Malleostapedotomy in the pathology of the incudomalleolar complex combined with fixation of the stapes

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Abstract: Introduction: Stapes fixation combined with disorders of the incudomalleolar complex requires sound transmission reconstruction, which is often difficult to achieve. This situation can occur with several pathologies and can also be observed in revision surgery for stapedectomy. Patients and Methods: We present our experience of four patients who underwent malleostapedotomy with removal of the anterior mallear ligament and the anterior mallear apophysis. Results: We discuss the findings from each case. Closure of the gap was achieved in two cases and a hearing gain without complete gap closure in the other two. Discussion: We set out the etiology of malleus and incus hypomobility. We present a bibliographic review of the results obtained using this technique in revision stapedectomy.

Key words: Incudomalleolar hypomobility, Incus luxation. Revision stapedectomy, Malleostapedotomy.

INTRODUCTION

Stapes fixation combined with a disorder of the incudomalleolar complex requires adequate reconstruction of sound transmission, which can be difficult to achieve.

Malleus and/or incus fixation can occur in different situations. In regard to congenital etiology, it has been proposed that in a small attic, the malleus and/or incus may come into contact with the attic walls or with the tegmen, predisposing both structures to fixation. It has also been suggested that the lack of re-absorption of the mesenchyme may lead to the formation of fibrous bridges that can become ossified. Ossicular fixation can also be observed in Paget's disease. It has been said that chronic inflammatory processes of the middle ear are the cause of ankylosis from ligament degeneration, with calcification and ossification of the ligaments, resulting in fixation. Tympanosclerosis can block the chain at any level. Otosclerosis of the stapes can give way to torsion of the malleus and the incus, which is the cause of arthritic changes in their articulation with consequent fixation. Osteophytes that directly affect the malleus and cause it to become blocked have also been found. A diagnosis of malleus and incus mobility anomalies is usually difficult to establish when the study is conducted prior to surgical intervention for conductive hearing loss.

MATERIAL AND METHODS

We present the cases of 4 patients who underwent a stapedotomy from the handle of the malleus (also known as a malleostapedotomy) (Figure 1). Postoperative follow-up lasted between 3 months and 3 years.

Patient number 1 was a 59-year-old male who reported the presence of left unilateral hearing loss of more than 10 years' evolution which had worsened in recent months. The hearing threshold was 38dB. The suspected diagnosis was otosclerosis, which is why the projected intervention was an exploratory tympanotomy and probable stapedotomy.

Patient number 2 was a 56-year-old woman with a history of high blood pressure and heart rhythm disorders. Tympanosclerosis was suspected in the preoperative study because of the presence of plaques on the tympanic membrane. The hearing threshold was 38dB. The suspected diagnosis was otosclerosis, which is why the projected intervention was an exploratory tympanotomy and probable stapedotomy.

Patient number 3 was a 62-year-old man with a history of otalgia and otorrhea who had suffered from hearing loss in the right ear since childhood. He presented a hearing threshold of 28 dB.
In every case the intervention was performed under local anesthetic and sedation. The approach used in three cases (but not the one in which otosclerosis was suspected) was a tympanomeatal flap from 3 to 8 hours in the right ears and from 10 to 14 hours in the left ears, as described by Fisch\(^2\), but without extending the incision towards the exterior of the EAC between the tragus and the root of the helix as proposed by Seidman\(^3\). After lifting the cutaneous flap in line with the tympanic membrane, we proceeded to peel it back until the external apophysis of the malleus was completely uncovered. Next, we made a detailed study of the state of the eardrum and the mobility of the ossicular chain. In every case we performed a small atticotomy from the anterior spine as far as the posterior spine. Then, the incus was de-articulated and extracted. We then drilled the neck of the malleus, its anterior apophysis and the anterior ligament. After extracting the head of the malleus, the prosthesis was measured from the interior face of the malleus as far as the stapes footplate. A stapedotomy with CO\(_2\) laser was performed and the corresponding Causse prosthesis with automatic closure was inserted.

In the case in which isolated otosclerosis was suspected, we had to extend the flap forwards in the upper part because we had made the flap usually used for stapedotomies from the incus.

In the patient who underwent a stapedotomy revision, a small amount of scar tissue was vaporized with CO\(_2\) laser until the footplate prosthesis was uncovered. Once we had checked that the prosthesis was in place and that there was nothing hindering its normal functioning, the mobility of the malleus was assessed. Hypomobility was observed, despite there not being complete fixation. We first sectioned the prosthesis under the descending branch of the incus before proceeding to its extraction. The rest of the prosthesis was extracted when the platinotomy was widened.

**RESULTS**

Otosclerosis was suspected in the first case, but when the mobility of the chain was explored, incus hypomobility associated with stapes fixation was observed. Two years after the operation, closure of the audiometric differential threshold was observed at 0-10 dB.

In the second case, in which tympanosclerosis was suspected, it was confirmed that this process affected both incudomalleolar articulation as well as the stapes; erosion of the descending branch of the incus was also observed but this barely touched the stapes. After the intervention, closure of the audiometric differential threshold was obtained at 10-15 dB, although this dropped to 5-10 dB at each frequency after one year.

The third case presented fixation of the chain at the attic, with multiple adherences to the incus along with stapes hypomobility. After the intervention, a closure of the audiometric differential threshold of 0-10 dB was obtained; this remained constant for more than a year of follow-up.

The only perioperative anomaly found in the fourth case was malleus hypomobility. The prosthesis from the previous operation was in place. Following the stapedotomy from the handle of the malleus, hearing improved to an average of 10 dB but there is still an audiometric differential threshold of 15-20 dB.

All the patients were discharged the morning after the operation. None suffered postoperative vertigo.

**DISCUSSION**

Malleus and/or incus fixation is an uncommon cause of conductive hearing loss\(^1\) that can have different origins. Its frequency varies greatly according to different statistics. According to De la Cruz\(^2\), malleus fixation was found in 0.8% of the stapedectomy revisions, while Lesinsky\(^3\) recorded a figure of 4% and
Fisch\textsuperscript{2} 8.7\% (although Fisch found anomalies of some kind in 48.6\%). Incus fixation was observed in 2.8\%, 2\% and 13.7\% respectively, and erosion of the incus in 25.8\%, 31\% and 37.5\%. Lesinsky stated that there was subluxation of the incus in 4\% of cases, while Fisch reported an incidence of 28.7\% (De la Cruz does not refer to this complication).

Lesinsky\textsuperscript{5} attributed the differences found in the percentages of the various etiologies reflected in the studies to different factors. Lesinsky highlighted the fact that there are different ways of standardizing the findings and that each anomaly is referred to separately, but that they can present in the same ear.

The possibility that conductive hearing loss could be due to luxation of the incus should also be contemplated. This could be due to surgical trauma, although medial luxation sometimes occurs from the incus sticking to the promontory in patients who have undergone surgery for otosclerosis\textsuperscript{5}.

When there is otosclerosis of the stapes footplate or stapes fixation of another origin, the preoperative diagnosis of concomitant malleus fixation and/or fixation of the incus can prove to be a very difficult one. It is usually based on observing the mobility of the external apophysis of the malleus under the microscope in response to the increase in pressure produced in the EAC with air insufflation otoscopy. A diagnostic procedure based on a system of optical analysis of the vibrations of the tympanus in response to sound has recently been developed\textsuperscript{6}. This is called laser Doppler interferometry (LDI). The exploration lasts 30 minutes and enables conductive hearing loss to be differentiated from perceptive hearing loss (although it does not distinguish between a normal subject and one with perceptive hearing loss). Amongst the different types of conductive hearing loss, it is capable of distinguishing whether the disorder is of the malleus, incus or stapes (the main differences in mobility of the tympanus can be observed in cases of malleus fixation).

In 1982, Sheehy\textsuperscript{7} published 48 reviews of stapedectomy operations with the technique starting at the malleus. Sheehy reported 53\% of gains with an audiometric differential threshold of 10 dB or lower and 20\% of gains with an audiometric differential threshold of 11 and 20 dB. 4.5\% of cases presented significant sensorineural hearing loss and 1.5\% a profound deficit.

In 1991, Farrio\textsuperscript{8} presented a series of 48 patients, 57\% of whom showed a gain with an audiometric differential threshold of between 0 to 10 dB and 21\% a gain with an audiometric differential threshold of between 11-20 dB. Severe sensorineural hearing loss appeared in three cases.

In 2001 Fisch\textsuperscript{2}, published the results of a total of 56 patients who had undergone a malleostapedotomy, describing an audiometric differential threshold of 0-10 dB in 59\%, 11-20 dB in 25\% while 9\% presented an audiometric differential threshold of more than 30 dB.

The presence of fixation of the anterior malleolar ligament or of the anterior malleal apophysis produced an audiometric differential threshold of more than 10 dB in low and average frequencies following the stapedectomy\textsuperscript{9}.

Experience shows that when patients with tympanosclerosis who also have fixation of the stapes undergo a stapedectomy, their hearing initially improves, but the audiometric differential threshold generally deteriorates with the passing of time\textsuperscript{10}. This occurred with one of our patients whose hearing, after a little more than a year since the operation, dropped 5-10 dB in all frequencies.

Given the small number of cases in our series, we cannot conduct a detailed assessment of the results we obtained. But that is not to say we do not consider the technique to be a very useful one, it is certainly worthy of consideration in cases of conductive hearing loss caused by fixation at the incudomalleolar level associated with stapes fixation.

CONCLUSIONS

1. In revision stapedotomy and when incudomalleolar pathology is suspected, it is advisable to use an approach extended forwards in the revision stapedectomy so as to be able to perform a stapedectomy from the handle of the malleus, should it be necessary.

2. Cases of persistent hearing loss following stapedotomy can be due to total or partial malleus or incus fixation that went undetected in the initial operation.

3. The anterior malleal ligament and anterior apophysis should be eliminated in the malleostapedotomy, as they can reduce the mobility of the handle of the malleus.

4. The results obtained are sufficiently encouraging for this technique to be kept in mind when resolving the different pathologies of the incudomalleolar complex combined with stapes fixation.

References