A Study of Ossiculoplasty in Chronic Otitis Media using different types of Prostheses
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Abstract

Introduction: A wide range of prostheses, autologus and synthetic are available for use these days. Ideally, the ossicular reconstruction prosthesis should be biocompatible, safe, easy to handle and capable of efficient sound transmission.

Aim and objectives: To study operative ease and post-operative hearing results in patients undergoing ossiculoplasty with different types of prostheses.

Materials and methods: A prospective randomized study of 25 patients with Chronic Otitis Media, undergoing ossiculoplasty was conducted at Command Hospital, Kolkata. Tragal cartilage was used in 05 patients, conchal cartilage in 05, refashioned incus in 05, hydroxyapatite in 05 and titanium prostheses in 05 patients. Subjects with mixed hearing loss, multiple co-morbidities and revision surgeries were excluded. Hearing assessment was done by pure tone audiometry pre-operatively and 04 and 12 weeks postoperatively. Results were analyzed statistically.

Results: Using tragal or conchal cartilage took almost equal time as autologus incus. Using synthetic material saved time. Titanium prosthesis gives maximum surgical ease. Post-operative air-bone gap reduction within 20 dB was seen in all, irrespective of type of prostheses.

Conclusion: Surgical ease is considerably better with titanium prostheses; however hearing results are equally good in all.

Introduction

Ossiculoplasty is frequently used in the treatment of conductive hearing loss. Earliest recorded attempt to re-establish a connection between tympanic membrane and oval window in case of a missing ossicle was in 1901. Since then, numerous materials have been used to re-create the middle ear sound-conducting mechanism. Many different materials have been used for ossicular reconstruction over the past 50 years, including both biologic and alloplastic materials, with varying degrees of success. Ideally, the ossicular reconstruction prosthesis should be biocompatible, safe, easy to fit and handle, and capable of efficient sound transmission. Biologic materials include autograft or homograft ossicles, cortical bone, teeth, and cartilage. Body of Incus, often reshaped, has been most commonly used as autograft ossicular prosthesis. Hydroxyapatite prostheses, introduced by Grote in 1981, are one of the most common currently used ossicular reconstruction implants. Hydroxyapatite is a bioactive ceramic of calcium phosphate that in composition resembles the matrix of bone. In the 1970s, Titanium was established as an excellent biocompatible material and was introduced as an alloplastic material for ossiculoplasty in 1993.

Materials and Methods

A prospective randomized study of 25 patients with Chronic Otitis Media, undergoing ossiculoplasty was conducted at Command Hospital (EC), Alipore, Kolkata-27, a tertiary care centre.

Preoperative assessment of severity of hearing loss was done by pure tone audiometry. Audiometric testing was done in double-walled sound protective rooms with standard procedures. Preoperative audiometric testing was performed at 500, 1000, 2000 and 3000 Hz. Postoperative air- and bone-conduction scores were recorded at 500, 1000, 2000 and 3000 Hz.

Preoperative and perioperative findings noted were: status of tympanic membrane, ossicles and attic; presence of cholesteatoma; presence of granulation.

Most patients underwent surgery under local anesthesia. Local anesthetic is administered in the form of 2% lignocaine with 1 in 80,000 epinephrine.
Tragal cartilage was used in 05 patients, conchal cartilage in 05 patients, refashioned incus in 05 patients, hydroxyapatite in 05 patients and titanium prostheses in 05 patients.

Subjects with mixed hearing loss, multiple co-morbidities and revision surgeries were excluded from the study.

Post-operative hearing assessment was done by pure tone audiometry at 04 weeks and 12 weeks after surgery.

Results were analyzed statistically.

Results
A total of 16 female and 09 male patients were evaluated. The mean age of the patients at the time of surgery was 37 years, with a range of 13 and 72 years.

The ossicular chain was reconstructed with a tragal cartilage, conchal cartilage, refashioned incus, hydroxyapatite and titanium prostheses in 05 patients each.

<table>
<thead>
<tr>
<th>Table 1: Air-Bone Gap (Pre-operative) Distribution:</th>
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<tr>
<td><strong>Air-Bone Gap (Pre-op)</strong></td>
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<tr>
<td>---------------------------</td>
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<tr>
<td>26-35 dB</td>
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<td>36-45 dB</td>
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<th>Table 2: Post-operative Air-Bone Gap Reduction:</th>
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<tr>
<td><strong>Air-Bone Gap Reduction</strong></td>
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<td>----------------------------</td>
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<tr>
<td>11-20dB</td>
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<td>21-30dB</td>
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Table 1 shows the pre-operative Air-Bone Gap, while Table 2 shows the postoperative Air-Bone Gap Reduction.

In our study, we found that the Incus was the most commonly involved ossicle. No cases of graft extrusion or failure were encountered.

Patients with prosthesis showed faster Air-Bone gap closure than those having undergone autologous ossiculoplasty.

Using tragal or conchal cartilage took almost equal time as autologous incus. Using synthetic material saved time.

Titanium prosthesis gives maximum surgical ease.

Equally good results may be achieved with various autograft materials used when compared with prosthetic ossiculoplasty.

Discussion
The incudostapedial joint and the lenticular process of the incus are the most common sites of ossicular discontinuity. This defect can lead to an air-bone gap of up to 60 dB. Interposition of incus body as a bridge between the stapes and the malleus was the original ossicular reconstruction surgery. Disadvantages of autograft ossiculoplasty are: prolonged operative time, possible displacement or resorption, possibility of the autograft harboring microscopic cholesteatoma, poor fit if the stapes superstructure is absent. Advantages of autograft ossiculoplasty are: low extrusion rate, low cost and excellent biocompatibility.

Irradiated homograft ossicles and cartilage were first introduced in the 1960s in an attempt to overcome some of the disadvantages of autograft implants. In the late 1970s, a high-density polyethylene sponge (HDPS) that had nonreactive properties was developed. The original form was a machined-tooled prosthesis (Plasti-Pore). A more versatile manufactured thermal-fused HDPS (Polycel) arrived later.

Applebaum designed a Hydroxyapatite prosthesis for defects of the incus long process. Kurz angular prosthesis made of a gold shaft, gold cup, and titanium clips was also developed. In 1993, the Total (Arial) prosthesis and the Partial (Bell) prosthesis were made of Titanium. In 1996, Spiggle and Theis introduced a new Titanium prostheses that can be trimmed intraoperatively to the appropriate length. The use of Hydroxyapatite and Titanium implants has become popular in ossicular reconstruction surgery since their introduction in 1981 and 1993, respectively.

A study by Ho and Battista published in 2003 found no evidence of inflammatory granulomatous reaction to the HA in the ears of patients undergoing revision surgery.

Extrusion rates for HA implants have been cited in the literature as ranging from 4% to 21%. On long-term follow-up, Goldenberg and Drive found a satisfactory hearing result (defined as a postoperative ABG of <20 dB) in more than 50% of their patients. Success rates in other studies have varied from 46% to 83.3%.

Titanium has also been found to have excellent biostability in the middle ear. A theoretical advantage of Titanium implants is that the prosthesis weight is more similar to the native ossicles compared with Hydroxyapatite. Truy et al compared 2 groups of patients who underwent Titanium versus Hydroxyapatite ossiculoplasty and found no significant difference in hearing results or extrusion rates.
although on long term follow-up, the results did favour Hydroxyapatite slightly. Yuri M. Gelfand and C. Y. Joseph Chang in their study found no significant difference in hearing result between the Hydroxyapatite and Titanium implant groups.

Dr Sushil Jha et al studied 76 patients prospectively who underwent ossiculoplasty. Majority of the patients were between the age group of 14 to 35 years. Pure tone average for 3 frequency (0.5,1,2 kHz) were used to calculate and compare the air bone gap preoperatively and postoperatively at 2 and 5 months. The graft materials used for ossiculoplasty were cartilage, bone, gold, plastipore and titanium. Study revealed very good results with the titanium prosthesis with about 75% of success rate. 52.6% of patients with gold prosthesis had a hearing improvement between 10-30 db at 5 months of follow-up.

Ossiculoplasty with biocompatible alloplastic materials like Teflon, Poroplast have sometimes resulted in migration, extrusion or penetration into the inner ear. Extrusion of prosthesis is reduced considerably when cartilage is placed between the prosthesis and the tympanic membrane.

Conclusion

No significant difference was found in our study between different implants in terms of hearing results. This finding supports those of several other studies in the literature that have arrived at similar conclusions. We evaluated only short-term audiological results, and it is possible that differences between different prostheses may appear on long-term follow-up. The selection of prosthesis will largely depend upon surgeon’s personal preference and comfort. We found surgical ease is considerably better with titanium prostheses. A large, randomized, long term prospective study is necessary for a more definitive comparison between different prostheses.

References