Sliced Island Tragal Cartilage Perichondrial Composite Graft in Type I Tympanoplasty: Early Results and Experience

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Abstract: Aim: The purpose of this study is to evaluate anatomical and audiological results using technique of sliced island of tragal cartilage perichondrial composite graft in type I tympanoplasty.

Study Design: Prospective study.

Methods and Materials: A total of 56 type I tympanoplasties (51 primary and 5 revision ears) were operated using sliced island tragal cartilage graft from December 2011 to August 2012 in M.I.M.E.R Medical College and Sushrut ENT Hospital with a follow up ranging from 6 months to 16 months.

Results: Our early results revealed a successful closure of the tympanic membrane in all patients at the end of the follow up period ranging from 6 to 16 months. The average postoperative Air Bone Gap was 10.035±1.7473 dB.

Conclusion: To our knowledge, this is the first study which involves the modification of the sliced tragal cartilage into island as a sliced tragal cartilage island perichondrial composite graft in tympanoplasty. This technique is reliable not only in terms of successful closure of tympanic membrane perforations but also overall reduction of residual and recurrent perforations.

Keywords: Sliced island tragal cartilage, tympanoplasty, functional results.

INTRODUCTION

Cartilage for ossicular and tympanic membrane reconstruction is not a new concept. Utech was the first to use cartilage as an interposition graft in 1959 and as the collumella graft for ossiculoplasty between stapes and the tympanic membrane. Salen and Jansen first reported tympanic membrane reconstruction by autologous and homologous septal cartilage respectively. Since then various cartilages and techniques have been practiced including the Heermann Cartilage Pallisade Method, composite cartilage-perichondrium graft, the annular graft by Goodhill, attic composite island graft by McCleve, posterior pars tensa composite cartilage-perichondrium graft by Linde, the total pars tensa composite cartilage-perichondrium graft by Tolsdorff and Nitsche [1]. Tos has classified all the cartilage tympanoplasties into 6 types. In our otological practice we use tragal cartilage for tympanic membrane as well as for ossicular reconstruction. Till now the studies involving cartilage mentioned in the literature including the palisade [2] and cartilage island techniques [3] are full thickness cartilage grafts. Our previous study [4] of sliced tragal cartilage tympanoplasty with 223 patients has yielded good results of 98.20% at 2 years follow up. The present technique of tympanoplasty involves modification of sliced tragal cartilage graft into a sliced island perichondrium composite graft. The aim of the present study is to evaluate the anatomical and audiological results using our technique for tympanic membrane pars tensa perforations in type I tympanoplasties. To our knowledge this is the first study describing results with sliced island tragal cartilage in type I tympanoplasty as studies reported previously use full thickness cartilage perichondrial grafts [3, 5-10].

METHODS AND MATERIALS

A prospective study of all type I tympanoplasties performed on patients with pars tensa perforations from December 2011 to August 2012 using the technique of sliced island tragal cartilage perichondrium composite graft was carried out in M.I.M.E.R Medical College and Sushrut ENT Hospital, Talegaon-Dabhade, Pune, India.

Study Population

The current study included 56 ears (51 primary and 5 revision ears) operated using sliced island tragal cartilage perichondrium composite graft with a follow up ranging from 6 to 16 months. The patients with perforations of the pars tensa (irrespective of size of the perforation) with an intact ossicular chain with no otorrhea were included. The total number of males in our study group was 21 and females were 35. The patients ranged from 8 to 65 years of age.
Otomicroscopic examination, pre and postoperative pure tone audiogram, pre and post-operative video-otoendoscopic recording was done. The patients were explained about the operative procedure, failure rate, post-operative care and the follow up visits. Written consent was taken. Institutional Review Board approval was obtained for this study.

**Anaesthesia**

All patients were operated under local anesthesia (2% lidocaine with 1: 2, 00,000 Adrenaline) with adequate sedation except children who were operated under general anesthesia.

**Procedure of Sliced Tragal Cartilage Island Perichondrial Composite Tympanoplasty**

Lempert’s end aural incision is taken. Tragal cartilage graft (measuring approximately 10 mm x 10 mm) is harvested via the vertical limb of the endaural incision (Figure 1). We do not take another horizontal incision to harvest the tragus. Edge of the perforation in the pars tensa is freshened with the help of a sickle knife. Tympanomeatal flap is elevated after giving 6’o clock and 12’o clock incision. After elevation of the tympanomeatal flap, ossicular mobility and continuity is assessed. The handle of malleus is denuded.

![Figure 1: Tragal cartilage harvested through endaural incision.](image1)

To achieve this acoustic benefit, we prefer to slice the tragal cartilage [4] with the help of a Cartilage Splitter (Precise Cartilage Splitter, Germany). Our present technique is a modification of our previous sliced tragal cartilage composite perichondrial tympanoplasty [4]. The sliced cartilage perichondrium composite shield graft of approximately 0.5mm thickness is now fashioned as a cartilage island graft by removing the peripheral rim of cartilage. The size of the perforation is assessed with help of opening action of the alligator micro ear forceps. The surrounding unneeded tragal cartilage is then removed, retaining the central disc of cartilage of approximate size of the perforation. This results in a sliced island of cartilage disc in the middle with a large piece of surrounding perichondrium (Figure 2). In the area where the sliced cartilage disc comes in contact with the handle of malleus, a V shaped notch (Figure 3) is made to accommodate the handle of malleus. This prepared

![Figure 2: Sliced Tragal Cartilage Island Perichondrial Graft.](image2)

![Figure 3: Sliced Tragal Cartilage Island Perichondrial Graft with a notch for malleus.](image3)
sliced island graft is then placed by underlay technique (Figure 4) in a meticulous manner with the cartilage side facing laterally and the cartilage disc coming out through the perforation edges (Figure 5). The remnant tympanic membrane is thus strengthened by the perichondrium of the island graft. The middle ear is filled with Gel foam. Tympanomeatal flap is repositioned (Figure 6). Gel foam is placed over the graft and meatal pack is placed. Endaural incision is sutured and mastoid bandage is tied.

**Postoperative Monitoring**

All patients are operated on a day care basis and are discharged within six hours of surgery if the vital signs are stable and adequate control of pain with oral analgesics (Ibuprofen + Paracetamol). Patients are put on prophylactic broad spectrum antibiotics (amoxicillin + clavulanic acid) and analgesics (Ibuprofen + Paracetamol) and Antihistaminics (Fexofenadine) for a week postoperatively.

![Figure 4: Placement of the Sliced Tragal Cartilage Island Graft with perichondrium resting on canal wall.](image1)(image2)

**Follow Up Visits**

Meatal pack and mastoid bandage is removed after 48 hours. Patient is advised and explained about ear care and use of topical antibiotic – steroid ear drops (Neomycin + Polymixin B + Hydrocortisone).

Subsequent post-operative visits are at two-weekly intervals for 1 month and thereafter monthly for 6 months. At the end of 3 months, first post-operative pure tone audiometry (average threshold at 500, 1000, 2000 and 4000 Hz) is done to evaluate Air Bone Gap Closure.

**RESULTS**

A prospective study of 56 type I tympanoplasties performed on patients with perforations of pars tensa using sliced island tragal cartilage perichondrium composite graft was carried out. The patients (21 males and 35 females) ranged from 8 to 65 years of age with mean of 14.27 years (Table 1). This included 32 small and 24 large pars tensa perforations. Two patients, who developed acute otitis media in the 5th and 14th month post operatively, responded to antibiotic therapy.

The preoperative Air Bone Gap was 39.8928 +/- 7.914 dB and postoperative Air Bone Gap was 10.035 +/- 1.7473 dB at 6 months and 10.081 +/- 1.9632 dB at 12 months.

![Figure 5: Sliced cartilage disc jutting out through the perforation edges.](image3)
dB at 1 year (Table 2). The difference between the pre and postoperative Air Bone Gap was statistically significant using SPSS statistical analysis ($p<0.05$). The successful closure to about 10 dB is suggestive of good sound conduction offered by the sliced island tragal cartilage graft.

**DISCUSSION**

Though the rigidity of the cartilage resists resorption, re-perforation and retraction even in the milieu of continuous Eustachian dysfunction [10], several doubts are raised regarding the sound conduction properties. The stiffness of the cartilage is primarily influenced by its thickness. In the palisade technique 2, full-thickness cartilage is used. In other techniques, slices of different thicknesses are cut from the original cartilage [11, 12]. An optimal cartilage thickness should be a compromise between good acoustic properties and sufficient mechanical stability against static middle-ear pressure changes. In experimental study by Zahnert, it is suggested that reducing the thickness of the cartilage slices to less than 500 micrometers gives acoustic properties similar to the tympanic membrane [12].

In our otological practice, we prefer sliced tragal cartilage perichondrium shield composite graft [4]. The current study is a modification of our earlier study with Sliced Tragal Cartilage [4] in type I Tympanoplasty. The successful closure of the postoperative Air Bone Gap to about 10dB is indicative of effective sound conduction by the sliced island tragal cartilage graft.

There was no residual or recurrent perforation in the postoperative follow up ranging from 6 to 16 months and the graft acceptance rate (Figure 7) was 100%.

![Figure 7: Postoperative at 2 months.](image)

This technique offers advantage of the cartilage island which snugly fits into the perforation and also the residual tympanic membrane gets reinforced by the perichondrium graft thereby reducing both the occurrence of residual and recurrent perforations without interfering with the sound conduction (Figure 8).

**Advantages of Sliced Island Cartilage Perichondrium Composite Graft**

The central island of cartilage is approximately of the same size as the perforation and juts out through
the perforation edges, the advantages of this technique include:

1. Minimal displacement (lateralization or medialisation) of the graft as the cartilage disc snugly juts out through the perforation.
2. Remnant tympanic membrane is strengthened by the perichondrium
3. Reduced rate of residual perforation
4. Reduced rate of recurrent perforation
5. In contrast to full thickness island graft, the sliced island is of acoustic benefit.
6. Any site and size of the perforation can be reconstructed effectively by altering the size of the cartilage disc in the middle of the island
7. The “V” slot accommodates the handle of malleus
8. Graft preparation is non-time consuming.
9. The curling effect of the sliced cartilage is offset by fashioning as an island. Placement and manipulation of the island graft is simpler and easier

In a study by Karaman E and Duman C using full thickness composite cartilage island grafts in type I tympanoplasty, successful Graft take was achieved in 97.29% with mean postoperative pure-tone average air-bone gap improvement of 20.2 dB at 500 Hz, 23.58 dB at 1000 Hz, 22.23 dB at 2000 Hz, and 24.79 at 4000 Hz [5]. Whereas Kirazli T, Bilgen C et al. with 15 patients, the mean postoperative gains in air-bone gap were 11.9 dB with the cartilage island [6]. Another study of full thickness cartilage island graft in 60 patients by M. Tayyar, Yeşilir Firtaş et al. showed postoperative Air Bone gaps of 17.12, 16.48, 12.32, 9.09 and 7.19 dB at 250, 500, 1000, 2000, and 4000 Hz [7]. Aidonis Loannis, Robertson et al. reported their experience with Cartilage Shied Tymanoplasty Graft take up was in 98.4% with no postoperative complication. The average preoperative and postoperative pure tone average air bone gap were 32.4 +/- 14.1 dB and 24 +/- 13 .7 dB respectively (p < 0.05) [8].

In a study of 1,000 patients by Dornhoffer the average pre & postoperative ABG were 21.7 +/- 13.5 dB and 11.9 +/- 9.3 dB (p< 0.05) in 215 cases of high risk perforation. Complications included recurrent perforation (4.2%), conductive hearing loss requiring revision in 1.9 %, postoperative & intra operative tube insertion in 4 (1.9 %) & 6 ears (2.8), respectively [9].

CONCLUSION

To our knowledge, this is the first study which involves the modification of the sliced tragal cartilage into island as a sliced tragal cartilage island perichondrial composite graft in tympanoplasty.

Our study proves the reliability of this technique not only in terms of successful closure of tympanic membrane perforations but also overall reduction of residual and recurrent perforations.

REFERENCES


