How I Do It

Malleus Replacement Prosthesis Stapedectomy in a Patient With Otosclerosis

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INTRODUCTION
Different types of titanium prostheses are used for different types of ossicular chain reconstruction (OCR). However, various ossicular chain problems require different types of reconstruction (incus or prosthesis).

Recently, Vincent et al.1 published a new type of ossiculoplasty with a malleus replacement prosthesis (MRP). The details of this new prosthesis are described in their article.

One of the most important factors that influences the prognosis of successful OCR is the role of the malleus handle in cases with additional pathologies of the incus or suprastructure.

This new MRP might solve additional problems, especially in revision cases in which a problem exists with the footplate. These problems can range from thickness to fracture to even fixation of the footplate.

In this article we demonstrate a new malleo-replacement-prosthesis-vestibuloplexy method in a patient without an ossicular chain.

MATERIALS AND METHODS
A female patient suffering from otosclerosis underwent surgery in 2008. During the first operation the surgeon did not notice the fixation of the footplate and removed the incus, replacing it with a partial ossicular replacement prosthesis (PORP) titanium prosthesis. Due to her persistent conductive hearing loss, a second operation was performed in 2009. The prosthesis was replaced and the head of malleus was removed, again achieving no improvement in hearing. After the second operation the patient acquired a middle ear infection, which resulted in a perforated eardrum.

In 2012 the patient presented to our department for further treatment. A computed tomography (CT) scan was performed to rule out the existence of a third window as a cause for her persistent conductive hearing loss. The PORP was riding on the suprastructure, but the handle of the malleus was missing. The oval window showed sclerotic plaques. The patient also reported that her father had undergone operations on both ears due to otosclerosis.

Malleus Replacement Prosthesis
The MRP1 was designed in 2009 in cooperation with the Kurz company (Heinz Kurz Inc., Dusslingen, Germany). It is a titanium neomalleus, which is implanted underneath the tympanic membrane at any position in the bony rim of the external auditory canal. The 0.8-mm-diameter handle is attached via a Y-shaped titanium wire with two posts (0.3-mm diameter), which are intended to fix to the bony canal wall of the external auditory canal wall (EAC). These posts are inserted into two holes, which are drilled with a 0.6-mm burr. The surgeon introduces the MRP and can connect almost any partial or total replacement prosthesis because of the malleable MRP.

Surgical Technique
As the patient’s left ear was being operated on, two tunnels were drilled through the EAC at the one and three o’clock positions with a 0.6-mm diamond dust burr for the two posts of the MRP (Fig. 1). The distance between the two EAC tunnels was equal to the distance between the two posts of the MRP. Drilling the two tunnels required regulated speed with constant irrigation to prevent burning or pressure necrosis of the bone.1

Due to the increased thickness of the footplate, it was opened using a CO2 laser. Laser parameters were set to: 1 W, 0.1 second single shot.

The two posts of the MRP were introduced into the tunnels without the usage of any further fixation such as cement.

A 7-mm K-Piston stapes prosthesis was placed in the perforated footplate and attached to the MRP (Fig. 2). The posts of the MRP were covered with a thin piece of cartilage, and conventional tympanoplasty with fascia was performed. The operation was performed by senior author.

RESULTS
The patient’s hearing results (preoperative and postoperative) are presented in Figure 3.

At a follow-up visit 3 months postoperatively, the patient reported satisfying hearing ability. Pure tone
audiometry showed a remaining air-bone gap of less than 10 dB.

**DISCUSSION**

Two structures influence the results and prognosis of OCR: 1) the presence of the malleus and 2) the supra-structure. The MRP is a newly developed prosthesis that offers more solutions in ossicular chain reconstruction. A combination of an MRP plus total ossicular replacement prosthesis (TORP) or MRP plus PORP could lead to a better prognosis.

Footplate problems have their own place in OCR. It is always a huge challenge to reconstruct or repair thin or fractured footplates. Bremke et al. discussed a solution for this problem in their article.²

Stapes fixation combined with fixation, absence, or malformation of the malleus-incus complex is another rare problem. Some otology surgeons might avoid reconstructing this situation to prevent deafness. Battaglia et al.³ described a surgical procedure for this in their article.

Generally, there are two main problems: 1) the intrusion of the prosthesis into the vestibule and 2) the stability of the TORP in its position. Removing the footplate and grafting it with soft tissue (vein, perichondrium, fascia, or periosteum) is possible and feasible, but the soft tissue might not resist the forces of the TORP positioned over it, together with the cartilage positioned on top of the TORP. The second problem is the stability of the prosthesis. It is known that the prognostic and functional results of TORP prostheses are worse than those of PORP. According to Mardassi et al.,⁴ success with PORP is almost 32% higher than success with TORP. It is a matter of mechanical leverage. To this respect, the OMEGA connector was developed to improve the stability of TORP.⁵

Fig. 1. Two tunnels were drilled through the external auditory canal wall (EAC) at the one and three o’clock positions. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

Fig. 2. The position of the a malleus replacement prosthesis (MRP) and its connection to the K-Piston prosthesis. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

Fig. 3. The patient’s hearing results (preoperative and postoperative).
From these points of view, the surgical technique described in our article not only avoids the intrusion of the prosthesis into the vestibule, but it also enables perforation of the footplate without removal, which reduces the risk of deafness as used in stapes surgery.

This problem occurs rarely and thus far it has been very difficult to collect patient’s data. Given the results, we think that it is a good approach to use the MRP (available, Bess Medizintechnik GmbH, Berlin, Germany: http://www.bess.de/otologie/mittelohrprothesen/tympano-plastik/mrp-malleus-ersatz-prothese.html) in a surgical combination such as we have described.

This patient was operated on in May 2012. So far, there is no evidence of eroding through the tympanic membrane. However, it is recommended to cover the MRP with a thin cartilage.

CONCLUSION

Stapes fixation (otosclerosis or severe tympanosclerosis) with the absence of the malleus-incus complex is a rare and challenging combination. The reconstruction may lead to intrusion of the prosthesis into the vestibule, as well as instability and poor positioning of the TORP. With the help of a malleus replacement prosthesis combined with a stapes piston, it is possible to reconstruct such cases with satisfying results.

BIBLIOGRAPHY


