

HYBRID-L AND CI422 FOR TREATMENT OF PARTIAL DEAFNESS

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Abstract

The Nucleus Hybrid-L and the Nucleus CI422 Cochlear Implant (CI) can be used for treatment of partial deafness due to the dimensions and features of both electrodes. The audiometric thresholds before and after surgery have been measured and indicate a hearing preservation with both electrodes, since the hearing preservation with Hybrid-L could be reached in 100% and with CI422 in 91% of the measurable cases. The Hybrid-L subjects can benefit from their acoustical hearing and gain a larger benefit with the combination of electrical and acoustical stimulation versus normal CI user with electrical only stimulation, because the CI users cannot benefit from their former hearing experiences with their residual hearing.

Background

Due to the dimensions and characteristics of the Nucleus Hybrid-L and the Nucleus CI422 CI, both implants can be used to preserve residual hearing [1]. The lateral placement can be conducted with both implants due to the straight electrode design. Figure 1A and B show the comparison of lateral wall placement versus perimodiolar placement with a Contour Advance electrode.

The main difference between Hybrid-L and CI422 is the length of the active electrode array. The dimensions and features of both implants are displayed in Figure 2A and B.

The goal of this study was to determine whether a longer electrode offers the same amount of hearing preservation while allowing electro-acoustical as well as electrical only stimulation without compromising speech performance [2].

Material and methods

Subjects with a severe to profound sensorineural hearing loss for frequencies >1500 Hz and substantial residual hearing for frequencies ≤1500 Hz have been implanted with a Nucleus Hybrid-L or a CI422 Implant. 123 of the subjects have been implanted with a Hybrid-L (incl. 30 children) and 50 subjects with a CI422 implant (incl. 8 children). A single subject design with repeated measures of unaided pure tone air and bone conduction thresholds and speech performance was used comparing electro-acoustical and electrical only stimulation. The speech understanding was measured with Freiburger monosyllabic in quiet @ 65 dB, HSM sentence test in quiet @ 65 dB and in background noise (10dB SNR) under S0N0 condition. A reference group containing 165 Contour Advance users without residual hearing was identified for group comparison of speech performance results. The inclusion criterion for the reference group was: ≥15% speech understanding

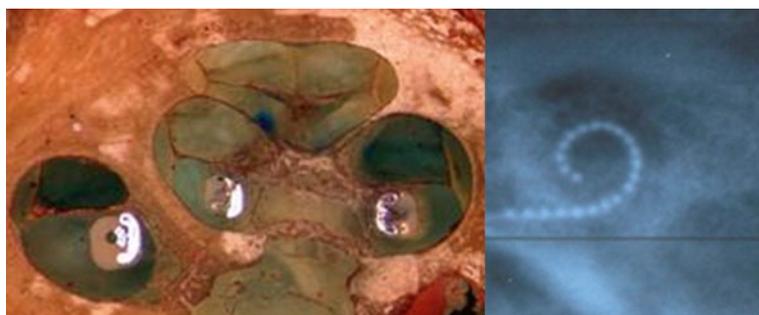


Figure 1A. Contour Advance perimodiolar placement.

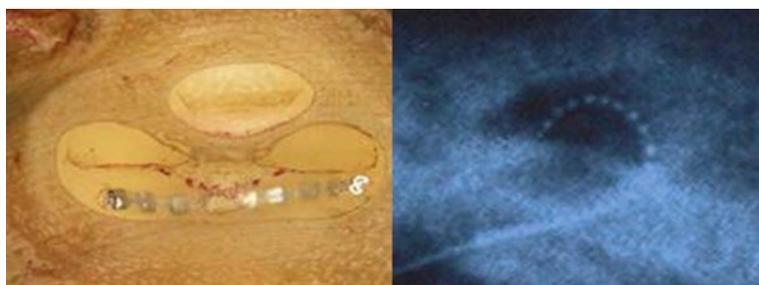


Figure 1B. Hybrid-L lateral placement.

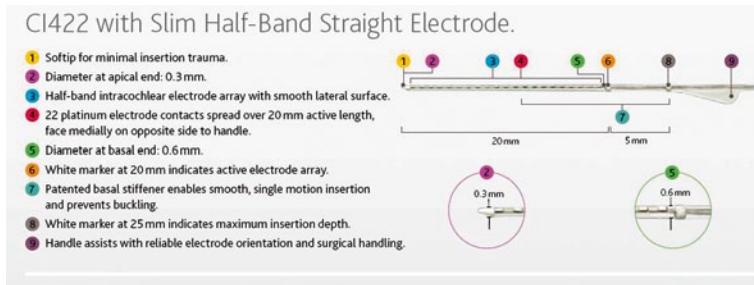


Figure 2A. CI422 dimensions and features.

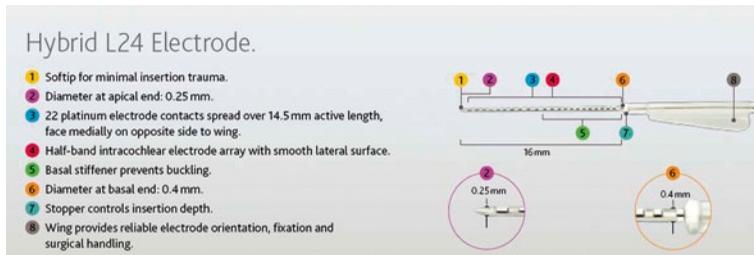


Figure 2B. Hybrid-L dimensions and features.

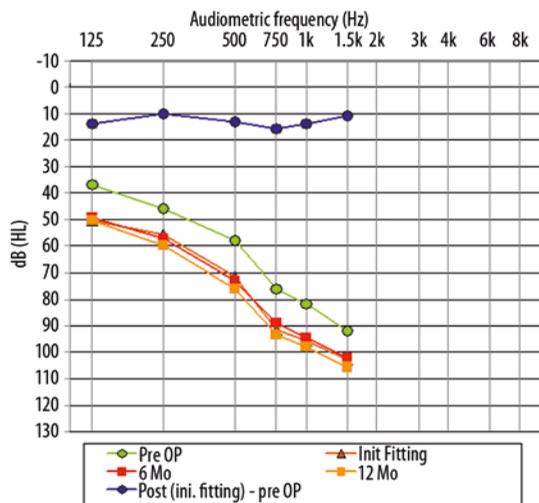


Figure 3. Hybrid-L pure tone air conduction thresholds.

during week of initial activation to provide similar pre-conditions in terms of speech understanding versus electro-acoustical stimulation [Büchner 2011].

Results

Hearing preservation (HL<30dB) has been observed in 100 percent of the measurable cases with the Hybrid-L implant. The median pure tone air conduction thresholds of the 91 subjects displayed in the Figure 3 shows the different time intervals after surgery and the preoperative results for comparison. The bone conduction thresholds confirmed the results and indicate a conductive loss directly after surgery. This conductive loss is a result of fluid in the middle ear after surgery and couldn't be verified during measurements at initial activation.

The hearing preservation of 31 subjects implanted with CI422 is displayed in Figure 4. The median hearing loss between preoperative thresholds and thresholds measured at Initial Activation was identified to be 10–20 dB SL in

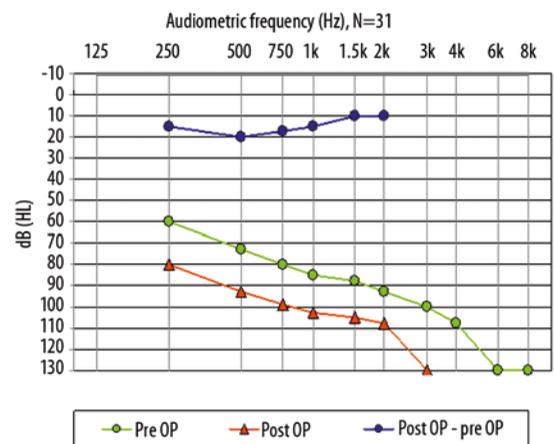


Figure 4. CI422 pure tone air conduction thresholds.

the range of 250 Hz to 2 kHz. Hearing preservation (HL <30 dB) has been observed in 91 percent of the measurable cases with the CI422 implant.

Speech understanding results measured during Initial Activation for the reference group (N=108), the CI422 group (SRA N=30) and Hybrid-L with electrical only stimulation group (N=37) indicate no significant difference for sentences in quiet and in noise. A significant difference could be found for the monosyllabic test as seen in Figure 5.

The speech understanding results after 6 months in Figure 6 compare the control group (N=134) with Hybrid-L with electro-acoustical stimulation (N=44) and electrical stimulation (N=47). Significant differences could be found between groups for the sentence test in noise and for the monosyllabic test.

Discussion

The results indicate that residual hearing can be preserved with the Hybrid-L and the CI422 electrode, but not at the same amount. The significant difference in speech

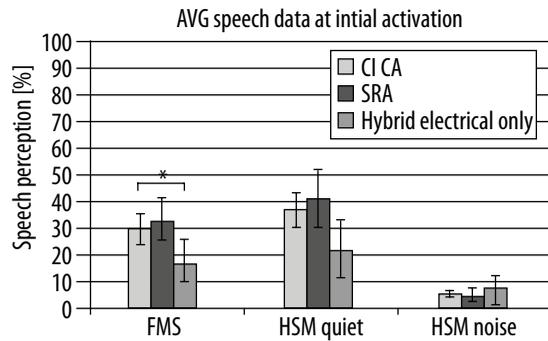


Figure 5. Speech understanding results at Initial Activation (CI CA Group was measured without noise reduction (SmartSound)).

understanding between electrical stimulation with CI CA/CI422 and Hybrid-L found during Initial Activation could be caused by plugging the ears of the Hybrid-L subjects during the measurement. The Hybrid-L subjects have better hearing performance at low frequencies and are used to their acoustical hearing. During the measurements the Hybrid subjects couldn't use their acoustical hearing anymore for the first time. This explains a drop in performance for electrical only stimulation. Also after 6 months, the Hybrid-L subjects can benefit from their acoustical hearing and gain a larger benefit with the combination of electrical and acoustical stimulation versus normal CI user. When changing the conditions by not allowing the

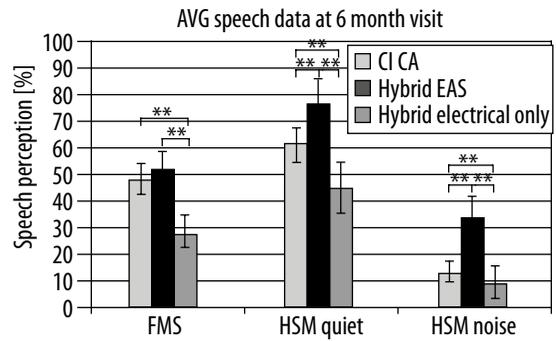


Figure 6. Speech understanding results after 6 months (CI CA Group was measured without noise reduction (SmartSound)).

Hybrid-L subjects to use the acoustical hearing, the performance drops significantly.

Conclusions

Long term hearing preservation is possible with the Hybrid-L and the CI422 electrode in adults and children. The electro-acoustical stimulation tested with Hybrid-L provides a benefit for speech understanding in noise after 6 months. The full flexibility of a 22 channel arrays in both implants while offering electro-acoustical and electrical only stimulation offers a substantial functional benefit with both implants. These are important foundations for treatment of partial deafness.

References:

1. Lenarz T, Stoeber T, Buechner A et al: Hearing Conservation Surgery Using the Hybrid-L Electrode. *Audiol & Neurotol*, 2009; 14(Suppl.1)
2. Buechner A, Schuessler M, Battmer RD et al: Impact of Low-Frequency Hearing. *Audiol Neurotol*, 2009; 14(Suppl 1): 8-13