

Role of Tragal Cartilage And Perichondrium in Middle Ear Reconstruction

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Abstract:

Objective: The objective of study was to assess the efficacy of tragal perichondrium and cartilage, the functional capacity in restoring hearing acuity, it's mechanical survival, it's extrusion rate and it's functional integrity in tympanomastoid reconstruction.

Materials and methods: The present study was a prospective study of tympanomastoid surgeries performed on 50 patients. The main outcome measures were both anatomical and functional in form of graft incorporation and postoperative hearing function, over 3 months of follow-up.

Results and conclusion: There were 50 patients (mean age 27.8±10.8 years). Preoperatively, 23 patients had near-total perforation, 29 had Cholesteatoma, 8 had postero-superior retraction pocket, and 9 had a marginal perforation. There were no immediate postoperative or long term complications of surgery except for 5 cases in which there was a failure of graft uptake. There was a 7.6-decibel (dB) improvement in mean air conduction threshold post-operatively. There were no cases of retraction, adhesion, or lateralization. Conclusion: tragal cartilage and perichondrium in middle ear reconstruction has excellent surgical results and minimal complications, even in patients with poor prognostic factors, and should thus be considered in those patients.

Keywords: Tragal Cartilage and Perichondrium Graft, Pure Tone Audiometry, Air Bone Gap

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I. Introduction

A dry and intact hearing apparatus is an essential prerequisite for normal hearing. Chronic suppurative otitis media leading to tympanic membrane perforations, retractions, atelectasis and cholesteatoma has a deleterious effect on some part of the sound conducting mechanism. The long term aim of middle ear reconstruction is to reconstruct the tympanic membrane and sound conducting mechanism and to keep ear dry. Since the introduction of the tympanoplasty, various graft material and perforation techniques have been described. Among them, Temporalis fascial is the most frequently used graft material due to its ease of accessibility at the surgical site and the successful closure of the perforation in most of the normally ventilated middle ears but has higher failure rates in advance middle ear pathology, large perforations and retractions.² This is because of the post operative dimensions of the temporalis fascia are unpredictable as it is composed of irregularly arranged elastic fibre and fibrous connective tissue.³ In such cases, a more rigid grafting material such as cartilage is preferred because of its increased stability and resistance to middle ear pressure even in cases with chronic Eustachian tube dysfunction. Utech was first to introduce the cartilage in middle ear surgery.⁴ After that various techniques were introduced using cartilage for middle ear reconstruction.

The mechanical characteristics of cartilage offer the advantage of high resistance to retraction and perforation. Cartilage has a constant shape, firmer than fascia and also lacks the fibrous tissue, so that the post operative dimensions remain the same and shows great adaptation with the tympanic membrane.⁵ Although a significant conductive hearing loss might be anticipated with cartilage owing to its thickness and rigidity, several studies suggest hearing results no different than those for fascia.^{6, 7} The present study aims to evaluate the results of using the autologous tragal cartilage graft in the surgical treatment of the various defects caused by chronic suppurative otitis media.

II. Materials And Methods

The present prospective study “Role of tragal cartilage and perichondrium in middle ear reconstruction” was carried out in the Department of Otorhinolaryngology and Head and Neck Surgery, JLN Medical College and Hospital, Ajmer.

Case Inclusion Criteria-

1. Tubotympanic type of CSOM in the quiescent stage
2. Patients with active Tubotympanic type of CSOM not improving with conservative management
3. Patient with retraction pocket and conductive hearing loss
4. Patients with atticointral type of CSOM in whom cartilage was used for reconstruction of the ossicular chain

Case Exclusion Criteria-

1. Patients of tubotympanic CSOM having septic foci in nose and throat.

A detailed history including duration and nature of symptoms, history of previous surgery was taken. Detailed clinical examination of ear, nose and throat was done with special reference to the ear noting the defect in tympanic membrane and other co-existent pathology. Examination under microscope was done which has provided useful information i.e., perforation size, location according to quadrant, Tympanosclerosis and presence or absence of inflammatory mucosa in the middle ear. Pre-operative pure tone audiometry was done in all the patients to assess the hearing status.

All patients underwent nasal examination to check nasal conditions, looking for pathologies that could interfere in functioning of the Eustachian tube. Routine investigations were done in every case. X-ray Mastoids and C.T. Scan were done. The audiometry was done following standard protocol. Three frequencies of 500, 1000 and 2000 Hz were used for calculation of average of hearing loss (air conduction threshold).

The operations are performed under local or general anaesthesia using a microscope. 2% xylocaine with 1:200000 adrenaline was infiltrated locally at the post-aural groove and in the tragus. Post-aural approach was used in majority of cases. After elevation of the posterior tympanomeatal flap upto fibrous annulus, status of the middle ear structure was assessed to decide the type of tympanoplasty and size and shape of the tragal cartilage required. Harvesting the tragal cartilage graft, after that a small incision about 1.5 cm was given on the skin on the medial side of tragus. A plane was developed superficial to the perichondrium on both sides. Skin and soft tissue were dissected free from the cartilage, with attached perichondrium. The cartilage was then grasped and retracted inferiorly to deliver the superior portion from the incisures area. An inferior cut was made to harvest the perichondrium and cartilage graft. The perichondrium was then separated from the cartilage and removed. The donor site was approximated using small interrupted ethilon suture.

Once harvested, the tragal cartilage was sliced to 1 mm thickness using cartilage slicer and then used for tympanic membrane reconstruction via underlay technique in type I tympanoplasty in which ossicular chain was intact and functional. If there was necrosis of the incus then the cartilage was reshaped and kept over the stapes head and malleus in type II tympanoplasty. Follow up was done at 4 weeks, 6 weeks and 3 months. At each follow up the complaints of the patients were noted. Microscopic examination was done to see the condition of the canal and graft. Pure tone audiometry was done at 3 months of follow up. Graft uptake was considered successful if there was no residual perforation on follow up at 3 months. Hearing results were compared using the guidelines recommended by Committee on Hearing and Equilibrium of the American academy of otolaryngology-head and neck surgery for the evaluation of results for the conductive hearing loss. This includes reporting of the mean, standard deviation and range of the post-operative air bone gap. Statistical analysis of these results was done by paired t test.

III. Results

Our study was comprised of 50 patients of chronic suppurative otitis media who underwent middle ear surgery. Majority of cases (58%) were in the age group of 21-40 years with mean age of 27.8±10.8 years. Male (54%) were more compared to female (46%). Most common presenting complaint was otorrhea in all the patients followed by hearing loss in 88% of cases. Earache was present in 24% with tinnitus and vertigo was seen in 4% cases. Central perforation was present in 46% cases. Cholesteatoma was noted in 18 (36%) patients, out of which 8 had postero-superior retraction pocket and 9 patients had marginal perforation. Type I tympanoplasty was done in 36% cases, type II tympanoplasty in 28% cases and type III tympanoplasty in 36% cases.

Table 1: Surgical success rate

Surgical success rate	No of patients	Percentage
Perforation closure	45	90%
Residual perforation	5	10%

Table 2: Comparison of air bone gap

Air bone gap(dB)	Preoperative	Postoperative
≤ 15	7 (14%)	28 (56%)
16-25	24 (48%)	7 (14%)
26-40	15 (30%)	15 (30%)
>40	4 (8%)	0

Table 3: Comparison of pre and post operative hearing results

	Pre-operative	Post-operative
Air conduction	35±12	27.4±11.5
Bone conduction	8.76±3.8	9.26±4.03
A-B gap	26.4±10	18±9

IV. Discussion And Conclusions

Temporalis fascia is the most commonly used graft material in reconstruction of the tympanic membrane perforations and has >90% success rate.⁶ Since postoperative dimensions of the fascia are unpredictable due to irregularly arranged elastic fibres and fibrous connective tissue composition, it leads to higher failure rates.³ To overcome this, a more rigid and resistant graft material is required which is provided by cartilage.

Use of the cartilage in the middle ear reconstruction introduced by Utech⁴ in 1959 and Heerman⁸ used the cartilage palisade technique. Jenson⁹ and Salen¹⁰ used the cartilage –perichondrium composite graft of tympanic membrane reconstruction. It is also used for limited management of the retraction pocket and encouraging results have been shown after its use for the reconstruction of the tympanic membrane in cases of recurrent perforations.² Cartilage is also used to re-establish the annulus in cases of anterior blunting and to reconstruct the tympanic membrane in congenital atresia cases. Studies have shown that it is well tolerated in middle ear¹¹ and cartilage graft take their nutrition by diffusion.⁵ The main advantage of the cartilage graft is that even after anterior detachment, epithelialisation may continue over the cartilage and also it provides advantage of avoiding synchae formation between graft and promontory.¹² Neumann *et al.*¹³ reported 100% graft take rate in palisade cartilage tympanoplasty study and there were no retraction or recurrent perforations. Using shield-sliced tragal cartilage –perichondrium composite graft, Khan *et al.*¹⁴ reported 97.7% success rate. Sismanis *et al.*¹⁵ reported 93.5% success rate in revision tympanoplasty cases. Altuna *et al.*¹⁶ reported 87% graft success rate in revision cases and suggested that cartilage provides structural support during times of negative middle ear pressure and resist continued Eustachian tube dysfunction. In our study, graft success rate was 90% with no post operative retraction or lateralisation of graft.

Hearing improvement may not be good due to its effect on elasticity of the tympanic membrane despite higher graft take rate with cartilage as compare to fascia graft. But many recent studies shows that there was no statistically significant difference exists in cartilage and fascia in terms of hearing improvement. Dornhoeffer⁶ in their study reported an Air Bone gap of 6.8 dB for cartilage. Gerber⁷ *et al.* compared the cartilage and fascia in a frequency-specific manner and found in their study that there is an average improvement of 10 dB in air conduction threshold. Thus, the post operative hearing loss after use of cartilage may be due to changes in middle ear structure rather than graft material used. However, Bozdemir *et al.*¹⁷ reported better hearing results with temporalis fascia graft than cartilage. In present study there was an improvement of 7.6 dB in air conduction threshold. Cartilage can be used coupled with prosthesis to reconstruct posterior half of tympanic membrane in cases of cholesteatoma. But in cases of cholesteatoma, it is difficult to detect the recurrence if entire tympanic membrane is reconstructed using cartilage.⁵ Rather it is safer to leave cartilage off the anterior portion to assist in the early detection of the recurrent disease.⁶ After 3 months of follow up period, 5 residual perforation of the tympanic membrane were observed. Sismanis *et al.*¹⁵ reported that 2/3 graft failure were secondary to residual cholesteatoma occurred in the attic.

Conclusion: Tragal cartilage is effective in treatment of middle ear reconstruction with good graft success rate and hearing improvement.

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