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TECHNICAL NOTE

Un nouveau cas d'ostéointégration de prothèse en titane sur la platine de l'étrier : est-il sans risque de l'obtenir ?

A new case of osseointegration of titanium prosthesis on the stapes footplate: Is it safe to get it?

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Résumé

Le succès de la chirurgie reconstructrice de l'oreille moyenne dépend du couplage stable entre la prothèse et les osselets résiduels. Le titane est un matériel d'implant bien établi, utilises plusieurs années en oto-rhino-laryngologie et chirurgie de la tête et du cou. Les prothèses en titane du type Kurz sont particulièrement appropriées pour la reconstruction de la chaîne ossiculaire et sont d'une manipulation facile et donnent d'excellents résultats fonctionnels. Nous présentons un cas d'ostéointégration de prothèse en titane Kurz, avec stapedectomie accidentelle après une révision d`ossiculoplastie. Malgré le succès de la prothèse de titane Kurz dans la chirurgie réparatrice de l'oreille moyenne, le remodelage osseux incontrôlé doit être envisagé dans les cas de révision d'ossiculoplastie et d'ostéointégration au titane.

Mots-clés : Ostéointégration, platine de l'étrier, Kurz, prothèse en titane.

Summary

The success of middle ear reconstructive surgery depends on stable coupling between the prosthesis and residual ossicles. Titanium has been a well-established implant material for several years in otolaryngology, head, and neck surgery. The Kurz titanium prostheses are particularly suitable for the reconstruction of the ossicular chain and offer excellent functional results. We present a case of osseointegration Kurz titanium prosthesis, with accidental stapedectomy after ossiculoplasty review. Despite Kurz titanium prosthesis present a high success rate in reconstructive surgery of the middle ear, the uncontrolled bone remodeling should be considered in situations of ossiculoplasty revisions and titanium osseointegration.

Key-words: Osseointegration, stapes footplate, Kurz, titanium prosthesis.

INTRODUCTION

Ossicular chain reconstruction represents an attempt to restore the mechanical transmission of sound from the tympanic membrane to the oval window (inner ear) when the ossicular chain has been affected by a pathological process or trauma.

In the unfavorable event of complete ossicular chain destruction with only the stapes footplate remaining in the oval niche, implanting of columella prosthesis, to achieve the sound transmission between the tympanic membrane and the inner ear, represents the gold standard (1).

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Titanium ossicular prostheses have been used since the nineties and have proven to be an excellent material for ossicular reconstruction because of its high biocompatibility, biostability, low weight and high rigidity, which are the characteristics suitable for excellent sound transmission (2-6).

To establish a stable fixed point on the stapes footplate for subsequent prosthesis reconstruction, a titanium footplate anchor could be coated with osteoinductive substances to induce a controlled osseointegration on the footplate. Various studies have shown that collagen-based matrices with and without bone growth and differentiation factors can induce and enhance bone formation and consequently increase implant stability (7).

The literature has reported extrusions that occurred only in cases of middle ear atelectasis, with resorption of interposed cartilage in less than 1% of implanted cases (6).

This work aims to present a case of osseointegration Kurz titanium prosthesis, with accidental stapedectomy after ossiculoplasty review.

CASE REPORT

A young male, eleven year-old, was subjected to a tympanoplasty in closed technique (technique canal wall up) with atticotomy and posterior tympanotomy for presenting right congenital cholesteatoma associated with hearing loss.

The ossicular chain was reconstructed in a second stage, using a 3.5-mm Total Variac titanium prosthesis (Kurz Company) and the posterior-superior portion of the tympanic membrane was rebuilt with fascia and cartilage. After ossiculoplasty, he obtained a hearing improvement and speech audiometry thresholds went from 45 dB to 15 dB.

Five years after, the patient was subjected an ossiculoplasty review with technique canal wall down. The revision became necessary because of recurrence of cholesteatoma with a partial extrusion of the prosthesis through the tympanic membrane.

When we wanted to remove the Kurz prosthesis it appeared to be completely fixed to the footplate. After dissection of the fibrosis around it, the removal of the titanium prosthesis went out with the complete footplate attached to it, resulting in an accidental total stapedectomy.

Through the operative microscope with the higher magnification we did not see any connective tissue and the foot of the prosthesis was firmly attached and osseointegrated to the stapes. It necessitated some pressure to divide both elements.

The opened vestibule was covered with a connective tissue and cartilage fragments to replace the footplate and the reconstruction of the ossicular chain was subsequently performed with a new 3.5-mm total Variac Titanium prosthesis from Kurz Company.

No vestibular symptoms were noticed and pure-tone audiometry revealed a 40 dB conductive hearing loss postoperatively.

At this time the patient is clinically stable and is waiting for MRI control.

DISCUSSION

Reconstruction of a disrupted ossicular chain and restoration of sound transmission are one of the most delicate tasks to achieve in otologic surgery. Over 60% of cases with chronic otitis media are reported to have ossicular involvement; therefore the need for ossiculoplasty is compulsory (8, 9)

High success rates has been reported with the use of implants in reconstructive surgery of the middle ear, nevertheless the stability of such reconstruction is always difficult and for the long term some extrusion of the ossicular reconstruction could appeared due to a lack of biocompatibility or to a retraction disease (10).

Osseointegration is the perfect acceptance of a metal implant by a living bone without any reaction to a foreign body at the interface implant-bone. It has proved for many years to be affective with titanium implant dental rehabilitation (Brånemark et al) and also hearing devices (BAHA) (11, 12).

The Kurz titanium prosthesis introduced in the 90's, proved to be an excellent biocompatible material, suitable for ossicular reconstruction, it is bio-stable, light and strong with excellent osteoconductive behavior (3, 4)

Our case report and some experimental results obtained in animals prove the osseointegration mechanism of the titanium implant with footplate (13). However this uncontrolled bone remodeling resulted in an involuntary stapedectomy and although to be a rare situation, it should be considered in situations of ossiculoplasty revisions.

According to the literature, there is only a similar case of osseointegration reported by Shudof et al and in their study, new bone formation was determined by morphology, histology, and scanning electron microscopy (6).

After performing ossiculoplasty with standardized techniques using modern alloplastic material, we do not want the process of osseointegration, because it makes an ossiculoplasty revision very difficult and dangerous.

The same applies if we use autologous ossicles in the case of an ossiculoplasty revision with, for example, the transposition of incus in a stapes, if they are completely fixed.

Despite the most frequently reported complications using incus are lateralization, bony fixation, atrophy, displacement and perforation of the stapes footplate with perilymphatic fistula (1), an accidental removal of footplate can happened in an ossiculoplasty revision because when we want to remove the incus which is completely fixed to stapes, we are exposed to this risk. However, we did not find similar complication using autologous ossicles, described in the literature.

Although the case reported supports the clinical potential of footplate osteoblasts to form a new bone, footplate does not always present a favorable environment for osseointegration due to their constant movement and the size of contact zone between the implant and footplate. The human footplate is thin and only 1/3 is bone with few osteocytes responsible for osseointegration (14).

These footplate conditions associated with changes in atmospheric pressure, middle ear effusion, or scar tissue development can destroy the prosthesis fit on the footplate (15).

Additional, dislocation of prostheses and interposition of connective tissue can impede a direct prosthesis

bone contact and are important reasons for poor postoperative sound transmission after ossiculoplasty (16-18).

Neudert et al proved in a study with sheep, that these situations could be overcome by controlled modification of the surface of the implants, which are biologically activated with artificial extracellular matrices (15).

This study describes osseointegration mechanisms using the staged procedure in two steps. First step, the footplate anchor is placed on the footplate and in a second step, the columella prosthesis is fixed by newly formed tissue.

Despite the successful attempt to induce osseointegration controlled footplate held in animals, these new options described by Neudert et al, should be evaluated carefully when applied in humans because these osseointegration mechanisms can be dangerous in ossiculoplasty revisions.

CONCLUSION

The results of ossiculoplasty should be cautiously interpreted, as several anatomical, pathophysiologic and technical factors can affect the functional outcome. Despite Kurz titanium prosthesis present a high success rate in reconstructive surgery of the middle ear, the uncontrolled bone remodeling should be considered in situations of ossiculoplasty revisions and titanium osseointegration.

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