency mapping The OTOPLAN software allows to to calculate the tonotopic frequency allocation of each electrode according to their exact position in the cochlear duct. This anatomical frequency mapping was compared to the default frequency mapping at the time of cochlear implant activation. Finally, the mismatch was confronted with the patients' auditory performance, represented by the Auditory Capacity Index (ACI). The average frequency mismatch (AFM) between default and anatomical mapping was calculated. Speech intelligibility was assessed using articulation function (AF) scores, and sound quality was evaluated through patient questionnaires.

Results: Thirteen patients were included in this study. All patients had a mismatch between the two frequency maps with a variable extent (200 Hz to 1100 Hz). There was a significantly inverse relationship between frequency shift and ACI, and between frequency shift and the time needed to improve speech intelligibility. In addition, the quality of sound was evaluated in patients presenting with single-sided deafness. A retrospective study was conducted on 19 SSD patients implanted with MED-EL CIs between 2014–2023. Sound quality aspects, including natural sound perception and similarity to the normal ear, inversely correlated with AFM. Global satisfaction scores were high, unaffected by AFM. Frequency-to-place mismatch impacts speech intelligibility and sound quality in SSD CI patients.

Conclusions: Anatomical frequency mapping using tools like OTOPLAN® allows an anatomy based fitting and can enhance CI outcomes, highlighting the need for individualized cochlear measurements and electrode assignment.

Free paper 0510

The invisible walls: Identifying and dismantling obstacles to CI access

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Introduction: The management options for hearing difficulties and the indications for implantable hearing devices have expanded greatly over time, providing an opportunity to treat most hearing disabilities. However, the current clinical practice can miss a large number of potential candidates due to improper referrals. Up until today, the referral criteria in Saudi Arabia are not well defined and depend on the judgment of the referring practitioner. This study aims to provide a guide for the referral of patients with hearing difficulties.

Material and methods: An expert panel of practicing professionals formed a core committee to carry out the process of developing this study. A comprehensive review was carried out to identify the current best evidence on the topic and to guide the core committee in developing the statements. For statement evaluation, we employed the Delphi consensus method, where the practicing otologists were invited to vote.

Results: Seventeen preliminary statements were included in the original draft. Thirtyseven otologists were invited to vote, out of which 33 provided their responses. In the first voting round, consensus was reached on 16 statements (94%). The mean level of agreement was 95% (±5) for all the preliminary statements.

Conclusions: This paper includes recommendation statements developed and approved by the SORL Society after review of the existing literature, using the Delphi consensus process. These statements may provide utility as evidencebased guide to improve patients' access to hearing care services.

Free paper 0730

The Oticon Ponto system in adults with severe-to-profound and mixed hearing loss: Audiologic outcomes and patient satisfaction

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Introduction: Assessing audiologic outcomes and patient-reported satisfaction is important in patients with severe-to-profound and mixed hearing loss treated with the Ponto system.

Material and methods: Audiological assessments included pure-tone audiometry, free-field hearing thresholds, effective gain, word recognition score in quiet, and speech reception threshold (SRT) in noise. Patient-reported outcomes were collected using the Clinical Global Impression Scale, Glasgow Benefit Inventory, and Abbreviated Profile of Hearing Aid Benefit (APHAB). Information concerning any medical complications was also gathered.

Results: Both word recognition score and SRT were significantly better after 12 months compared with before surgery. At normal speech level (65 dB SPL), 12 of 16 users had speech discrimination ≥70%. However, at the 12-month follow-up, the average effective gain was –6.2 dB. In general, the self-report outcomes showed good satisfaction in most patients. Postoperatively, skin complications were noted in six patients, of whom two underwent reoperation. All patients were still using the Ponto after an average observation time of 2.7 years.

Conclusions: Although skin complications were not uncommon, the Ponto system seems to be an effective method of improving hearing performance and provides subjective satisfaction in real-life situations in patients with severe-to-profound and mixed hearing loss. However, considering the significantly increased bone conduction thresholds and the risk of their further deterioration, long-term follow-up is still needed.

Free paper 0744

The outcomes of cochlear implantation in Usher syndrome: A case study

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Introduction: Usher syndrome is a rare genetic disease with prevalence vary depending on population, on level 3.5 to 6.2 on 10,000 people. The most characteristic features of the disease are: different types of deafness and partial deafness, vestibular disorders and blindness which is secondary to retinitis pigmentosa. There are identified three clinical types of Usher syndrome distinguished by their severity and the age when signs and symptoms appear. It is the most common condition among patients with congenital hearing impairment and progressive loss of vision.

Aim: The aim of the study was to present the case of a patient with Usher syndrome who underwent cochlear implantation and to assess the auditory and functional effects after the procedure. The assessment also concerned the vestibular organ.

Case report: Patient with Usher syndrome was diagnosed and treated in World Hearing Center of the Institute of Physiology and Pathology of Hearing in Kajetany. Clinical features of patient was characterized by, medical and instrumental

examination, genetic testing, surgical report and audiograms before and after the operation.

Results: During the follow-up period, significant improvements in sound perception and speech understanding were noted. The patient reported increased independence in daily functioning and improved quality of life. These results were particularly significant in the context of progressive vision loss, enabling compensation for visual deficits through better use of auditory stimuli.

Conclusions: In majority of cases Usher syndrome is characterized by progressive hearing loss. Early qualification to cochlear implantation and comprehensive rehabilitation are crucial to achieving optimal therapeutic results. Cochlear implantation is beneficial to patients with Usher syndrome and improved perception of their ability to hear in everyday life. Improving health depends largely on patient's motivation to independently exercise and work.

Free paper 0725

The Ponto bone-anchored hearing system: Benefits following radical mastoidectomy

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Introduction: Chronic otitis media with cholesteatoma requires surgical treatment. One technique used is radical modified mastoidectomy. However, if there is subsequent hearing loss, the patient will often need to be provided with a hearing prosthesis, and one option is to use a bone-anchored hearing device. One of the percutaneous bone-anchored hearing aids available in clinical practice is the Ponto system (Oticon Medical).

Material and methods: There were 27 patients enrolled in this study (13 females, 14 males), all of whom had previously undergone radical modified mastoidectomy. They were implanted with the Ponto bone-anchored hearing device from Oticon Medical. The mean age of the subjects at implantation was 59 years (36–75 years, SD = 11). Five patients had moderate conductive hearing loss in the implanted ear, and 22 had moderate to very severe mixed hearing loss. Benefits of the Ponto system were assessed using tone and speech audiometry (free-field), as well as with APHAB (Abbreviated Profile of Hearing Aid Benefit) and SSQ (Speech, Spatial and Qualities of Hearing Scale) questionnaires.

Results: The Ponto system resulted in a statistically significant improvement in hearing sensitivity and speech discrimination. The questionnaires confirmed the benefits of the Ponto system under various acoustic conditions.

Conclusions: Ponto was found to be a safe and effective tool in compensating for conductive or mixed hearing loss after radical modified mastoidectomy. The system can provide good support for auditory function in people who are at risk of recurrent otitis media with cholesteatoma and who may therefore require subsequent revision or further surgical intervention.

Free paper 0107

The relationship between electrical stapedial muscle reflex threshold and the electrical, behavioral measures in MED-EL cochlear implant users

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Programming of multichannel CI requires subjective response to a series of psychophysical percepts. It is often difficult for young prelingually deaf children to provide adequate responses for adequate fitting. This is true for setting levels of most comfortable loudness, whereby failure to indicate growth of loudness may result in elevation of stimulus level to the threshold of pain. The stapedial muscle reflex has been previously used to provide objective confirmation of acoustic stimulation. It has been suggested that ESRT may have applicability in confirming and quantifying electrical stimulation in CI users. To assess the relationship between ESRT and levels of loudness perception with CI, assess the reliability of the response, and investigate potential use of ESRT in CI programming, 26 prelingual deaf MED-EL CI users were evaluated. Comfort levels predicted by subjective judgment were highly correlated with ESRT. ESRT provides an accurate, rapid, and objective method of estimating MCL in CI users.

Free paper 0252

The relevance of cochlear anatomy in hearing preservation after cochlear implantation: A systematic review

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Introduction: Preservation of residual hearing (RH) after cochlear implantation is increasingly prioritized in adult candidates. While surgical technique and electrode design are well-studied, the predictive value of cochlear anatomy remains uncertain. This systematic review aimed to evaluate the association between cochlear anatomical parameters and hearing preservation (HP) after cochlear implantation in the adult CI population with preoperative RH.

Material and methods: Following PRISMA guidelines (protocol registered in PROSPERO: CRD420250630915), a systematic search was conducted across Embase, Medline, PubMed, Scopus, Web of Science for studies published between 2010 and January 2025. Eligible studies included adults (≥18 years) with preoperative RH undergoing cochlear implantation, assessed cochlear anatomy via computed tomography or magnetic resonance imaging, evaluated HP within the first 6 months postoperative, and examined the relationship between cochlear anatomy parameter(s) and HP. Risk of bias was assessed using QUIPS. Data were synthesized narratively; meta-analysis was performed using a random-effects model where possible.

Results: Nine studies (464 implants) met inclusion criteria. Risk of bias was highest for study participation and confounding. Greater cochlear duct length and larger cochlear volume may be associated with better HP, although findings were inconsistent. Six studies examined angular insertion depth (AID); four were pooled. The meta-analysis indicated a small positive correlation (pooled $r = 0.23$; $p = 0.004$; 95% confidence interval: –0.14 to 0.54), suggesting poorer HP with deeper insertion, with moderate heterogeneity ($I^2 = 48.5\%$). Certainty of evidence was rated very low, according to GRADE.

Conclusions: CDL, cochlear volume and AID appear to influence initial HP following cochlear implantation, but evidence is limited and heterogeneous. Residual hearing is better preserved in patients with longer CDL, larger cochlear volume, and shallower insertion depths. Detailed preoperative imaging may support surgical planning. However, standardized HP assessment and adequately powered prospective studies are needed to refine patient-specific strategies.

Free paper 0605

The role of technician–patient interaction in the quality of audiological diagnostics during cochlear implant qualification

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Introduction: Accurate audiological diagnostics are a cornerstone of cochlear implant (CI) qualification. Objective measurements such as auditory brainstem responses (ABR) require patient immobility, cooperation, and sustained tolerance of the procedure. In clinical practice, technicians frequently observe that anxiety, reduced trust, poor understanding of the examination, and previous negative medical experiences negatively affect recording quality, leading to motion artifacts, prolonged testing time, or repeated examinations. Despite its apparent clinical relevance, the role of the technician–patient relationship in shaping the quality of audiological recordings has not been studied sufficiently.

Objective: To evaluate the association between technician–patient communication, patient emotional state, and the technical quality of ABR recordings during cochlear implant qualification, and to identify key communicative factors contributing to optimal examination conditions.

Material and methods: This observational study will include patients undergoing ABR as part of CI qualification. Before examination, patient anxiety will be assessed using a Visual Analogue Scale for Anxiety (VAS-A) and a short perceived control questionnaire. Previous negative medical experiences will be recorded using a brief self-report checklist. During the examination, technician–patient interaction will be documented using a short observational checklist. Objective ABR quality indicators will include the number of motion artifacts, percentage of rejected sweeps, total examination time, and stability of wave V. Correlations between psychological, communicative, and technical parameters will be analyzed.

Conclusions: This study highlights technician–patient interaction as a measurable and clinically relevant factor influencing the quality of audiological diagnostics in CI qualification. Simple assessment tools usable by audiology technicians can identify patients at risk of poor cooperation and suboptimal recordings. The findings may support the development of practical communication guidelines aimed at improving diagnostic efficiency and patient experience in routine clinical practice.

Free paper 0677

The significance of etiology of hearing loss in intra-operative assessment of neural health

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The electrically evoked compound action potential (eCAP) reflects the combined responsiveness to electrical stimulation of the spiral ganglion neurons (SGNs) that form the auditory nerve. In animal studies eCAP measures correlate strongly with SGN survival, suggesting that these neural health measures might be used clinically to predict cochlear implant (CI) outcome. While several studies have indeed reported solid correlations between eCAP measures and speech perception (e.g., Zamaninezhad et al., 2023, Front Integr Neurosci 17), there have also been reports to the contrary. We hypothesize that major factors influencing the heterogeneity in human data include the extent, duration, and etiology of hearing loss.

In the present study we examine the potential of the eCAP, and various derivatives, as a neural health measure in a population of >180 MED-EL CI recipients. In this relatively large population, the influence of etiology on eCAP measures may also be observed. eCAPs were recorded intra-operatively with a short (2.1 μs) and a long (30 μs) inter-phase gap (IPG) using AutoART in MED-EL's clinical MAESTRO software. Both the absolute eCAP measures (e.g., amplitude, slope, dynamic range, latency) as well as their IPG effects were evaluated. Etiology of hearing loss was categorized, and pre-operative

pure tone audiograms were used to determine the extent of the hearing loss.

Moderate correlations were observed between speech perception in noise and several eCAP measures, including latency and slope. Etiology significantly affected multiple absolute eCAP measures and IPG effects, especially in the cochlear base. Most notably, eCAP measures in patients with auditory neuropathy were significantly different from those in patients with presynaptic pathologies. Across all groups, neural health measures scored lower in the cochlear base than in the apex. The extent of low-frequency hearing preservation moderately correlated with several eCAP measures including latency and maximum amplitude.

We conclude that given the myriad of causes for hearing loss, each affecting different structures of the hearing organ, we should be taking these causes into account when attempting to determine neural health objectively. Optimized research tools may provide more relevant insights than clinically approved software.

Free paper 0631

The use of PrompStim system

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Introduction: Auditory rehabilitation in children with suspected cochlear nerve deficiency remains particularly challenging when magnetic resonance imaging suggests cochlear nerve aplasia. In these cases, auditory brainstem implantation (ABI) is often considered the only viable option. However, radiologic absence of the nerve may not always exclude the presence of hypoplastic residual fibres, and intraoperative functional testing may provide critical additional information.

Case report: We report the case of a 2-year-7-month-old child with profound bilateral hearing loss. High-resolution CT and MRI demonstrated normal cochlear morphology bilaterally, with preserved inner ear structures, but failed to identify the cochlear nerves on either side. Auditory brainstem responses (ABR) were absent to click and tone-burst stimuli at maximum intensities bilaterally. Given the suspicion of right-sided cochlear nerve aplasia, the patient underwent right auditory brainstem implantation, with intraoperative confirmation of nerve absence. To assess potential neural integrity contralaterally, intraoperative electrical stimulation of the left ear was performed using the MED-EL PromStim system.

Results: PromStim stimulation on the left side elicited reproducible electrophysiological responses at stimulation levels of 750 and 850 current units [cu], suggesting activation of residual auditory neural elements despite negative imaging findings. These results raise the possibility of a hypoplastic but functional cochlear nerve on the left side.

Conclusions: This case highlights the potential diagnostic value of intraoperative PromStim testing in children with profound deafness, normal cochlear anatomy, and suspected cochlear nerve aplasia. Functional responses may reveal neural integrity not detectable on imaging, potentially influencing implant candidacy and guiding decision-making between cochlear implantation and ABI.

Free paper 0196

The use of the communication skills assessment grid (GACC) in children with cochlear implants

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Introduction: Cochlear implantation has substantially improved access to auditory input in children with severe to profound hearing loss. Despite these advances, outcomes in spoken language and communication vary widely, highlighting the need for systematic and multidimensional assessment tools to guide intervention and monitor communicative development. There is no doubt that cochlear implants allow for the acquisition and development of language, but the proper development of the communicative abilities of children with cochlear implants is equally important. It is not enough to understand and construct sentences correctly. It is necessary to know how to adapt what is said or heard to the context in which it occurs.

Objective: To emphasize the relevance of the Grid for Assessment of Communication Skills as a structured tool for evaluating and monitoring communication abilities in children with cochlear implants.

Material and methods: The GACC was used to assess multiple communicative domains, including auditory comprehension, expressive oral language, non-verbal communication, pragmatic skills, and social interaction. The grid was applied to children with cochlear implants aged between 6 and 10 years.

Results: The structured use of the assessment grid enabled the identification of individual communicative strengths and specific challenges associated with auditory deprivation and post-implant auditory–linguistic adaptation. The tool supported objective goal-setting and facilitated the design of individualized, needs-based intervention strategies. Repeated application of the grid may allow speech and language therapists to monitor developmental progress over time and to evaluate the effectiveness of therapeutic interventions. Additionally, the use of this grig contributes to promoting interdisciplinary collaboration among professionals involved in auditory rehabilitation, education, and speech-language therapy and the child's family.

Conclusions: The Grid for Assessment of Communication Skills represents a valuable clinical and research instrument for the systematic evaluation of communication abilities in children with cochlear implants. Its use supports evidence-based decision-making, enhances the precision of intervention planning, and contributes to the optimization of communicative outcomes. It also contributes to involving the family in the rehabilitation and communication development process.

Free paper 0650

Thinking outside the booth: How hearing assessments are changing to reflect functional listening performance

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Introduction: Traditionally, speech testing has been limited to monoaural performance in quiet or co-located noise. Real-world listening, in contrast, occurs in the most complex multi-source environments, engaging motivational and cognitive processes. The Both Ears (BEARS) speech tests, a research tool implemented in virtual audio, capture speech discrimination, relative localisation, and listening effort requiring only an iPad and headphones to yield similar patterns of results to those obtained with an array of loudspeakers placed in an anechoic chamber.

Aims: To improve access to spatial hearing assessments and increase standardisation in testing across clinics by adapting the BEARS speech tests for clinical practice.

Material and methods: Following action research principles, two Patient and Public Involvement and Engagement (PPIE) events with clinicians and researchers were held. During event 1 (E1), more than twenty clinicians and researchers involved in the BEARS study provided free-text responses via Slido polling software to questions about their priorities for speech testing. Responses were analysed thematically. Findings from E1 were then presented at a second PPIE event (E2) with twelve clinicians and researchers for further discussion. The outcomes of this exercise informed the design of "BEARS Clinical", a new platform designed for clinical use.

Result: E1 yielded 23 responses from 13 participants. Overall, respondents prioritised specific assessment types (particularly speech in noise), usability (quick, easy, audiologist-friendly), and measurement quality (normative data, individual progress). E2 participants proposed four key recommendations for developing the digital testing platform: (1) assessments must be appropriate for a range of age groups and clinical contexts; (2) standard tests (AB Words, BKBs) should be included; (3) the reporting format should be clear and support clinical decision-making; (4) the platform could offer a hierarchy of tests with different attributes and considerations (spatial listening, speech discrimination, age appropriateness). New applications based on the Spatial Speech-In-Noise Virtual Audio (SSiN-VA) test, which uses a dual-task approach to assess speech discrimination and sound localisation, were designed. These new applications include a short version of SSiN-VA (SSiN-VAmini), preserving the dual-task aspect of the test, and individual tests of speech discrimination and sound localisation to cater for younger participants or for those with intellectual disabilities.

Free paper 0075

Three-dimensional micro-CT: Based analysis of cochlear implant electrode positioning

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Introduction: The spatial relationship between cochlear implant (CI) electrode contacts and neural structures is a critical determinant of auditory performance and stimulation-related complications. Precise three-dimensional data on electrode positioning relative to the cochlear nerve and adjacent facial nerve remain limited. This study aimed to quantify electrode–nerve distances using high-resolution imaging and 3D reconstruction to better understand factors influencing CI outcomes and potential adverse effects.

Material and methods: Two MED-EL FLEX28 electrode arrays were surgically implanted into human temporal bones. High-resolution micro-computed tomography (μCT) scans were acquired with the electrodes in situ. Following careful electrode removal, specimens were decalcified and post-fixed to enable detailed visualization of cochlear ducts and neural structures. A second μCT scan was performed. Electrode arrays, cochlear compartments, spiral ganglion regions, and adjacent facial nerve segments were manually segmented and registered into a unified 3D model. Individual electrode contacts were segmented separately, and distances between each contact and the spiral ganglion within Rosenthal's canal were quantified using Hausdorff distance measurements.

Results: Electrode placement had a greater influence on electrode–nerve distance than cochlear anatomy in specimens without malformations. Contacts located in the middle third of the electrode array exhibited distances approximately four to five times greater from the spiral ganglion compared with basal and apical contacts. In one specimen, incomplete insertion resulted in markedly increased distances at basal contacts, highlighting the impact of surgical placement. Additionally, contacts corresponding to the mid-basal region demonstrated close spatial proximity to the facial nerve, indicating a potential anatomical basis for facial nerve stimulation in susceptible cases.

Conclusions: Three-dimensional μCT-based reconstruction provides detailed insight into CI electrode positioning relative to critical neural structures. Increased distances in the middle electrode region and close adjacency to the facial nerve at specific contacts may influence programming requirements and complication risk. These findings support the value of precise surgical technique and individualized electrode design to optimize cochlear implant performance and safety.

Free paper 0496

Tip Fold Over: Diagnostic and repair options

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Introduction: Tip fold over (TFO) is a term for incorrect rotation of the electrode in the cochlea. TFO may lead to insertion trauma and malfunction of the cochlear implant. Several possible causes are discussed, such as incorrect rotation of the preformed electrode to the modiolus, premature ejection from the inserter, but also the speed of insertion.

Material and methods: A group of pediatric patients who underwent cochlear implantation in the years 2014–2024 was retrospectively evaluated. The occurrence of TFO in individual electrode types and the subsequent solution was evaluated. The diagnosis of TFO was determined according to X-ray in transorbital projection or by measuring transimpedance matrix (TIM). Standard measurement of NRT action potentials was also performed in all patients.

Results: 585 cochlear implantations were performed during the period. TFO was diagnosed in 17 of them. There were 11 boys and 6 girls in the group. Straight electrodes were used in 26.3% and pre-shaped electrodes in 73.7% of surgeries. The most of TFOs were observed by pre-shaped type of electrode (15 out of 17). There were 14 TFOs on the right side and 3 TFOs on the left side. The entrance to the cochlea was a round window in all cases. Overall, TFO was observed in 2.8%. The incidence of TOF with pre-shaped electrodes was 3.1% and with straight electrodes 1.3%. Intra-operative X-ray was used in 11 cases, followed by trans-impedance matrix (TIM) in 4 cases and post-op CT scan in one case. Correction of TFO was performed in the same surgery through re-insertion in 12 ears and 5 ears required a revision surgery. In all cases of TFO, normal NRT responses were obtained. The incidence of TFO in our centre is lower (2.8%) than average occurrence (4.2%).

Conclusions: TFO is a rare yet one of the serious intra-operative complications. Pre-shaped electrode array was found to cause TFO in 3.1% of cases and mainly on the right side. Plain film x-ray and TIM are reliable methods to detect TFO unlike NRT. If the tip fold-over occurred, the position of the electrode was immediately intraoperatively corrected.

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Free paper 0733

Titanium prostheses for treating posttraumatic ossicular chain disruption

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Introduction: Posttraumatic chain disruption may be caused by blunt head trauma, barotrauma, or a penetrating foreign body. In cases of severe damage to the incus or its absence, a titanium prosthesis is a good option for reconstructing the ossicular chain.

Material and methods: A retrospective analysis was performed on 24 cases of posttraumatic ossicular chain disruption that had been treated with a titanium partial or total ossicular replacement prosthesis. Air conduction, bone conduction, and air-bone gap were measured before, 6–12 months after, and more than 2 years after the operation. Hearing thresholds were calculated as the mean of 4 frequencies (0.5, 1, 2, and 4 kHz).

Results: The most common cause of ossicular chain disruption was blunt head trauma due to a traffic accident (9 of 24 cases), and there was also a diverse group of foreign bodies that caused damage. In cases where the incus was absent or significantly damaged, titanium ossiculoplasties were performed (partial or total ossicular replacement prosthesis, depending on the presence of the stapes superstructure). Analysis showed a significant improvement in average air conduction threshold and in air-bone gap after surgery ($P < .05$). Closure of the air-bone gap to within 20 dB was observed in 67% of patients.

Conclusions: Although posttraumatic ossicular chain disruption is not common, it is suspected whenever conductive hearing loss persists for several months after injury. In such cases, ossiculoplasty with a titanium prosthesis is likely to provide satisfactory audiological results.

Free paper 0056

Toward implant-integrated reflex assessment: Monitoring stapedius reflex via middle ear pressure during cochlear implant stimulation in sheep

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Introduction: The stapedius reflex (SR) attenuates loud sound transmission to the cochlea, serving as a protective mechanism. In cochlear implant (CI) users, SR thresholds are often

used to estimate maximum comfort levels (MCL) during fitting. This approach is particularly beneficial in infants and other users with limited communication skills. Previous studies demonstrated that monitoring middle ear pressure can identify acoustically evoked SR during human surgery. This study investigates the feasibility of applying this technique during sheep mastoidectomy and CI implantation.

Material and methods: Five Merino sheep underwent surgical tympanotomy and acute CI electrode insertion (MED-EL, Austria). After implantation, a solid-state pressure transducer (Mikro-Cath, Millar, USA) was placed in the middle ear. Electrical stimulation bursts of increasing intensity were delivered through individual CI contacts while middle ear pressure was recorded. For comparison, acoustic stimulation was applied ipsilaterally and/or contralaterally using a tympanometer (eTymp, Biomed Jena, Germany).

Results: We were able to successfully insert at least one CI electrode on each sheep, allowing us to stimulate the cochlea in at least one region. SR-related pressure changes were detected in 4 of 5 sheep, correlating with tympanometry assessment. Absence of SR in one case was confirmed by both methods, indicating true reflex absence rather than detection failure. Similar to human, heartbeat-induced artefacts were also observed, but the SR signal for sheep was much larger that such artefacts were neglectable. Moreover, the middle ear sealing was not as critical as observed in human, but this might be related to the fact that the middle ear was constantly flooded with liquid.

Conclusions: This work contributes to the development of middle ear pressure as an objective measure for SR detection. It shows that it can be implemented with acoustic and electrical stimulation with similar results. Further work is necessary to address the differences observed between the human and animal experiments. Nevertheless, the data provides evidence that the method has comparable results with the current gold standard of acoustic stimulation via tympanometer devices.

Free paper 0544

Trans-Impedance Matrix Heatmap patterns in cochlear implant patients with different cochlear pathologies; Meningitis, otosclerosis, and temporal bone fractures

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Transimpedance matrix (TIM) imaging is an electrical field imaging modality, visualizes intracochlear current spread as heatmaps and holds promise for detecting electrode malposition and subtle cochlear pathology beyond radiological resolution. This observational retrospective case series investigated TIM heatmap patterns in 11 adult cochlear implant recipients (15 ears) with specific etiologies necessitating implantation: head trauma/temporal bone fracture (5 ears), post-meningitis deafness (5 ears), and cochlear ossification/otosclerosis (5 ears). Preoperative CT/MRI confirmed pathology; postoperative X-ray verified electrode position. TIM was measured using Cochlear® CustomSound EP, with normal patterns defined by a continuous diagonal gradient from bottom-left to top-right. Results demonstrated etiology-specific deviations: trauma cases exhibited off-diagonal irregularities and signal dissociation (e.g., electrodes 14–18, 11–19) mirroring fractures or over-insertion, though one showed mild scatter despite normal imaging. Post-meningitis ears commonly revealed off-diagonal signal drop or apical intensity reduction, frequently without corresponding radiological abnormalities, except one normal TIM in Incomplete Partition Type II. Severe ossification and under-insertion yielded "Ocean Pattern" (>25% low potential) with absent extracochlear signals (electrodes 1–4); one otosclerosis case maintained a continuous diagonal despite full insertion. The TIM proved to be very sensitive in detecting changes in tissue conductivity and breakdown of the electrode/tissue interface, including identifying early fibrosis/ossification, which would be undetectable on imaging. In addition, periodic patterns were noted – scatter in trauma, blade-like attenuation in meningitis, and; the Ocean Pattern in severe malposition – as potential diagnostic features associated with the above-mentioned conditions. The TIM may be a useful adjunct to traditional imaging used for postoperative evaluations, as well as assist in managing clinical features, and requires prospective studies to assess periodic patterns.

Free paper 0531

Transferring AI-driven hearing aid signal processing strategies to cochlear implant speech processors

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Introduction: In recent years, advances in hearing aid technology have been largely driven by artificial intelligence (AI)–based sound processing methods, enabling effective noise reduction, acoustic scene analysis, and adaptive signal processing in complex listening environments. In parallel, cochlear implant (CI) systems have continued to evolve; however, the sound processing capabilities implemented directly in CI speech processors remain more limited due to physiological and stimulation-related constraints.

Objective: The aim of the present study is to investigate the feasibility and potential benefits of transferring AI-based sound processing from hearing aids to cochlear implant speech processors by means of an interconnected system. In the proposed setup, the hearing aid functions as a front-end processing unit: incoming acoustic signals are analyzed and enhanced using AI-based algorithms, and the processed audio signal is subsequently delivered to the CI speech processor, which performs the electrical stimulation encoding.

Material and methods: The performance of this interconnected hearing aid–CI system was evaluated in cochlear implant users under noisy listening conditions. Speech perception tests were conducted using competing noise and non-stationary background sounds, and results obtained with the conventional CI processing were compared to those achieved when the CI speech processor received the AI-processed signal

from the hearing aid. Outcome measures focused on speech intelligibility and subjective listening comfort.

Results: The results indicate that the transfer of AI-based sound processing to the CI speech processor leads to improved speech understanding and increased listening comfort, particularly in challenging and dynamically changing noise environments. These findings suggest that advanced sound processing strategies, already established in modern hearing aids, can provide measurable benefits when applied indirectly to cochlear implant systems.

Conclusions: In conclusion, AI-based hearing aid sound processing has a justified role in the future development of cochlear implant speech processors. Hybrid and interconnected processing approaches represent a promising direction for enhancing CI user performance in real-world noisy listening situations.

Free paper 0555

Transform-based audio processing for neuromorphic cochlear implants

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Cochlear implants provide essential auditory perception for individuals with severe or partial hearing loss. However, the limited number of stimulation channels and the simplified spectral representation often result in reduced speech intelligibility. This work proposes a transformation-based reconstruction method to restore missing frequency components in individuals with partial deafness, focusing on spectral regions typically inaudible due to sensorineural impairment. In these patients, shorter electrodes are implanted to stimulate areas of the cochlea with damaged hair cells while preserving healthy cells.

Using the LibriSpeech corpus, audio recordings of spoken text are transformed into the frequency domain using several mathematical transformations, including the Fast Fourier transform, the digital cosine transform, the Walsh-Hadamard transform, and the discrete wavelet transform. The patient's natural hearing range is preserved, since only inaudible frequencies are sampled using regular and logarithmic strategies to simulate the limited channel resolution of cochlear implants (5–30 channels).

The sound in the hearing loss range is transformed using a mathematical transform, sampled, and then reconstructed using inverse transformations. The reconstructed spectral components are merged with the naturally audible part of the signal to form a complete audio output. Speech intelligibility was evaluated using word error rate (WER) computed with an AI speechtotext model, with optional human listening tests planned to validate perceptual quality beyond modelbased metrics.

The proposed approach enables a systematic comparison of transformation types, sampling strategies, and spike-based coding schemes for reconstructing missing spectral information in cochlear implant processing. The results provide insights into how transformation domain representations and neuromorphic coding can improve speech perception in partially deaf individuals, offering a potential path to even better synergy between natural hearing and cochlear implants.

Free paper 0548

Use of cochlear implants in the management of hearing loss in patients following purulent meningitis

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Introduction: Purulent meningitis is a known cause of severe to profound sensorineural hearing loss due to damage to the cochlea and auditory nerve. Cochlear implantation (CI) is often the only effective method of auditory rehabilitation in such cases; however, post-meningitic changes such as cochlear ossification may pose diagnostic and surgical challenges. The aim of this study was to evaluate the effectiveness and clinical outcomes of cochlear implantation in patients with profound hearing loss following purulent meningitis, with particular emphasis on auditory performance and speech perception.

Material and methods: This retrospective study was conducted in a tertiary referral center and included 11 patients with profound sensorineural hearing loss caused by purulent meningitis who underwent cochlear implantation. All implantations were performed using a minimally invasive round window approach. Preoperative audiological assessment included Auditory Brainstem Response (ABR) testing in children and pure-tone audiometry in adults. Postoperative auditory outcomes were evaluated using free-field pure-tone audiometry and free-field speech audiometry in quiet and in noise.

Results: Preoperatively, word recognition scores (WRS) ranged from 0% to 20%. Postoperatively, mean speech perception results in free-field speech audiometry were 60 dB in quiet and 35 dB in noise. The mean hearing threshold in free-field pure-tone audiometry was 34 dB. All patients demonstrated a significant improvement in auditory performance after cochlear implantation.

Conclusions: Cochlear implantation is an effective and safe treatment option for patients with profound hearing loss following purulent meningitis, providing substantial improvement in auditory thresholds and speech perception. Despite

potential anatomical alterations and surgical difficulties, satisfactory hearing outcomes can be achieved with appropriate patient selection, thorough preoperative diagnostics, and refined surgical technique.

Free paper 0681

Use of Cone-Beam Computed Tomography (CBCT) for the evaluation of facial recess dimensions, and prediction of chorda tympani injury

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Introduction: Posterior tympanotomy via the facial recess (FR) is the standard surgical route for cochlear implantation. The FR is anatomically defined by the facial nerve, the chorda tympani, and the incudal buttress. Iatrogenic injury to the chorda tympani occurs in up to 50% of cases, frequently resulting in persistent dysgeusia. Currently, surgeons lack reliable preoperative metrics to predict whether nerve sacrifice will be necessary to achieve adequate surgical exposure.

Objectives: To evaluate the utility of Cone-Beam Computed Tomography (CBCT) in the precise anatomical characterization of the chorda tympani and FR dimensions, and to compare these findings with clinical measurements of the drilled recess in postoperative patients.

Material and methods: The study consisted of two parts: (1) Ten cadaveric temporal bones underwent high-resolution CBCT scanning. Oblique reconstructions measured the facial nerve mastoid segment, chorda tympani length within the posterior tympanic canaliculus, bifurcation angle, and exit direction. (2) Postoperative scans of 14 ears from 11 patients were analyzed to measure the actual drilled recess dimensions required for successful implantation.

Results: CBCT allowed consistent identification of the chorda tympani and facial nerve in all specimens. Substantial anatomical variability was observed: the mean facial nerve mastoid segment was 12.05 (range 5.9–17.9) mm, and the mean chorda tympani length was 9.54 (range 4.5–13.8) mm, with a strong correlation between them ($R = 0.929$, $p < 0.001$). The average bifurcation angle was 27.8 (range 19–48) deg. Notably, in 90% of cases, the chorda tympani emerged laterally or antero-laterally from the facial nerve. While the anatomical facial recess area varied widely, the clinical area required for drilling was significantly more consistent, averaging 13mm square.

Conclusions: CBCT is an effective modality for preoperative mapping of the FR. The high anatomical variability compared to the relatively constant area required for drilling suggests that preoperative imaging can identify patients at high risk for chorda tympani injury. Furthermore, the frequent lateral exit of the nerve indicates that traditional drilling to identify the bifurcation may cause inadvertent damage, highlighting the importance of CBCT in surgical planning and patient counseling.

Free paper 0296

Use of S53P4 (Bonalive®) in VSB surgery. A solution for the treatment of chronic otitis with therapy-resistant otorrhea and for ensuring preload in round window coupling

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Introduction: The use of the Vibrant Soundbridge for hearing rehabilitation in chronic otitis has gained immense importance due to V. Coletti's approach of coupling the FMT to the round window. This coupling, in particular, can occasionally pose challenges for the ear surgeon and the affected patient. Due to the tendency of the autologous material used to create the pressure of the FMT in front of the round window (preload) to shrink, and due to scar contracture, coupling problems can occur after VSB implantation, necessitating revision surgery. Due to the regular use of S53P4 in middle and inner ear surgery, it is known that this bioactive glass shows no tendency to shrink and the required volume can be calculated accurately.

Material and methods: At the ENT Clinic in Halberstadt, Bonalive® is routinely used in VSB and CI surgery for chronic otitis media after CWD surgery. In two cases of uncontrollable, therapy-resistant otitis, Bonalive® was used in combination with subtotal petrosectomy and obliteration of the middle ear. In three other cases, S53P4 was used as a material to ensure preload in front of the round window.

Results: The initial results after the first VSB placement in the five cases described show good coupling of the FMT to the round window and a significant improvement in speech intelligibility.

Conclusions: Bonalive® is an alloplastic material that can be used in VSB surgery. The use of this bioactive glass ensures the necessary tension of the FMT when coupled via the round window. Long-term results are still pending; however, the absence of shrinkage in the material suggests that reliable coupling over an extended period can be expected.

Free paper 0030

Using a piezoelectric drill to fenestrate semicircular canals

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Objective: To investigate the effects of piezoelectric drill use for semicircular canal fenestration on the endolymphatic membrane, hearing, and vestibular function.

Material and methods: The piezoelectric drill was used to fenestrate semicircular canals in five patients undergoing surgical plugging of a semicircular canal. This involved posterior canal plugging ($n = 4$) for intractable BPPV and superior semicircular canal plugging ($n = 1$) for superior canal dehiscence syndrome. Primary outcome measures included: (1) Preservation of endolymphatic membrane intraoperatively; bone conduction pure tone average of 1, 2 and 4 kHz ($PTA_{1,2,4}$); (2) Air conduction 8 kHz threshold; (3) Lateral semicircular canal VHIT vestibulo-ocular reflex gain (VOR gain) and asymmetry; (4) cVEMP and oVEMP thresholds. Secondary outcome measures included VHIT VOR gain and asymmetry of the plugged and non-plugged vertical canals of the operated ear. Audiovestibular testing was performed preoperatively, and at 1 week and 2 months postoperatively (VEMPs only at 2 months postoperatively).

Results: The membranous labyrinth was preserved in all cases following fenestration of the canals using the piezoelectric drill. No endolymphatic leakage was observed. No significant sensorineural hearing loss was found in $PTA_{1,2,4}$ at one week and two months postoperatively. Two out of five patients demonstrated a high-frequency hearing loss of >10 dB at 8 kHz, assessed two months postoperatively (both 15 dB increase). No unintended loss of vestibular function was found at 1 week and 2 months postoperatively.

Conclusions: The piezoelectric drill appears safe for semicircular canal fenestration. Findings of this study should be validated in a larger cohort of patients. If replicated, vestibular surgery might become a 'piezo of cake'.

Free paper 0099

Validation of a Screw Implantation Safety Index for bone conduction implants

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Most bone conduction implants restore hearing by transmitting mechanical vibrations to the inner ear through screws anchored in the temporal bone. Secure screw fixation is essential to ensure efficient signal transmission and long-term implant stability. We hypothesized that prioritizing regions of higher bone density for screw placement would improve fixation strength. This ex vivo study aimed to validate the Screw Implantation Safety Index (SISI), defined as the percentage of the screw insertion path consisting of dense bone, as a preoperative marker for safe and effective screw placement.

Twenty-four bone specimens (1 cubic centimeter in size) were extracted from the temporal bones of two Thiel-preserved human cadaver heads. Each specimen underwent quantitative clinical computed tomography (CT) and micro-computed tomography (micro-CT) imaging to calculate SISI values. Self-tapping titanium screws with a length of 5 millimeters were inserted into each sample. Mechanical stability was assessed through pull-out testing, measuring maximum pull-out force, stiffness, and strain energy at the bone-screw interface. Linear regression analyses were used to evaluate the association between SISI values and mechanical outcomes.

SISI values ranged from 29 to 81 percent based on micro-CT and from 39 to 93 percent based on clinical CT imaging. The mean pull-out force was 535 newtons, with a standard deviation of 151 newtons. CT-based SISI values showed weak but statistically significant correlations with pull-out force ($R^2 = 0.24$, $p = 0.01$) and strain energy ($R^2 = 0.23$, $p = 0.01$). Comparisons with micro-CT measurements supported the validity of SISI values derived from clinical CT. These findings suggest that the SISI score may support preoperative planning for bone conduction implants by identifying optimal screw placement sites. Further studies are required to evaluate clinical applicability and long-term outcomes.

Free paper 0513

Vestibular dysfunction after cochlear and auditory brainstem implantation: Insights from a 10-year tertiary centre's experience

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Introduction: Cochlear implantation (CI) and auditory brainstem implantation (ABI) are established surgical interventions for severe-to-profound sensorineural hearing loss. Owing to the close anatomical and functional relationship between the auditory and vestibular systems, these procedures may influence vestibular pathways, resulting in post-operative imbalance or vertigo. This study evaluates the incidence, pattern, and clinical relevance of vestibular dysfunction following CI and ABI based on long-term experience from a tertiary referral centre.

Material and methods: A retrospective review was conducted on 320 cochlear implant recipients and 48 pediatric auditory brainstem implant recipients. Patients presenting with post-operative vertigo, imbalance, or gait disturbance underwent detailed vestibular evaluation including videooculography, caloric irrigation, and cervical vestibular-evoked myogenic potentials. During ABI surgery, the cerebellar flocculus was graded intraoperatively (Grades 1–4) to assess its correlation with post-operative vestibular symptoms.

Results: Vestibular symptoms following CI were observed in 23 of 320 patients (7.2%). Otolithic dysfunction predominated, with abnormal or absent cervical vestibular-evoked myogenic potentials noted in 82.6% of symptomatic patients, while caloric weakness was identified in several cases. Symptoms were mild and self-limiting, resolving spontaneously within 2 to 10 days without long-term sequelae. Among ABI recipients, 8 of 48 children (16.7%) developed early transient vestibular symptoms. These were strongly associated with larger cerebellar flocculus size (Grades 3 and 4), where greater cerebellar retraction was required for implant placement. Clinical manifestations included transient nystagmus, imbalance, and gait disturbance, all resolving within 5 days.

Conclusions: Vestibular dysfunction following CI and ABI is infrequent, transient, and generally mild. CI-related vestibular symptoms predominantly reflect temporary otolithic

dysfunction, whereas ABI-related symptoms correlate with flocculus size and surgical complexity. Careful surgical technique, vestibular-preserving strategies, and appropriate pre-operative counseling are essential to minimise post-operative vestibular morbidity in auditory implant recipients.

Free paper 0745

Vestibular dysfunction in patient with large vestibular aqueduct syndrome (LVAS): Case report

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Introduction: Large vestibular aqueduct syndrome (LVAS) is one of the most common congenital malformation of the inner ear that predisposes individuals to variable vestibulo-cochlear symptoms. LVAS is associated with sensorineural hearing loss, or sometimes with mixed hearing loss, often vestibular dysfunction. Audiological care is still largely based on observation and prosthetics of hearing loss. Vestibular balance disorder, due to its diverse nature, requires adaptation of the therapeutic method to the clinical situation of the patient. The latest scientific reports associate high hopes with the possibility of surgical methods of treatment through endolymphatic duct blockage (EDB) surgery.

Case report: We present case of 30 year old male patient who was diagnosed in Institute of Physiology and Pathology of Hearing in Kajetany, Poland. The patient suffer from chronic paroxysmal dizziness which were triggered by physical activity.

Results: During a physical examination patient was in good general health condition and without sense of balance problems. Patient had left-sided tinnitus and hearing loss. Due to lack of coherence between anamnesis, medical and instrumental examination, crucial to make diagnosis was radiological examination of ears. High resolution computer tomography showed LVAS.

Conclusions: Patient presented symptoms that were the consequence of hypertension in the inner ear and damage of the left side vestibulum. High pressure in the inner ear may be the reason for the discrepancy in the results of instrumental otoneurological tests. We should remember that in cases of paroxysmal dizziness or vertigo the causes may be associated with anatomical malformation.

Free paper 0717

Vestibular screening at the elders: Pilot project in Uzbekistan

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Dizziness remains one of the most common complaints among the elderly population. Alongside headaches, gait disturbances, balance issues, hearing loss, and tinnitus, older individuals frequently seek help from neurologists, therapists, and cardiologists. Many are unaware of the existence of such a specialty as an otoneurologist or vestibulologist, as well as the availability of computer-based technologies for diagnosing vestibular disorders. The issue of limited mobility among elderly individuals, especially those suffering from dizziness and balance disorders, remains particularly relevant. Uzbekistan, with a population exceeding 37 million people, has more than 7.7 million elderly citizens (according to the Statistics Agency under the President of the Republic of Uzbekistan, 2024). Despite demographic, geopolitical, and geographic challenges, the country has experienced dynamic economic growth and the implementation of new medical programs in recent years. Over the past 5–6 years, the Vertigo Laboratory has conducted a survey of elderly patients. The main reasons for not seeking specialized diagnostic and medical assistance included: inability to travel due to dizziness, long distances to the capital, lack of awareness among both doctors and patients regarding specialized care and diagnostics for vestibular disorders, and financial difficulties. In response, a service titled "Specialized Diagnosis and Rehabilitation of Elderly Patients Using Modern Computer Technologies" was established at the Republican Research Institute of Otorhinolaryngology and Head and Neck Surgery. This initiative formed the foundation of the innovative grant project "Dignified Aging," which identified several priority areas: early diagnosis of cochleovestibular disorders, adequate rehabilitation, scientific and educational activities aimed at raising awareness among the public and healthcare professionals, and training of specialists based at regional branches of the center.

Free paper 0405

When anatomy fails but the brain adapts: bilateral cochlear implantation in a teenager with Cogan's syndrome and severe cochlear obliteration

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Introduction: Cogan's syndrome is a rare autoimmune disorder that can cause sudden, profound bilateral sensorineural hearing loss, often accompanied by rapid inflammatory

obliteration of the cochlea. Early cochlear implantation is crucial, but it is also surgically challenging in advanced cases.

Case report: We present the case of a 16-year-old female with sudden-onset bilateral deafness due to Cogan's syndrome. Because of her complete hearing loss, communication was conducted via a smartphone application that converted speech into written text. Computed tomography revealed bilateral hyperdense changes within the cochlea, suggesting progressive obliteration. Given the high risk of further cochlear ossification, a prompt decision was made to perform bilateral cochlear implantation, with a 3-week interval between surgeries, in line with simultaneous implantation protocols. During the second procedure (right ear), the round window niche could not be identified due to obliteration. Drilling of the basal turn in the region of the scala tympani and scala vestibuli revealed no patent lumen. Consequently, the electrode array was inserted into the middle turn of the cochlea. At initial activation, technical difficulties required reversed frequency mapping due to the non-anatomical orientation of the electrode array. The patient initially reported poor sound quality and difficulty accepting auditory input; however, her motivation was exceptionally high, and she used the processor for 10–12 hours daily. After activation of the second implant, despite the atypical electrode placement, the patient quickly became verbally communicative. At the 2-year follow-up, she reported no subjective difference in sound quality between ears.

Conclusions: This case demonstrates that successful auditory rehabilitation is possible despite severe cochlear obliteration and non-anatomical electrode placement. Early bilateral cochlear implantation, combined with flexible surgical and programming strategies and intensive device use, can yield excellent outcomes in young patients. The remarkable neuroplasticity of the adolescent brain may compensate for anatomical limitations, emphasizing that cochlear implantation outcomes are ultimately determined by central auditory adaptation rather than cochlear anatomy alone.

Free paper 0632

When MRI is inconclusive: Intraoperative PromStim testing in a child with suspected cochlear nerve aplasia

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Introduction: Auditory rehabilitation in children without a clear cochlear nerve in imaging exams remains particularly challenging when magnetic resonance imaging (MRI) or auditory brainstem responses (ABR) suggest possible cochlear nerve presence. In these cases, auditory brainstem implantation (ABI) is often considered. However, imaging exams may not always be conclusive about the presence of hypoplastic residual fibres, and intraoperative functional testing may provide critical additional information.

Case report: We report the case of a 2-year-7-month-old child with profound bilateral hearing loss. High-resolution CT and MRI demonstrated normal cochlear morphology bilaterally, with normal and duplicate inner auditory canals on the left and right sides, respectively. There was no cochlear nerve on the right side, but on the left, there was a very thin and weak signal. Auditory brainstem responses (ABR) were absent to click and tone-burst stimuli at maximum intensities bilaterally. Given the suspicion of right-sided cochlear nerve aplasia, the patient underwent right auditory brainstem implantation, with intraoperative confirmation of nerve absence. To assess potential neural integrity contralaterally, intraoperative electrical stimulation of the left ear was performed using the MED-EL PromStim system.

Results: PromStim stimulation on the left side elicited reproducible electrophysiological responses at stimulation levels of 750 and 850 current units [cu], suggesting activation of residual auditory neural elements despite negative imaging findings. These results raise the possibility of a hypoplastic but functional cochlear nerve on the left side.

Conclusions: This case highlights the potential diagnostic value of intraoperative PromStim testing in children with profound deafness, normal cochlear anatomy, and suspected cochlear nerve aplasia. Functional responses may reveal neural integrity not detectable on imaging, potentially influencing cochlear implant (CI) candidacy and guiding decision-making between CI and ABI.

Free paper 0488

When nothing can be done to restore hearing: A case report of a patient with bilateral profound hearing loss in course of McCune–Albright syndrome

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Introduction: Hearing loss is a very common problem among ENT patients. However, effective treatments are now available for almost every case (external and middle ear surgery, hearing aids, and hearing implants). Among the many possible causes of progressive hearing loss, one of the rarest is McCune–Albright syndrome. Due to the multidisciplinary nature of the disease, patients require specialized care, which poses both diagnostic and surgical challenges.

Case report: We present the case of a female patient with McCune–Albright syndrome who had been treated for many years in our clinic for progressive hearing loss. She presented significant craniofacial deformities, fibrous dysplasia of the skull, bilateral external auditory canal atresia, and, in recent years, a cochlear malformation. Initially, she had mixed hearing loss and was fitted with bilateral bone conduction hearing implants (implanted sequentially). The patient was satisfied

with the implants for several years. However, over time, her hearing deteriorated further, leading to bilateral, profound sensorineural hearing loss. Cochlear implantation and auditory brainstem implant were both considered, but due to the patient's unfavorable anatomical conditions (size and deformity of the head, significant cochlear malformation) and overall clinical burden, she was disqualified from such surgeries.

Conclusions: Currently, many treatment options are available for patients with hearing loss. However, certain clinical situations, such as the presented case, fall outside the scope of standard management and illustrate the current limitations of hearing restoration possibilities.

Free paper 0674

Why a pre-shaped peri-modiolar electrode only covers basal turn and not beyond that? Are all straight lateral wall electrode variants to be considered same?

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The question of why pre-curved modiolar hugging (MH) electrodes only cover the basal turn of the cochlea and not beyond that is unanswered yet in the CI field. Therefore, the aim of this article is to show what the practical limitations are with the pre-curved MH electrode design in not being able to fabricate beyond one full turn. Every CI electrode design needs a metal mold with grooves for placing the platinum wires and for injecting with the silicone elastomer. Limitations in making a mold with groove that goes beyond one full turn of curvature along with the mechanical deformation of the curved silicone elastomer, prevents making a pre-curved MH electrode beyond one full turn. Electrode tip fold-over, electrode scalar deviation and the inconsistent electrode to modiolus wall proximity are the reported issues with this electrode type which does not help by any means to the operating surgeon and the pediatric candidates especially. Straight lateral wall electrode variants from across manufacturers vary in array length. This is often not considered in the equation when comparing peri-modiolar vs straigth electrodes. This will be explained with relevant literature reports showing longer length lateral wall electrodes provide superior hearing outcomes compared to shorter length lateral wall electrodes.

Free paper 0294

Why is language still a challenge for children with cochlear implants? The role of verbal working memory

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Introduction: Despite significant technological advances in cochlear implants and the increasingly early inclusion of children with severe hearing loss, numerous studies indicate that language outcomes in this population still lag behind those of their typically hearing peers. Previous research has largely focused on language outcomes, particularly receptive vocabulary development, while the role of cognitive factors such as verbal working memory has been less systematically explored. Given that working memory plays a crucial role in the temporary storage and processing of phonological information, its relationship with language comprehension is especially relevant for children developing spoken language under conditions of degraded auditory input.

Objective: The aim of this study was to examine and compare receptive vocabulary, grammar comprehension, and verbal working memory in children with cochlear implants and their typically hearing peers, as well as to analyze the relationships between language and cognitive variables within and between the two groups.

Material and methods: The study included 35 children with cochlear implants and 23 typically hearing children aged 6 to 15 years, matched for gender and chronological age. Receptive vocabulary and grammar comprehension were assessed using standardized tests (PPVT-III-HR and TROG-2: HR), while verbal working memory was evaluated using forward and backward digit span tasks.

Results: The results showed that children with cochlear implants achieved significantly lower scores in receptive vocabulary, grammar comprehension, and verbal working memory compared to their hearing peers. Furthermore, stronger associations between language measures and verbal working memory were observed in the cochlear implant group than in the hearing group, suggesting a greater reliance on cognitive resources for language comprehension in children with cochlear implants.

Conclusions: These findings highlight the need for an integrated approach to assessment and intervention that systematically addresses both language abilities and cognitive factors – particularly verbal working memory – in order to improve language outcomes in children with cochlear implants.