Evaluation of Efficacy of Butterfly Cartilage Tympanoplasty

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Abstract

Objective: Evaluation of efficacy of butterfly cartilage tympanoplasty.
Material and methods: This prospective study was conducted on forty patients between the ages of 16 to 50 years. All patients had a central tympanic membrane perforation of 2 to 5 mm in size without infection in middle ear or upper respiratory tract.
Results: Of the forty patients, 52.5% were males and 47.5% females. The graft success rate was 95% with an improvement in the AB gap of less than 20 dB.
Conclusion: Butterfly tympanoplasty is simple to perform, takes less operative time, there is no donor site cosmetic deformity, there is immediate improvement in hearing on the operating room table. The trans canal approach was useful in females who do not want their hair shaved for cosmetic reason.

Introduction

Salen from Sweden was probably the first person who experimented with cartilage myringoplasty with good results. He used septal cartilage with mucosa and perichondrium on one side, harvested from the anterior part of the septum. He placed the graft, with the mucosa lined surface of the cartilage graft, towards the middle ear. The edges of the perforation were removed and the graft placed after paring the thickness of the cartilage to thin the graft. He achieved a success rate for closing the perforation in 92% of patients, along with very good hearing results. Later Heermann, et al., introduced the cartilage palisade tympanoplasty to support the facial graft. They called this technique as simmering.
At almost the same time, Goodhill\(^3\) introduced the first cartilage perichondrium composite graft for reconstruction of the tympanic membrane after earlier experimenting with its use during stapedectomy. In 1998, Eavey\(^4\) described a novel technique cartilage tympanoplasty. He used tragal cartilage with perichondrium on both sides in children with very good results. He introduced this technique as inlay cartilage tympanoplasty and termed it as the butterfly technique. Latter, Tos\(^5\) classified cartilage tympanoplasty in six broad groups. The sixth (Group F) was comprised of two sub-groups: Inlay butterfly tympanoplasty and composite chondroperichondrial clip tympanoplasty or the triple “C” technique. Later on many authors used the butterfly myringoplasty due to ease of the technique. We describe our experience using the Eavey\(^4\) cartilage myringoplasty technique with little modification as advocated by Tos,\(^5\) in 40 consecutive cases of small to moderate size perforation.

Methods

The present prospective study was conducted in forty patients between the ages of sixteen to fifty years, who suffered from chronic suppurative otitis media with dry central tympanic perforation. All underwent Type 1 modified cartilage butterfly tympanoplasty via a transcanal approach. Patients were excluded from the study if they had any of the following: Ear discharge within the preceding one month, hearing loss disproportionate to size of perforation, possibility of cholesteatoma, granular myringitis, Perforation size equal to or greater than 50% of the total surface area of the tympanic membrane, ossicular erosion or sensorineural deafness. Preoperatively, patients underwent routine investigations including tuning fork tests, Hb, bleeding time, clotting time, complete urine examination and if necessary lateral view X-ray. All patients were operated under local anesthesia using xylocaine. Pure-tone audiometry was performed in each case and the average air bone gap of each patient was calculated preoperatively and postoperatively at the frequency of 500, 1000 and 2000 Hz. The purpose audiometric testing was also to ascertain the cochlear function (reserve) of the patient. All patients fasted at least six hours before surgery and consent was taken in writing.

Premedication with pentazocin 30 mg, promethazine 25 mg and atropine 0.4 mg intramuscular was given half an hour prior to the operative procedure. The operated area was cleaned with betadine and methylated spirit and draped ensuring complete asepsis. Local anesthesia (xylocaine 2% with 1:100000 adrenaline) was injected in the pre auricular, post auricular, supra auricular and infra auricular area. An incision in the skin was made 2 mm away from the lateral edge of the tragus (Figure 1). Tragal cartilage was exposed and an incision was made on the cartilage on the medial side 2 mm away from the cartilage summit so that a small strip of cartilage was left in place to maintain tragal contour postoperatively. The cartilage was harvested along with intact perichondrium (Figure 2). The surfaces and the wound were sutured with silk, which was removed after 7 days. The cartilage graft was tailored according to the size of the perforation, i.e., approximately 2 mm larger in diameter.

Enlarged Pictures at End of Manuscript
The cartilage graft was held with a gloved thumb and index finger and carefully grooved all along its perimeter using surgical blade no.15. Extreme care was taken to avoid peeling off the perichondrium (Figure 3). The margins of perforation were freshened and the cartilage graft was slipped across the perforation one edge of the cartilage at a time, as if a cuff link was being inserted across a button hole. Initially the butterfly cartilage perichondrium graft was placed anteriorly and inferiorly. The margins of the perforation usually went inside the groove to about 1 to 2 mm depth and the plugged cartilage formed an island, as one surface of cartilage with its perichondrium lies inside the middle ear and other on the lateral side of the margin of the perforation. The canal was packed with medicated gelfoam and a sterile cottonball was put in the external meatal opening. Postoperatively, ciprofloxacin 750 mg BID, levocetrizine 5 mg and tablet diclofenac 50 mg SOS (Si Opus Sit - it there is need) for 10 days. The patient was discharged on the same day. At one week follow up, suture removal was done and the operated tympanic membrane was inspected and patient was called after 4, 6, and 12 weeks for follow up (Figure 4). The graft was considered successful if the tympanic membrane was found intact at 6 weeks and pure tone averages were also obtained at the same time. The hearing results between the pre and postoperative group were compared by student’s t-test.
Results

The majority (75%) of the patients were in the age group of 16 to 24 years. Out of the total patients, 52.5% were males and 47.5% were females (see Table 1).

Table 1: Age and sex of the patients.

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-24</td>
<td>18</td>
<td>12</td>
<td>30</td>
<td>75%</td>
</tr>
<tr>
<td>25-34</td>
<td>02</td>
<td>04</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>&gt;35</td>
<td>01</td>
<td>03</td>
<td>04</td>
<td>10%</td>
</tr>
</tbody>
</table>

Postoperatively, 38 out of the 40 patients had an intact tympanic membrane at six weeks accounting for a 95% success rate. Out of 21 male patients, we had success in 20, i.e., 95.23% whereas out of 19 females, 18 had a successful outcome, i.e., 94.73%. The size of the perforation was 2, 3, 4 and 5 mm in 4, 18, 10 and 8 numbers of patients, respectively. The maximal closure rate was observed in 3 mm perforations; however, the healing was almost the same in the rest of the perforation. Twenty-three patients had an air bone gap in the range of 11-20, 9 patients 21 to 30 dB and 8 patients showed an air bone gap of greater than 30 dB, preoperatively whereas no patient had an air bone gap below 10 dB prior to surgery. Postoperatively, at six weeks, 8 patients had an air bone gap below 10 dB, whereas 28 patients improved below 20 dB and 4 cases remained at the same level as preoperative (Table 2). Two cases had graft acceptance initially but after 2 weeks had recurrence of perforation and extrusion of cartilage graft due to otomycosis.

Table 2: Comparisons of pre and postoperative air bone gap on pure tone audiometry.

<table>
<thead>
<tr>
<th>Air Bone Gap (dB)</th>
<th>Preoperative (Number of Patients)</th>
<th>Postoperative (Number of Patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤10</td>
<td>0</td>
<td>08</td>
</tr>
<tr>
<td>11-20</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>21-30</td>
<td>09</td>
<td>04</td>
</tr>
<tr>
<td>&gt;30</td>
<td>08</td>
<td>0</td>
</tr>
</tbody>
</table>
Discussion

Chronic suppurative otitis media is a very common condition in the practice of otolaryngology both in developed as well as developing countries. The common sequel of chronic suppurative otitis media is perforation of the tympanic membrane which results in recurrent otorrhea and hearing loss. Every otolaryngologist must know how to repair a tympanic membrane perforation. A commonly used graft is the temporalis fascia which may be used in an underlay or onlay technique.6

In current surgical practice, the tragal cartilage with perichondrium graft has gained popularity, more so after the technique was described by Eavey.4 However, the introduction of cartilage as a graft for tympanoplasty debuted almost at the same time as temporalis facia. The cartilage tympanoplasty offers an otologist another reliable material in his armamentarium for tympanic membrane reconstruction.7

The choice of technique largely depends on the surgeon's preference. Eavey4 first used tragal cartilage with perichondrium on both sides for myringoplasty for small tympanic membrane perforation in children. The logic for this technique was that since the children have repeated upper respiratory infections, and the cartilage graft type I tympanoplasty will resist reperforations subsequent to these infections. He also placed a split thickness skin graft on the cartilage. However, in our patients we used neither skin or any other graft over the cartilage.

Cartilage tympanoplasty has many advantages in situations such as recurrent, residual, total perforations, chronic mucosal dysfunction or severely atelectatic tympanic membranes, where facia and perichondrium undergo atrophy and subsequent failure.8 In these high-risk situations, cartilage is increasingly accepted as grafting material.9,10 In comparison to fascia and perichondrium, it is characterized by increased stability and resistance to negative middle ear pressure. Further, it has a low metabolic rate to survive long and is well accepted in the middle ear.11 Cartilage, when used for reconstruction of the posteriosuperior quadrant of the tympanic membrane, has been shown to reduce the incidence of recurrent retraction pockets because of its rigidity.12 The graft is easy to harvest from the tragus or conchal bowl and is well tolerated in the middle ear. However, cartilage has been criticized due to concern regarding hearing results because of its thickness.13 However, this is not the case, since Aarnisalo, et al.14 evaluated the middle ear mechanics of 0.5 and 1 mm thick tympanoplasty by computer assisted optoelectric laser halography and vibrometry in an experimental study in cadavers and found no significant effect except above 4 KHz.

Gerber, et al.15 studied the hearing results in patients who had cartilage tympanoplasty. The results were comparable to temporalis fascia. They advocated that a cartilage perichondrium graft is useful to prevent recurrence or progression of postoperative retraction pockets. Recent studies by Mohamad, et al., reported better results with cartilage as compared to temporalis facia.16 Lin, et al., also observed good results and advocated that this technique be used in older patients and in patients with co-morbidities.17 Tos, an authority in tympanoplasty, classified 23 different types of cartilage tympanoplasty in six groups.18

- Group A the tympanic membrane is repaired using many full thickness strips of cartilage with perichondrium on canal side. Six different methods are included in this group.
- Group B consists of cartilage tympanoplasty with several foils, thin and thick plates of bare cartilage without perichondrium. Four different methods are included in this group.
• Group C consists of a cartilage perichondrium composite island graft where perichondrium suspends and fixates the cartilage island. In this group also four different methods are included.
• Group D, a total pars tensa perforation is reconstructed using a large cartilage perichondrium graft. There different methods of reconstruction were used in this group.
• Group E, anterior, inferior and subtotal perforations were repaired using a cartilage perichondrium composite graft. In this group, four methods were used including two inlay and two onlay techniques.
• Group F, the cartilage disc is placed under the perforation and perichondrium on top of the tympanic membrane on the denuded margins of perforation. Butterfly cartilage tympanoplasty is included in this group.

We performed cartilage tympanoplasty in healthy young patients. Lin, et al., carried this out in different age groups and did a multivariate analysis. They found that age, sex, size and side of perforation, diabetes mellitus and otomycosis didn’t have any effect on graft uptake. Only smoking was found to have an adverse effect on graft uptake. They specially recommended butterfly cartilage tympanoplasty in older patients or who had no other comorbidities.

Results of cartilage tympanoplasty, even in large perforations, was found to be good. Chen, et al., achieved an 85.8% success rate, although they included cases where simultaneous ossiculoplasty was also done. Kim, et al., achieved a success rate of 96.3% and recommended it because of its ease, speed, and patient’s comfort.

Cartilage tympanoplasty is described to be of utmost value in large size perforations which include revision surgery, anterior, marginal or even a draining perforation at the time of surgery, subtotal or total perforation and bilateral perforation.

Initially, butterfly cartilage tympanoplasty was used in children by Evay. Since the children are more prone to URI, hence the chances of reperforation after tympanoplasty are increased. In such situations, cartilage tympanoplasty should theoretically be better. The cartilage thickness of the tragus and cymba is the same in children as in adults, however, the perichondrium is more adherent in children. Hence while making a groove or if the perichondrium is to be removed from one side, one must be careful while making a butterfly cartilage graft in children. Cartilage should be held between the finger and thumb and not in tooth forceps to avoid breakage. Tragal cartilage is ideal since it is thin flat and in a reasonable quantity to reconstruct even the entire tympanic membrane (Dornhoffer). We used tragal cartilage in all of our cases.

The concept of cartilage tympanoplasty is not a new one, and it has only been used in few cases till recently. Previously, it was believed that there will be some degree of conductive loss after cartilage myringoplasty because of its thickness and rigidity as compared to the commonly used temporalis fascia. However, Milewski reported that this is not so. Cartilage is as well tolerated and accepted as other commonly used grafts. It is nourished by diffusion and gets well incorporated in the tympanic membrane. Further some softening occurs over time due to the development of empty lacunae as a result of the degeneration of chondrocytes.

On the contrary, cartilage graft tympanoplasty is beneficial, since the cartilage graft maintains some degree of rigidity which resists resorption and retraction that can occur in some stubborn cases. Recently, Ayache described butterfly cartilage tympanoplasty by a transcanal endoscopic procedure. He achieved a 96% success rate. Furthermore, there were no cases of anterior blunting and lateralization and the procedure was minimally invasive.
Conclusion

Butterfly tympanoplasty is simple to perform, takes less operative time, there is no donor site cosmetic deformity, there is immediate improvement in hearing on the operating room table. The trans canal approach was useful in females who do not want their hair shaved for cosmetic reason.

References


