Use of a Remodeled Autologous Incus as an Ossicular Prosthesis

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Abstract:

Objective: This study explores the hearing results of tympanoplasty with ossiculoplasty in chronic otitis media using an autologous incus graft and to determine the stability of the remolded incus.

Methods and Materials: A total of eighteen patients who had undergone tympanoplasty with ossiculoplasty using an autologous incus were studied. All cases were followed for six or more months. Pre-operative and postoperative audiometric findings at the final followup visit were compared. Results were considered good if the postoperative air-bone gap was reduced to 20 db or less.

Results: Out of 18 cases, in 12 (66.7%) the final postoperative audiogram recorded an air-bone gap of 20 dB or less. Comparison of pre and postoperative air-bone gap had a significant P value of less than 0.000 (paired t-test).

Conclusion: Ossiculoplasty using autologous incus graft material is an effective and safe surgical method for reconstruction of the ossicular chain and for hearing restoration.

Introduction:

In India, chronic ear disease can damage both the eardrum and the three middle ear bones (ossicles). A tympanoplasty refers to the repair of either of these structures. The term ossiculoplasty refers to the
reconstruction of the ossicular chain. The object of this report is to evaluate the use of an autologous incus as a grafting material for ossiculoplasty.

Historically, restoration of sound conduction had been largely ignored because of the primary concern of the surgeon was the creation of a “safe” ear. However, with the introduction of sculpted autograft incus interposition by Hall and Rytzner in 1957, the goals of chronic ear surgery expanded to both disease removal and hearing restoration. Since then, many innovative designs and materials have been used to bridge the gap between the malleus and stapes, and numerous approaches to ossicular reconstruction have been shown to be successful.

The past three decades have witnessed an evolution of a continuum of various ossiculoplasty materials with varying results and this evolution still continues. This short study assesses the results of ossiculoplasty in ears with chronic otitis media without cholesteatoma using only autologous incus as a graft material.

Methods:

A total of 18 patients had undergone ossiculoplasty at SSG hospital (Government Medical College, Baroda) over a period of three years, from 1999 to 2002. Nine patients had a central perforation, nine cases had a posterior superior retraction pocket. The stapes was intact in all but one patient. The patients’ ages ranged from 15-35 years with a mean age of 23.44 years (Table 1); seven were males and eleven were females (Table 2).

Table 1: Age Distribution

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>6</td>
<td>33.3</td>
</tr>
<tr>
<td>20-25</td>
<td>7</td>
<td>38.9</td>
</tr>
<tr>
<td>25-30</td>
<td>4</td>
<td>22.2</td>
</tr>
<tr>
<td>30-35</td>
<td>1</td>
<td>5.6</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2: Sex Distribution

<table>
<thead>
<tr>
<th>Sex</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>11</td>
<td>61.1</td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
<td>38.9</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Only patients followed postoperatively for at least 6 or more months were included in the study. None of the patients had otorrhea at the time of surgery. Ossiculoplasty was performed using a remodeled incus as an autologous graft material. Out of the eighteen cases, in ten cases a tympanomastoid with ossiculoplasty was performed and in the remaining eight cases only tympanoplasty with ossiculoplasty was carried out. Temporalis fascia graft was used in seventeen cases and in one case the tragal perichondrial graft was used for tympanic membrane grafting.
The picture to the right shows a craved incus to be used as a bridge between the head of the stapes and the eardrum. The long process of the incus has been removed. A notch or facet for the head of the stapes has been created in the body of the incus.

Hearing levels were measured using a clinical audiometer. Pre-operative and postoperative comparisons were performed by pure tone audiometry in standard conditions. The mean hearing thresholds and air-bone gap were measured by calculation using frequency 0.5, 1, 1.5 and 2 kHz. Pre-operative bone conduction thresholds were used in calculation of air-bone gap. The postoperative hearing results have been considered to be satisfactory if the mean postoperative air-bone gap was 20 dB or less.  

Results

The average followup period was 9 ± 3 months. The operation resulted in an intact eardrum in the majority of cases, fifteen ears (83.3%). The mean pre-operative air-bone gap was 38.22 dB and the mean postoperative air-bone gap was 18.11 dB. Results observed using an autologous incus reconstruction in 18 patients, 12 (66.7%) cases had a postoperative air-bone gap less than 20 dB as calculated from the last patient's audiogram (Chart 1). Comparison of the pre and post-operative air-bone gap with a paired t-test found that this difference was significant with a p value of less than 0.0000 (Table 3).

<table>
<thead>
<tr>
<th>Air-Bone Gap (dB)</th>
<th>Mean</th>
<th>N</th>
<th>Std. Dev</th>
<th>P-Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Operative</td>
<td>38.22</td>
<td>18</td>
<td>4.29</td>
<td></td>
</tr>
<tr>
<td>Post Operative</td>
<td>18.11</td>
<td>18</td>
<td>6.14</td>
<td></td>
</tr>
<tr>
<td>Pre - Post Op</td>
<td>20.11</td>
<td></td>
<td>4.59</td>
<td>&lt; 0.0000</td>
</tr>
</tbody>
</table>
Discussion:

Reconstruction of the ossicular chain is still a developing surgical discipline in otolaryngology. The operation removes disease and pathology from the tympanum and reconstructs the tympanic membrane and ossicular chain. The goal is a stable and reliable connection between the tympanic membrane and the mobile stapes footplate, and to achieve the best long term hearing result.

Replacement prostheses can be divided into three types: Autograft, homograft (or allograft) and synthetic. Autografts are derived from the same patient and are usually obtained from the temporalis fascia, auricular cartilage (conchal or tragal) or the patient's own remaining ossicles. Homografts (or allografts) are obtained from other individuals of the same species but with a different genetic makeup. Disadvantages of homografts are the possibility of disease transmission\(^1\), biocompatibility, rejection and are more likely to become displaced. Homograft eardrums with complete ossicular chains have been used in the past to reconstruct severely damaged tympanic membranes and middle ears.\(^1\) Synthetic prosthesis are readily available, are presculptured and easy to use. However, they can have difficulties with displacement and extrusions. This was common with the porous polyethylene prostheses which were inserted in the early 1980s, that had a five year success rate as low as 22%.\(^2\) Newer prostheses using biocompatible materials, such as hydroxyapatite\(^3\) titanium\(^4\), have much higher success rates. Extrusion of synthetic prosthesis can be lowered by the placement of bone or cartilage between the eardrum and the prosthesis.
O'Reilly, R.C., et.al, reported that twenty-seven percent of patients who underwent ossiculoplasty achieved an air-bone closure within 10 dB, and 66.4% within 20 dB of the postoperative bone conduction hearing threshold. Average time to the last postoperative audiometric testing was 15.8 months, with a range of 2 to 62 months. Wehrs, R. E. used an autologous incus for ossicular reconstructions and reported satisfactory results in 83% of patients. Desaulty, A., et.al, reported that 78% of patients who underwent an autologous incus reconstruction had a final air-bone gap less or equal to 30 decibels. The mean pre-operative air-bone gap was 38.23 dB and the mean postoperative air-bone gap was 18.12 db. The average gain was 20 decibels. The cost of the autograft was null and tolerance was excellent. Zheng, C., et.al, study revealed the residual air-bone gap was less than 20 dB in 86.1% of cases two months after surgery. The result dropped to 77.0% one year later, and then remained stable over time, even in patients seen 5 to 15 years after the operation.

In our study, the mean pre-operative air-bone gap of approximately 38.22 dB was reduced to 20 dB postoperatively, leading to a 19 dB average gain in hearing. This produced a pleasing level of hearing improvement to the patient.

Conclusion

In patients with chronic otitis media causing hearing loss from ossicular chain damage, this study concluded that ossiculoplasty using an autologous incus as a grafting material was an effective and safe surgical method for reconstruction of the ossicular chain and restoration of sound transmission. A remolded autologous incus provided not only hearing restoration but also has a very low extrusion rate. The patient's incus is also readily available, cost effective and can be remolded according to the type of ossicular defect found in the patient.

References:


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