Technique and results of cartilage shield tympanoplasty

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Abstract

Aim: *Use of cartilage for repair of tympanic membrane is recommended by many otologists. The current study aims at evaluating results of cartilage shield tympanoplasty in terms of graft take up and hearing outcomes.*

Material and Methods: *In the current study, cartilage shield tympanoplasty(CST) is used in ears with high risk perforations of the tympanic membrane. A total of 40 ears were selected where type I CST was done in 30 ears and type III CST was done in 10 ears.*

Results: *An average of 37.08 dB air bone gap(ABG) was present in pre operative time and an average of 19.15 dB of ABG was observed at 6 months after the surgery with hearing gain of 17.28 dB on average was observed. Graft take up rate of 97.5% was observed. The technique is modified to make it easier and to minimize chances of lateralization of graft.*

Conclusion: *The hearing results of this technique are comparable to other methods of tympanic membrane repair.*

Keywords: *Cartilage shield, Results, Tympanoplasty*

Introduction

Results of tympanoplasty can vary according to many conditions. One of the major reasons for failure is the type of perforation of the tympanic membrane and conditions of middle ear mucosa. We consider high risk perforation as large perforation with more than 50% the size of tympanic membrane, one with active discharge at the time of surgery, an anteriorly located perforation, perforation persistent after previous surgery, perforations in both ears, perforation with hypertrophied middle ear mucosa, a marginal perforation, atelectatic tympanic membrane, or extensive tympanosclerosis or with retraction pocket. Temporalis muscle fascia shows disorderly arrangement of elastic fibers (loose, crisscross and interrupted). The irregular and unpredictable gaps between the elastic fibers are filled by the fibrous connective tissue, which shrinks and thickens more than elastic fibers do. Thus, shrinkage of the temporalis muscle fascia is unpredictable.[1] Cartilage, devoid of such unpredictable component of fibrous tissue, was introduced for tympanic membrane reconstruction as a composite graft. Cartilage shield is a reliable and effective technique for such patients. Tragal cartilage shield tympanoplasty is a reliable technique; in fact, it has a high degree of graft take up and hearing results are satisfactory.[2] It was first described by Duckert *et al*.,[3] and the technique used in this study is described by Aristides Athanasiadis.[4] It is modified to make it easier and to minimize graft lateralization.

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Materials And Methods

Selection of the patient for cartilage shield technique is done if the patient has problematic perforation as described above. The technique is as follows: After infiltration with xylocaine + adrenaline, a post-auricular Wilde's incision was done and temporalis fascia graft was harvested. Margins of the perforation are denuded and areas of tympanosclerosis are removed as well. After raising the

canal flap, middle ear was inspected for ossicles and mucosa. A piece of tragal cartilage was harvested and perichondrium was removed from one side while preserved on the other. The piece measures about 8 × 8 mm. The cartilage is trimmed to accommodate the size of perforation. Thinning of the cartilage was done according to the space between the handle of Malleus and I-S (incudostapedial) joint. Cartilage can be thinned with No. 15 blade. If the handle of Malleus was found to be foreshortened and medially displaced, then tensor tympani tendon can be cut to make for middle ear space. The cartilage piece is kept medial to the handle of Malleus and lateral to I-S joint [Figure 1] and [Figure 2] and medial to

Figure 1: Cartilage piece being kept between handle of Malleus and incudostapedial joint

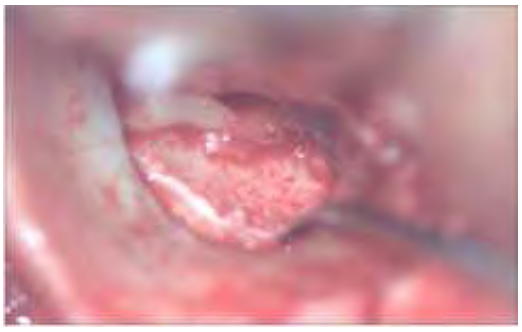

Figure 2: Cartilage in position

the remnant of tympanic membrane. The anterior margin of the cartilage does not extend till anterior annulus but lags 1-2 mm posterior to it. The temporalis fascia graft was kept lateral to the cartilage and medial to tympanic membrane remnant. Handle of Malleus was separated from tympanic membrane and squamous epithelium, and the temporalis fascia was kept lateral to the handle. Anterior tucking of the fascia was also done in addition. No notch was made in the cartilage piece and gel foam was kept in middle ear. This makes the placement of cartilage easy and also the chances of lateralization are less. The patients are instructed for follow up at 1, 3 and 6 weeks and audiological evaluation is done at 6 weeks and 6 months [Figure 3]. If Incus is absent, the cartilage is kept over head of Stapes without thinning the cartilage while the remaining of the procedure remains the same. It will be termed type III cartilage shield tympanoplasty. Type III cartilage "shield" tympanoplasty is an effective technique for hearing improvement in selected patients with chronic otitis media. The results of this procedure are similar to those obtained with partial ossicular replacement prosthesis (PORP).[5]

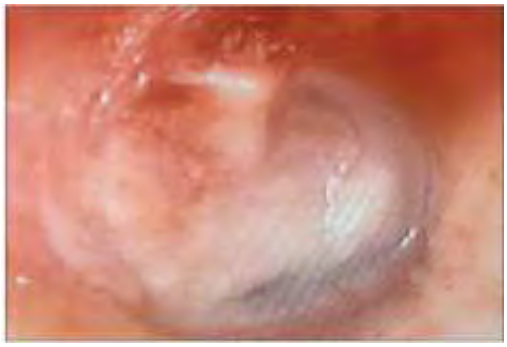

Figure 3: Postoperative picture at 6 months with cartilage in position

Results

A total of 40 ears (38 patients with 2 patients operated on both ears) were selected for this study, and the results are interpreted with regard to air bone gap (ABG) preoperatively and postoperatively and graft take up. Minimum 6 months follow-up is maintained. Among the 40 ears, 30 were of type I tympanoplasty and 10 were of type III tympanoplasty. Cortical mastoidectomy was done in 23 ears. The overall average ABG preoperatively was 37.08+/- 13 db. The overall postoperative ABG was 19.15+/- 10 db. The average gain in ABG was 17.28+/- 8 db. In calculation, pure tone average of 500, 1000 and 2000 Hz frequency thresholds are taken into consideration. The audiometer used is dual channel Amplaid A177 plus with standard calibration. Among the type I tympanoplasty, the average preoperative ABG was 37 db and the average postoperative ABG was 18.6 db with a gain of 18.6 db.

Among the type III tympanoplasty, the average preoperative ABG was 38 db and the average postoperative ABG was 21.9 db with a gain of 16.1 db [Table 1]. Postoperative ABG < 30 dB was seen in 90% of the cases whereas <25 dB was seen in 82% of the cases. No significant change in ABG was found between 6 weeks and 6 months of follow up

	Pre-op ABG	Post-op ABG	Gain (db)
Total (40)	37.08	19.15	17.93
Type I	37	18.6	18.4
Type III	38	21.9	16.1

ABG: Air bone gap

Table 1: Hearing evaluation at 6 months

The youngest patient was 16 years and the oldest was 72 years. Only 3 patients were above 50 years. Most patients were between 20 and 40 years. Retraction was present in 4 ears and managed by canal wall up procedure. There were 6 ears with extensive tympanosclerosis and 21 ears with subtotal perforation. There were 9 ears with active ear discharge at the time of surgery even after 3 weeks of oral and local antibiotic treatment.

Graft take up was complete in 39 (97.5%) patients; only 1 patient had a small residual anterior perforation, which healed with application of 25% Trichloroacetic acid after 2 weeks.

Discussion

The comparison with other different cartilage tympanoplasty studies is given in [Table 2].

Study	Graft type	Surgical technique	Graft take up (%)	Average hearing results
Current	Tragal	Cartilage shield	97.5	Type I: Pre-op/post-op ABG: 37/18.6 Type III: Pre-op/post-op ABG: 38/21.9
Emilia Iacoveu *et al*.[6]	Cymba concha	Cartilage shield	97.2	Type I pre-op/post-op ABG: 31.26/16.68 Type III pre-op/post-op ABG: 32.36/22.06
Duckert *et al*.[7]	Cymba	Cartilage shield	97	Closure of ABG within 10 dB in 82% of type I 20 dB in 80% of PORP and 30 dB in 85% of TORP cases
Dornhoffer[7]	Cymba/ Tragal	Cartilage palisades/ island	97.6	Type I pre-/post-op ABG: 16.1/11.3
Castiliere *et al*.[12]	Tragal	Cartilage shield	98.35	Type I pre-/post-op ABG: 36.80/6.40 Type III pre-/post-op ABG: 44.55/11.45

ABG: Air bone gap, PORP: Partial ossicular replacement prosthesis, TORP: Total ossicular replacement prosthesis

Table 2: Comparison with other cartilage tympanoplasty studies

Emilia *et al*.,[6] used conchal cartilage and the average gain in ABG was about 15 dB for type I tympanoplasty and about 10 dB in type III tympanoplasty. Dornhoffer [7] and Neumann *et al*.,[8] have described use of cartilage palisade technique and cartilage-perichondrium island technique with good results.

Kabdwal *et al*.,[9] have used temporalis fascia graft for type I tympanoplasty as well as canal wall up and canal wall down procedures. For type I tympanoplasty, an average gain of 7.8 dB was observed.

Goyal[10] observed in type I tympanoplasty patients with temporalis fascia graft, an average preoperative ABG of 28.42 and average postoperative ABG of 14.42 with significant hearing gain [Table 3].

Study	Graft type	Avg pre-op ABG	Avg post-op ABG	Avg hearing Gain
Current	Cartilage shield type I	37	18.6	18.4
Current	Cartilage shield type III	38	21.9	16.1
Goyal[10]	Fascia without mastoidectomy	28.42	14.42	14
Goyal[10]	Fascia with mastoidectomy	25.45	17.52	7.93
Kabdwal *et al*.[9]	Temporalis fascia for type I	28.4	18.13	10.27
Gupta *et al*.[11]	Temporalis fascia for type I	34.75	25.25	9.82
Gupta *et al*.[11]	Temporalis fascia for type III	52	48.75	3.25

Table 3: Comparison with tympanoplasty with fascia

In our study, cortical mastoidectomy does not appear to have an effect on the hearing outcome. Cortical mastoidectomy was done in 23 cases, where during surgery the condition of middle ear mucosa was unhealthy or there were hypertrophied mucosa with or without granulations. Medialization or lateralization was not found in any of the case in our study.

Conclusion

Cartilage shield tympanoplasty is an effective method of tympanic membrane repair with hearing outcomes comparable to other methods. The technique used in current study is modified to make it easier and to minimize chances of lateralization of graft. [11]

References

1. Indorewala S. Dimensional stability of the free fascia grafts: An animal experiment. Laryngoscope 2002;112:727-30. [PUBMED]
2. Cavaliere M, Mottola G, Rondinelli M, Iemma M. Tragal cartilage in tympanoplasty: Anatomic and functional results in 306 cases. ActaOtorhinolaryngol Ital 2009;29:27-32.
3. Duckert LG, Müller J, Makielski KH, Helms J. Composite autograft "shield" reconstruction of remnant tympanic membranes. Am J Otol 1995;16:21-6.
4. Athanasiadis A, Sismanis. Tympanoplasty: Tympanic Membrane Repair. In: Gulya AJ, Minor LB, Poe DS, editors:. People's medical publishing house - USA: Glasscock-Shambaugh Surgery of the Ear. 6 th ed. 2010. p. 478-82.
5. Kyrodimos E, Sismanis A, Santos D. Type III cartilage "shield" tympanoplasty: An effective procedure for hearing improvement. Otolaryngol Head Neck Surg 2007;136:982-5.
6. Iacovou E, Kyrodimos E, Sismanis A. Cartilage "shield" tympanoplasty: An effective and practical technique. Eur Arch Otorhinolaryngol 2014;271:1903-8.
7. Dornhoffer J. Cartilage tympanoplasty: Indications, techniques, and outcomes in a 1,000-patient series. Laryngoscope 2003;113:1844-56. [PUBMED]
8. Neumann A, Kevenhoerster K, Gostian AO. Long-term results of palisade cartilage tympanoplasty. OtolNeurotol 2010;31:936-9.
9. Kabdwal N, Varshney S, Bist SS, Bhagat S, Mishra S, Agarwal V. Pre and post operative evaluation of hearing in chronic suppurative otitis media. Indian J Otol 2013;19:164-8.
10. Goyal R. Role of cortical mastoidectomy in type I tympanoplasty. Ind J Otol 2010;16:8-12
11. Gupta S, Kalsotra P. Hearing gain in different types of tympanoplasties. Indian J Otol 2013;19:186-93.