

# ATROPHY OF THE LONG CRUS OF INCUS OF UNCLEAR ETIOLOGY: CASE REPORT

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## Abstract

**Background:** Study presents the case of a 27-year-old man admitted to our clinic with unilateral stable hearing loss in the right ear which had been present for about 10 years. Patient's medical history did not suggest inflammatory or trauma-related etiology of hearing loss.

**Materials and methods:** Pure tone audiometry tests showed conductive hearing loss of 40 dB in right ear and normal hearing in left ear. Exploratory tympanotomy revealed atrophy of the distal 2/3 of the long process of the incus, with an extant thin strand of connective tissue joining the remnant of the long process of the incus with the stapes head. During reconstruction, the missing part of the incus was rebuilt using glass ionomer cement, with this strand serving as a core of the reconstructed part.

**Results:** The missing part of the incus was successfully restored preserving the mobility of the ossicular chain. Pure tone audiometry performed at 1 and 12 months after surgery showed improved hearing in operated ear and closure of the air-bone gap.

**Conclusions:** There are rare cases presenting with ossicular damage without history of otitis media or head trauma in which etiology is not possible to ascertain. Alloplastic reconstruction of atrophied elements using a glass ionomer cement is an effective treatment method producing lasting hearing improvement.

**Keywords:** middle ear reconstructive surgery • incus atrophy • alloplastic material

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## ATROFIA DE LA RAMA LARGA DEL YUNQUE DE ETIOLOGÍA INDEFINIDA – DESCRIPCIÓN DEL CASO

### Resumen

**Introducción:** El informe presenta el caso de un hombre de 27 años, ingresado en nuestra clínica, con la pérdida auditiva permanente en el oído derecho desde hace unos 10 años. Según el historial médico del paciente, la pérdida del oído no se debía ni a una inflamación ni a lesión traumática.

**Material y métodos:** Mediante la prueba de la audiología tonal, se ha constatado la pérdida de audición conductiva en el oído derecho en el nivel de 40 dB y el oído correcto en el oído izquierdo. En base a la timpanostomía de exploración se ha constatado la atrofia de la 2/3 parte distal de la rama larga del yunque; en el sitio de la parte faltante permanecía una fina banda del tejido entre los restos de la rama larga del yunque y la cabeza del estribo. Durante la reconstrucción, la parte faltante del yunque ha sido reconstruida con el cemento ionómero de vidrio, aprovechando este fragmento del tejido como el núcleo del elemento en reconstrucción.

**Resultados:** La parte faltante del yunque ha sido reconstruida manteniendo la movilidad de la cadena de huesecillos del oído. La audiometría tonal realizada 1 mes y 12 meses después de la intervención de cirugía han demostrado la mejora de la capacidad auditiva en el oído operado y la disminución de la reserva coclear.

**Conclusiones:** Existen pocos casos de lesión de la cadena de huesecillos sin historia de inflamación del oído ni de traumatismo de la cabeza, en los que es imposible determinar la etiología de la enfermedad. La reconstrucción de los elementos atrofiados utilizando materiales aloplásticos- cemento ionómero de vidrio-es un método eficaz y seguro de tratamiento, que garantiza una mejora permanente del oído.

**Palabras clave:** cirugía reconstructiva del oído medio • atrofia del yunque • materiales aloplásticos

## АТРОФИЯ ДЛИННОЙ НОЖКИ НАКОВАЛЬНИ С НЕЯСНОЙ ЭТИОЛОГИЕЙ

### Изложение

**Введение:** Рапорт представляет случай 27 летнего мужчины, поступившего в нашу клинику с односторонней постоянной тугоухостью на правом ухе, продолжающейся около 10 лет. История болезни пациента не показывала ни воспалительную этиологию тугоухости, ни посттравматические повреждения.

**Материалы и методы:** В исследовании тональной аудиологии обнаружена кондуктивная тугоухость на правом ухе на уровне 40дБ и нормальный слух в левом ухе. В проведенной эксплорационной тимпанотомии обнаружена атрофия 2/3 дистальной части длинной ножки наковальни, с оставшейся на месте недостающей части тонкой полоской соединительной ткани между остатком длинной ножки наковальни и головкой стремени. Во время реконструкции недостающая часть наковальни была восстановлена с помощью стекло-иономерного цемента, с использованием этой полоски ткани в качестве стержня воссоздаваемого элемента.

**Результаты:** Нехватающая часть наковальни была воссоздана с сохранением мобильности цепи слуховых косточек. Тональная аудиометрия проведенная через 1 и 12 месяцев после операции показала улучшение слуха в оперированном ухе и уменьшение улиткового резерва.

**Итоги:** Есть редкие случаи повреждения цепи слуховых косточек без истории воспаления уха или травмы головы, в которых невозможно определить этиологию болезни. Реконструкция элементов, которые были подвергнуты атрофии, с использованием аллопластического материала в виде стекло-иономерного цемента является эффективным и безопасным методом лечения, дающим устойчивое улучшение слуха.

**Ключевые слова:** реконструктивная хирургия среднего уха • атрофия наковальни • аллопластический материал

## ATROFIA ODNOGI DŁUGIEJ KOWADEŁKA O NIEJASNEJ ETIOLOGII

### – OPIS PRZYPADKU

#### Streszczenie

**Wprowadzenie:** Raport przedstawia przypadek 27-letniego mężczyzny przyjętego do naszej kliniki z jednostronnym stałym niedosłuchem w prawym uchu, trwającym od około 10 lat. Historia choroby pacjenta nie wskazywała na etiologię zapalną niedosłuchu ani uszkodzenia pourazowe.

**Materiał i metody:** W badaniu audiologii tonalnej stwierdzono niedosłuch przewodzeniowy w prawym uchu na poziomie 40 dB i normalny słuch w uchu lewym. W wykonanej tympanotomii eksploracyjnej stwierdzono atrofię 2/3 dystalnej części odnogi długiej kowadełka, z pozostałym w miejscu brakującej części cienkim pasmem tkanki łącznej pomiędzy resztką odnogi długiej kowadełka a główką strzemiączka. Podczas rekonstrukcji brakująca część kowadełka została odbudowana za pomocą cementu szkło-jonomerowego, z wykorzystaniem tego pasma tkanki jako rdzenia odtwarzanego elementu.

**Wyniki:** Brakująca część kowadełka została odtworzona z zachowaniem mobilności łańcucha kosteczek. Audiometria tonalna wykonana 1 i 12 miesięcy po zabiegu wykazała poprawę słuchu w operowanym uchu oraz zmniejszenie rezerwy ślimakowej.

**Wnioski:** Istnieją rzadkie przypadki uszkodzenia łańcucha kosteczek słuchowych bez historii zapalenia ucha lub urazu głowy, w których niemożliwe jest ustalenie etiologii choroby. Rekonstrukcja elementów, które uległy atrofii z wykorzystaniem materiału alloplastycznego w postaci cementu szkło-jonomerowego jest skuteczną i bezpieczną metodą leczenia dającą trwałą poprawę słuchu.

**Słowa kluczowe:** chirurgia rekonstrukcyjna ucha środkowego • atrofia kowadełka • materiał alloplastyczny

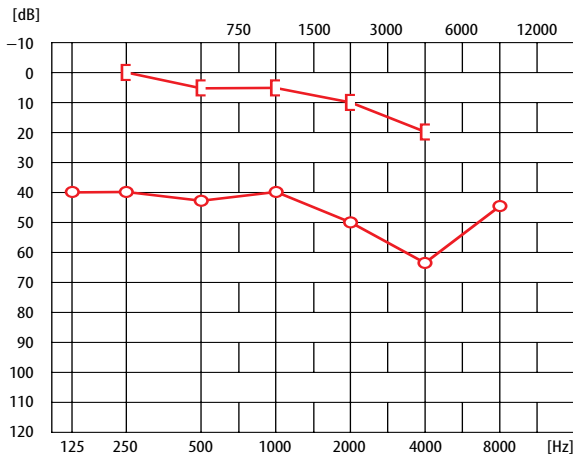
#### Background

Damage to the long process of the incus is a condition often encountered by ear specialists. It is usually caused by inflammatory processes, especially in cases of cholesteatoma or progressive middle ear adhesions such as a pocket in the posterosuperior part of the pars tensa of the tympanic membrane [1]. A less common cause is temporal bone trauma that damages the conductive apparatus of

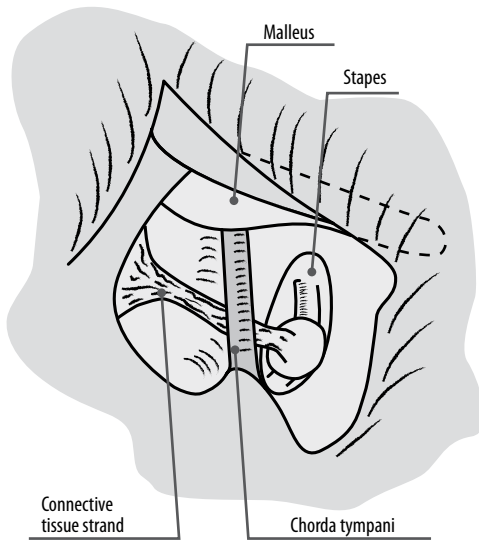
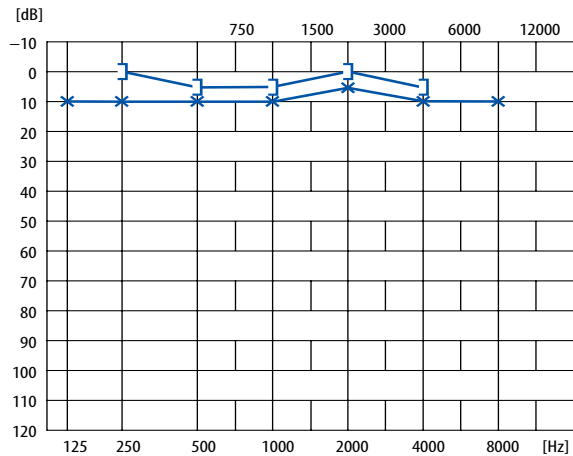
the middle ear. There are also a few case studies reporting the systemic diseases (diabetes) leading to ossicular damage [2–4]. But reports of damage to the incus without a history of chronic otitis media or ear trauma are scarce.

#### Material and methods

A 27-year-old man was admitted to our Oto-Rhino-Laryngology Surgery Clinic with unilateral hearing loss in



**Figure 1.** Results of pure tone audiometry before surgery



**Figure 2A.** Diagram depicting the atrophied long process of the incus before reconstruction



**Figure 2B.** Intraoperative picture of the atrophied long process of the incus before reconstruction

the right ear. The condition onset was over 10 years ago and it was stable during that period. A physical examination ruled out inflammation and post-traumatic dysfunction of the middle ear. There were no incidents of tinnitus or vertigo in patient's history and no cases of hearing loss in family. Video and micro-otoscopy of both ears showed normal ear canals and no changes in the tympanic membranes. Pure tone audiometry showed a 40 dB conductive hearing loss in the right ear at all frequencies, while hearing in the left ear was normal (Figure 1). Tympanometry was normal (Type A) in both ears but there was no stapedius reflex in the right ear. The patient had been referred for exploratory tympanotomy with the possibility of sequential stapedotomy or ossiculoplasty.

During the surgery, the tympanic cavity was visualized by lifting a flap of skin and the tympanic membrane through the endaural approach. It was found that the long process

of the incus was atrophied in over two-thirds of its distal part. There was an extant strand of connective tissue between the remains of the long process of the incus and the head of the stapes (Figure 2).

This connective tissue strand was used as a core around which a mass of glass ionomer cement was built to replace the missing element of the incus. Thus the connection between the head of the stapes and the long process of the incus was restored, as shown in Figure 3. After hardening of the cement, mobility of the reconstructed ossicular chain was evaluated as very good.

At the end of surgery, the flap of skin and tympanic membrane was fixed to the wall of the external auditory meatus with a drop of tissue adhesive. Auditory meatus was packed with antibiotic dressing, removed after 7 days. The surgery and post-surgical period passed without complications.

Hearing results were ascertained through pure tone audiometry test conducted 1 and 12 months after surgery. Results, presented in Figure 4, show significant improvement of air conduction threshold in operated ear and closure of the air-bone gap.



**Figure 3.** Incus after reconstruction with glass ionomer cement

### Discussion

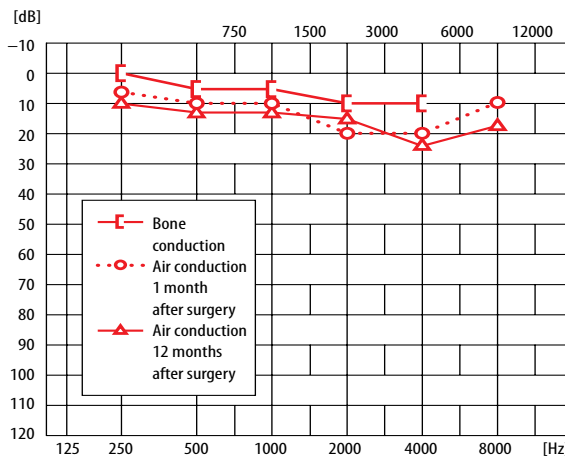
Attention should be drawn to two aspects of the above case. Firstly, the etiology of the destruction of the long process of the incus remains unclear. Secondly, it is worth discussing what surgical options are available when situations similar to the one found in this case are encountered.

There are several theories attempting to explain the sensitivity of incus to different processes in the middle ear. In the first place, limited arterial supply of this ossicle is being noted. It was first described by Alberti [5], who observed that there are three groups of arteries supplying the incus, with some anastomoses. The main arteries originate from the medial wall of the tympanic cavity and runs along the stapes branching from the stylomastoid artery, superficial temporal artery, caroticotympanic artery, and interior and superior tympanic arteries. Additionally, the stapes is supplied by arteries running along the stapedius tendon (branches of the superficial temporal artery). The third group comprises arteries descending alongside the long process of the incus. When the blood supply becomes limited, e.g. as the result of significant retraction of the tympanic membrane caused by adhesive otitis media, the long process of the incus wastes away first, before the other ossicles.

Another theory explains this situation with ageing causing the derangement of bone remodeling processes in the incus [6]. Bone tissue contains constantly active osteoblasts and osteoclasts. Their activity in the incus body remains balanced throughout life, but in the long process of the incus osteoclasts become with age more prevalent, weakening it. Other authors emphasize the importance of processes related to systemic diseases, such as diabetes, in the possible destruction of the incus [2–4].

In the case of the patient described in this case study, it has not been possible to determine the sequence of events resulting in damage to the incus.

The second issue to be addressed are the possibilities of reconstructing the ossicular chain. Until now, there have been several popular methods for surgical reconstruction of the incudostapedial joint. The treatment success is dependent



**Figure 4.** Results of pure tone audiometry performed 1 and 12 months after surgery

not only on the prosthesis used but also on conditions in the middle ear and the surgical technique [1]. In 1957, Hall and Rytznér [7] successfully used fragments of the patient’s own cartilage (extant parts of the incus) to reconstruct the conductive apparatus. This technique, now commonly used, is well tolerated by the human body and produces good results. However, it has some restrictions, such as the risk of graft necrosis, formation of adhesions between the graft and surrounding tissues, or dislocation of the graft. Moreover, there is a risk of inadvertent dislocation of the malleus or stapes or even damage to the exposed facial nerve during the extraction of the extant part of the incus.

There is also a whole range of alloplastic materials (polyethylene, TeXon, ceramic prostheses, glass ionomers, metals such as steel, gold, titanium) that have been used to restore the continuity of the ossicular chain in the form of ossicular prostheses, so called PORP - partial or TORP - total ossicular replacement prostheses [1]. An advantage of these prostheses is that they are ready to use without any prior working or preparation, but often they are not tolerated by the human body and may be expelled from the inner ear, especially in conditions of chronic otitis media or insufficient aeration of the tympanic cavity. The risk of rejection can be significantly lessened by inserting cartilage between the prosthesis and the tympanic membrane. Moreover, when using such prosthesis, there is a risk that it may be displaced causing deterioration of hearing results.

An increasingly popular material used for reconstructing the conductive apparatus of the ear is the glass ionomer cement. It can be freely molded without further dislocation of the ossicles [8]. Another advantage of the cement is preservation of the existing elements of the ossicular chain. This method of reconstruction causes the least interference. Moreover, there is no risk of prosthesis rejection nor displacement of an ossicle. In the case described here, glass ionomer cement was used to reconstruct the missing element of the ossicle with very good results. Additionally, in this case it was possible to use the remaining strand of tissue joining the incus body and the head of the stapes as a central core for reconstructing the middle ear conductive apparatus.

## Conclusions

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Atrophy of the long process of the incus without a prior medical history of chronic otitis media or head trauma is a very rare occurrence. In the case of the patient described

in this report the chosen approach was to reconstruct the ossicular chain continuity using the glass ionomer cement. The effect of this alloplastic reconstruction was very good and produced lasting improvement of hearing.

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