Tympanic membrane grafting: underlay periosteal versus inlay cartilage grafts, a comparative study

Abstract

Introduction: Infection of the middle ear has been a problem encountered in the human race; it is as old as humanity itself. Tympanoplasty was introduced by Zollner and Wullstein in 1952 for closure of the perforated tympanic membrane (TM). Numerous grafting materials and methods of placement have been described.

Material and methods: One hundred forty-nine patients were involved in this retrospective study. Patients were classified into two groups. Group A (88 patients underwent underlay periosteal TM grafting), Group B (61 patients subjected to inlay cartilage tympanoplasty). Results: Group A success rate was 93% with mean closure of air bone gap 6.6 dB while Group B success rate was 92% with mean closure of air bone gap 12.1 dB.

Conclusion: Both underlay periosteal and inlay cartilage grafts show high rates of graft take, with relatively better hearing results using the underlay periosteal grafts but shorter operative time with the inlay cartilage grafts.

Background

Infection of the middle ear has been a problem encountered in the human race, it is as old as humanity itself.10

Tympanoplasty was introduced by Zollner and Wullstein in 1952 for closure of the perforated tympanic membrane (TM). Numerous grafting materials and methods of placement have been described.11,12

Inlay myringoplasty using a cartilage graft has become a widely accepted technique for the repair of tympanic membrane perforations by the way of a transcanal approach.8 It provides several practical advantages, for example, no external canal packing or middle ear support is necessary because the graft stabilizes instantly at insertion, patient postoperative comfort is enhanced, and the procedure is less expensive because of diminished operative and recovery room time.8 However, one of the theoretical limitations initially was the inability to be performed for a perforation that could not be seen entirely by the way of transcanal view.4

Periosteum of the mastoid cortex was mentioned in the literature as a suitable material for repairing perforated ear drums with many worthy advantages.4

Materials and methods

This study was retrospective controlled trial, comparing two different techniques performed by two University hospitals, in the period from 2014 to 2016.

One hundred forty-nine patients were involved in this study. Patients were classified into two groups:

Group A
 Included 88 patients underwent underlay periosteal TM grafting performed.

Group B
 Included 61 patients subjected to inlay cartilage tympanoplasty.

All patients had dry central TM perforation for at least 2 months before surgery. Cases with granulations, discharge, myringitis, active infection, otomycosis, mixed hearing loss, previous failed myringoplasty, and cases which required cortical mastoidectomy, middle ear exploration were excluded.

Preoperative history taking and audiological assessment were done. Air Bone Gap (ABG) was calculated from the mean of 500, 1000 and 2000 Hz hearing frequencies.

Intraoperatively the time consumed during the operation was recorded.

Postoperative evaluation was done 6 months post surgery included: graft take and mean ABG.

Surgical technique

Group A

All procedures were performed under general anesthesia. Perforation’s edges were refreshed by Rosen needle. Infiltration of the post-auricular region and posterior canal wall was done using a mixture of 2% Lidocaine with 1:100,000 adrenaline. Postauricular incision, dissection of post auricular muscles and apponeurotic tissue was done until the periosteum over the mastoid cortex is exposed. Number 15 scalp knife was used for cutting a rectangle of periosteum over the mastoid cortex just behind the ear meatus (about 10x15 mm or according to the size of the perforation). Dissection was continued till exposure of the middle ear cavity. Graft was applied by underlay technique then the meatal flap was replaced back and small pieces of Gelfoam were introduced through the meatus to stabilize the graft at the edges of the perforation. Finally the post auricular incision was sutured and a piece of Vaseline gauze impregnated with Oxytetracycline ointment was applied through the external canal (Figure 1).
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Group B

Under general anesthesia, trimming of perforation’s edges and infiltration of tragal skin with lidocaine and epinephrine were done as above. A 1.5-cm skin incision was made just posterior to the free edge of the tragal cartilage with a number 11 scalpel blade. The subcutaneous tissue was dissected posteriorly and anteriorly from the perichondrium. Graft was harvested leaving 1-2 mm of the outer rim of the cartilage for cosmetic purpose. Graft size was approximately one and half the size of the perforation after trimming. Bleeding was controlled. The incision was sutured with 3 sutures of prolene 3-0.

Using a number 15 blade, a layer of the cartilage with the overlying perichondrium was elevated from all the edges of the graft, kept attached to the remaining part of the graft at its center and kept to dry in this position “Lotus-shaped” or “Butterfly-shaped”.

The graft was held with a forceps where the cartilage proper positioned on the undersurface, passed through the perforation to cover the medial surface of the drum while the upper layer (cartilage and perichondrium), which was still attached to the under layer of the graft, was spread to cover the lateral surface of the drum (sandwich-like).

The technique was totally permeatal. Gel foam was placed and the ear was covered by dressings (Figure 2) (Figure 3).

Table 1 Comparison between both groups regarding the graft take, mean ABG and operative time

|                | Group A | Group B |
|----------------|---------|---------|
| Graft take (%) | 93      | 92      |
| Preoperative ABG (dB) | 17.9 | 20.8 |
| Postoperative ABG (dB) | 6.6  | 12.1   |
| Operative time (min) | 33    | 19      |

Discussion

Cartilage has been proved to be well tolerated by the middle ear and to survive for long periods. It is nourished largely by diffusion and becomes well incorporated in the tympanic membrane.

Early in 1964, Chiossone in his publication “Periosteal Grafting in Tympanoplasty” mentioned multiple advantages of periosteal grafts; the structural similarity with the middle fibrous layer of the tympanic membrane makes it adhere firmly to the handle of the malleus and the peristeum of the external canal, periosteum is accustomed to live on relatively poor nutrition that it can resist well the first few days

Results

Considering group A to which underlay periosteal graft was used, 82 cases (out of 88) showed complete graft healing representing 93%, while in group B cases where inlay cartilage graft was used, 56 cases (out of 61) had completed graft healing representing 92%.

In group A, preoperative mean ABG (Air Bone Gap) of the group was 17.9dB while 6 months postoperative mean ABG was 6.6dB.

If we now turn to group B, preoperative mean ABG of the group was 20.8dB while 6 months postoperative mean ABG was 12.1dB.

Mean operative time in group A was 33 minutes while in group B was 19 minutes (Table 1) (Figure 4).

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after transplantation, and periosteal consistency and elasticity that make periosteal graft easy to manage; also the sufficient amount can be easily harvested which is an extra advantage.\textsuperscript{1,9}

These results matched our study results where both types of grafts showed high success rate of 93\% (group A) and 92\% (group B).

Because increased mass and stiffness of the cartilage-reconstructed tympanic membrane might adversely affect its acoustic transfer characteristics.\textsuperscript{3,7}

Similarly, in this study group A cases (which was subjected to underlay periosteal graft) had relatively better hearing results with contraction of the mean ABG to 6.6 dB compared to group B cases, where inlay cartilage grafting was used which resulted in contraction of the mean ABG to 12.1 dB.

Inlay transcanal cartilage myringoplasty has many advantages: no post auricular incision, no tympanomeatal flap, no ear packing post operatively as the graft gains support from its own stiffness, minimal pain, one day surgery where patient can leave hospital the next day after the surgery or even right after recovery from anesthesia, shorter OR times (mean= 19 min), and lower costs. Lastly the adult patient can return back to work the next day after surgery and the child can return back to school.

**Conclusion**

Both underlay periosteal and inlay cartilage grafts show high rates of graft take, with relatively better hearing results using the underlay periosteal grafts but shorter operative time with the inlay cartilage grafts.

**Compliance with ethical standards**

**Funding:** No funding was received.

**Ethical approval**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Conflict of interest**

The authors declare that they have no conflict of interest.

**Informed consent**

Informed consent was obtained from all individual participants included in the study.

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