

How I Do It

Otology and Neurotology A Specific Issue and Its Solution

The "Two-Hole" Ossiculoplasty Technique

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INTRODUCTION

The first ossicular reconstruction by means of autograft ossicular bone was performed by Hall and Rytznar in 1957.¹ During a stapedectomy they accidentally fractured the stapes superstructure and consequently interposed an autologous malleus between the tympanic membrane and the mobile stapes footplate. This resulted in a hearing gain, albeit not very lasting.

Repositioning or transposing the incus according to Farris² did not yield better results than the interposition technique because of too many ankyloses. This prompted most surgeons at that time to adopt the "loose" interposition technique (between both membrane and stapes head and membrane and stapes footplate). However, this type of reconstruction was not stable and was too much affected by tympanic membrane displacements. Also, too many fixations occurred to the bony tympanic wall, the promontory, or the Fallopian canal.³⁻⁵ Furthermore, demonstration of residual cholesteatoma and osteitis in autologous ossicles taken from patients presenting with cholesteatoma and chronic otitis media led many authors to discourage the use of autografts in such cases.^{3,6}

The introduction of allogeneic ossicles (homografts) in ossicular chain repair by House et al.⁷ in 1966 successfully overcame the previously described difficulty. Allograft ossiculoplasty became a standard technique in most otosurgical practices. Nowadays there is a growing tendency to use biomaterials, some of which are claimed to have equally good results.^{8,9} The advocates of the biomaterials justify the high cost by referring to the alleged disadvantages of allografts, namely, a longer operation time and a higher risk of resorption. Furthermore, there is a growing concern about the risk of transmitting viral diseases such as human immunodeficiency virus.¹⁰⁻¹² The long-term

results of the biomaterials are not (yet) convincing, whereas the autograft and allograft incus prosthesis techniques have shown excellent long-term results in the literature.¹³⁻¹⁵ Guilford⁵ in 1966 was the first to perform one of the most successful reconstructions, the malleostapedial assembly, which was characterized by an incus interposition between stapes head and handle of the malleus. With time, several refinements and adaptations were developed, all with the aim of increasing stability.^{3,16-18} Comparison of studies is difficult, mainly because of different criteria of success and durations of follow-up, small studied numbers, the heterogeneity of the analyzed groups, and the different presentations of hearing results.

One of the modifications is the "two-hole" technique proposed by Jean Marquet.¹⁹ He developed it to achieve better stability and thus better long-term hearing results. This technique is the standard ossiculoplasty technique for incus interposition in the Antwerp School of Otology. The present study reports on a retrospective analysis of the anatomic and functional results of incus interposition according to Jean Marquet for the repair of an incus in case of a normal malleus and shape.

MATERIALS AND METHODS

All consecutive files of patients who underwent an allograft or autograft incus interposition ossiculoplasty between 1981 and 1994 were retrieved. Only patients who had an isolated interruption of the incudostapedial joint with an intact malleus handle and stapes head (type A or M+S+)³ and with closed tympanic membrane were selected. All other ossiculoplasties and tympanoplasties were excluded, as well as incus interposition ossiculoplasties combined with myringoplasty at the same stage. Based on these criteria, 40 patients were included in the study.

As mentioned earlier, all incus ossiculoplasties were performed using the two-hole technique according to Marquet. In brief, this technique is performed with the patient under hypotensive general anesthesia²⁰ and starts with a transmeatal tympanotomy incision, after which the skin of the external auditory canal is dissected from the bony wall. The malleus is freed from its tympanic attachments from the umbo to the neck. An allograft or autograft incus is drilled into a figure-eight-shaped model with one hole at each ex-

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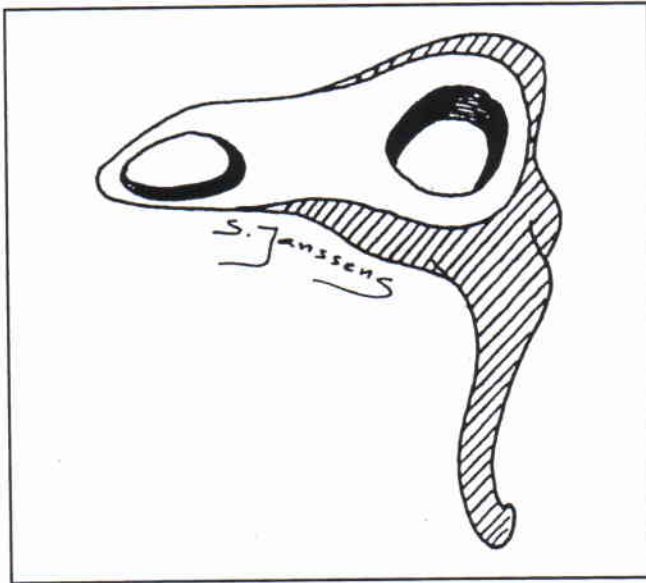


Fig. 1. The autograft or allograft incus is drilled into a figure-eight-shaped figure. The long process is to be removed.

tremity (Fig. 1). The angle between the holes can be adjusted, depending on the relative position of the malleus handle with regard to the inclination of the stapes head. One hole fits over the stapes head and the other over the handle of the malleus (Fig. 2). Both articulations are immobilized with fibrin glue (Tissucol®), and the tympanomeatal flap is put back in place. A few sponges, with an antibiotic ointment, are left in place for 3 to 5 days.

Nine variables were studied: gender, side, surgeon, state of the eardrum, history of myringoplasty or mastoidectomy, the use of allografts or autografts, and the preoperative and postoperative disease. Whenever available, four complete audiometric measurements, including measurements of bone and air conduction, were collected: the preoperative audiogram, the audiogram at 2 and 12 months, and the most recent audiogram. All audiometric measurements were performed in a soundproof room with an audiometer that was calibrated according to International Standards Organization standards.

No response to air-conducted sound was coded as 120 dB, to bone-conducted sound as 80 dB. Missing values were coded as such.

Descriptive statistical analyses were performed on all variables. Counts, percentages, histograms, and box plots were used to describe nominal data. Hence, audiometrical results (often expressed as Fletcher index, *i.e.*, the mean of hearing levels at 500, 1000, and 2000 Hz) were described by means of nonparametrical statistics.

A Kruskal-Wallis analysis of variance was performed to study the dependence of the audiometric results on the different variables. A level of significances of 5% was set forward.

RESULTS

The average age of the individuals in the study group was 36 years (range, 6 to 68 years). The male-to-

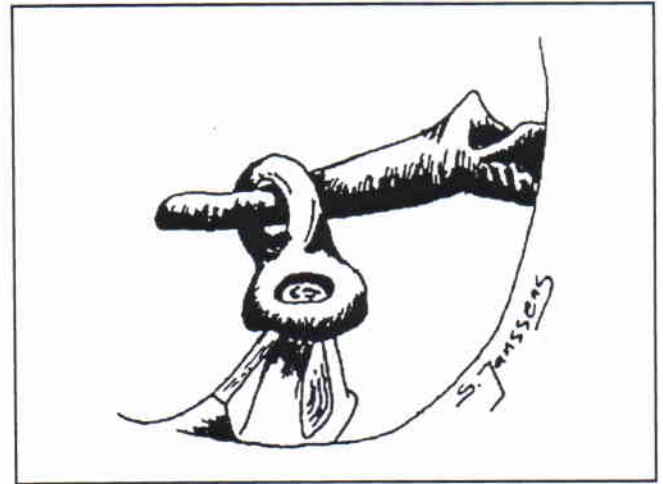


Fig. 2. The "two-hole" technique according to Jean Marquet: the remodeled incus is put in place by fitting one hole over the stapes head and the other over the handle of the malleus.

female ratio was 50:50, and the right- to left-side ratio, 58:42. The preoperative status of the eardrum was normal in 35% ($n = 14$); 2.5% ($n = 1$) presented granulating myringitis. Myringostapedopexy was observed in 10% ($n = 4$), and tympanic retraction was seen in 38% ($n = 15$). Both stapedopexy and tympanic retraction were seen in 15% of the cases ($n = 6$). Thirty percent ($n = 12$) had already undergone other ear surgery prior to the studied ossiculoplasty; 9 (22.5%) previously underwent a tympanoplasty with a tympano-ossicular allograft after removal of cholesteatoma. Two patients (5%) had ventilation tubes placed at an earlier age, and 1 (2.5%) underwent an allograft myringoplasty prior to the present surgery.

We used the autologous sculpted and interposed incus in 31 (78%) of the subjects, and allograft sculpted interposed incus in 9 (22%). The preoperative state of the middle ear mucosa was normal in 30 (75%). Three (8%) showed ossicular fixation and 7 (17%) presented an adhesive, fibrous middle ear.

The audiometric results at 2 and 12 months after operation and the most recent control are presented in Figure 3. The most recent audiogram was performed at a mean interval of 41 months, ranging from 2 to 155 months. The median gains (Fig. 4) are 20 dB at 2 months, 24 dB at 12 months, and 18 dB at the most recent evaluation. Figure 5 presents the median preoperative air and bone levels, the median gains at 2 and 12 months, and the gain at the most recent control. The median gains at 2 and 12 months were 20 dB HL and 24 dB HL, respectively. For the sake of comparability to other reports, and although we are not in favor of this type of representation, we do mention air-bone gap closures for the Fletcher frequencies (0.5, 1, and 2 kHz) to within 10 dB in 70% and to within 20 dB in 87.5% at the most recent evaluation. No correlations between the different variables were found. No postoperative complications were noticed.

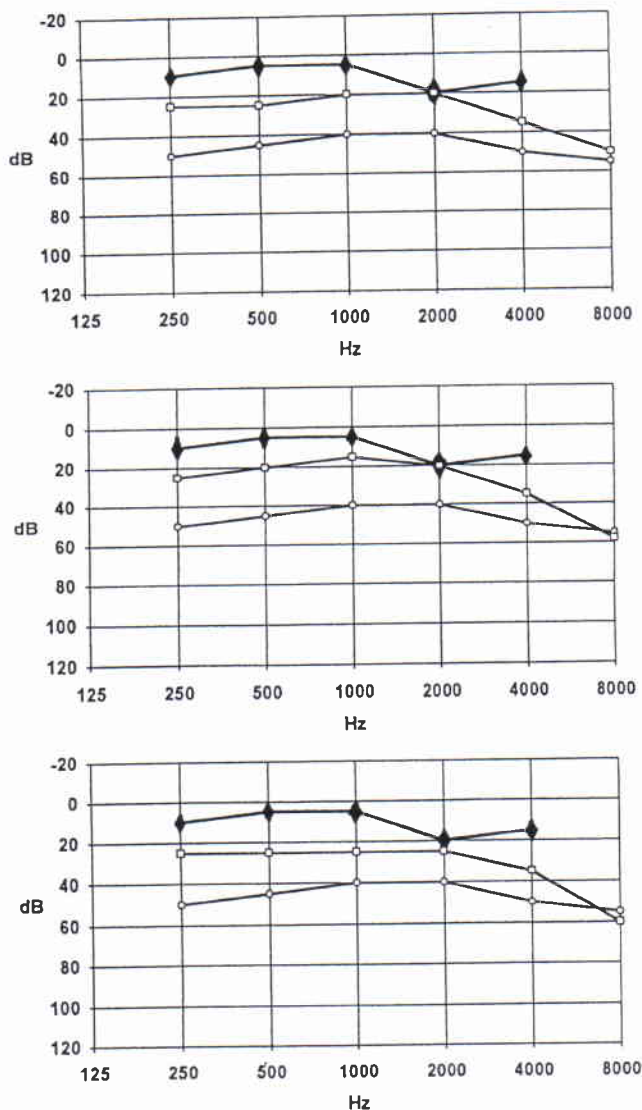


Fig. 3. Audiometric results, **top**, at 2 months after operation; **center**, at 12 months after operation; and, **bottom**, at the latest postoperative evaluation. Solid diamonds = median preoperative bone conduction threshold; circles = median postoperative air conduction threshold; squares = median postoperative air conduction threshold.

CONCLUSION

As mentioned earlier, many different refinements of the incus interposition technique have been developed. They all have in common the aim of achieving a stable reconstruction that permits long-term survival. However, when a study group is heterogeneous, including all types of tympanoplasties and combining ossiculoplasty and myringoplasty at the same stage as presented in the majority of the studies, one cannot analyze the true effects of the single assembly because many factors may influence the overall result.

The two-hole technique was developed to give the malleostapedial assembly a high and reliable stability, reducing the risk of displacement to a minimum.

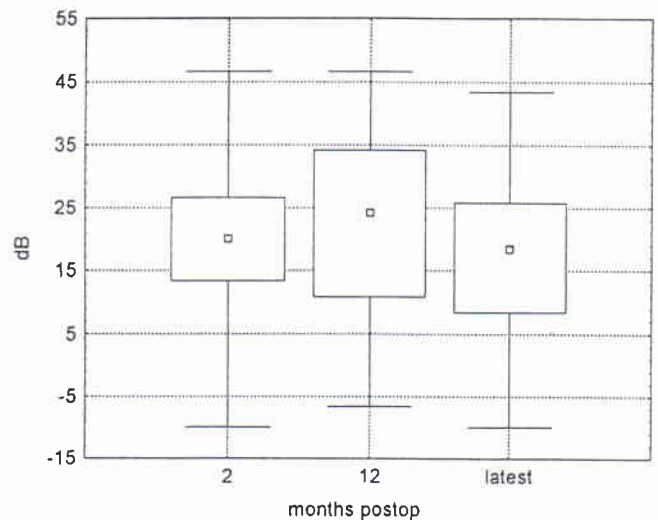


Fig. 4. Hearing gain of the two-hole incus interposition expressed as median gain (dB) of the Fletcher indices at 2 and 12 months after operation and at the most recent evaluation. Bars = minimum to maximum; large rectangles = 25% to 75%; small squares = median value.

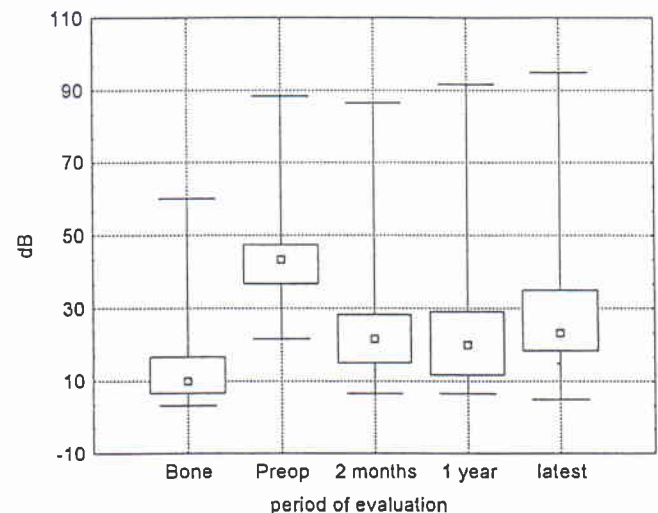


Fig. 5. Audiometric data. The preoperative bone and air conduction thresholds and the postoperative air conduction thresholds (all Fletcher indices) are shown. Bars = minimum to maximum; large rectangles = 25% to 75%; small squares = median value.

Therefore we selected a homogeneous study group, in which the only operative handling consisted of the reconstruction of an M+S+ type of ossicular defect,³ that is, a disrupted incudostapedial joint with an intact malleus and stapes head. Thus all potential influences of other surgery on the reconstruction have been eliminated, enabling us to analyze the real hearing gain achieved by the assembly itself.

The present results give evidence that the two-hole technique is capable of reaching the two major goals of every ossiculoplasty: a satisfactory hearing gain and stability. Knowing this, we do not hesitate to recommend this type of reconstruction whenever necessary, using either autografts or allografts.

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