

Original Research Article

DOI: <http://dx.doi.org/10.18203/issn.2454-5929.ijohns20183706>

## Impact of type of graft material on outcome of tympanoplasty: a comparison between temporalis fascia and cartilage with perichondrium

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**Received:** 28 June 2018

**Accepted:** 31 July 2018

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### ABSTRACT

**Background:** Various graft materials have been used to repair tympanic membrane perforations. Temporalis fascia and cartilage with or without perichondrium are the most commonly used materials. The objective of the study was to compare the anatomical and functional success in type I tympanoplasty by using cartilage- perichondrium graft with that of temporalis fascia in a homogenous group of population.

**Methods:** 64 patients with chronic otitis media - mucosal type were included in the study. This prospective, randomized controlled trial was conducted at a tertiary care centre between December 2012 to October 2014. Patients were grouped randomly between temporalis fascia (34/64) and cartilage group (30/64). In the fascia group, the graft was placed by underlay technique. In the cartilage group, tragal cartilage was thinned by cartilage thinner keeping the perichondrium attached on one side. The graft was placed by underlay or over-underlay technique. Postoperative results i.e. graft take up (anatomical success) and hearing improvement (functional success) were evaluated at 6 months.

**Results:** Graft take up rate was 94.11% for fascia group and 96.66% for cartilage group. The mean pure tone air bone gaps pre and postoperatively in the fascia group were 26.4±6.55 dB and 11.47±6.5 dB respectively, whereas for cartilage-perichondrium group, the values were 28.3±5.86 dB and 13.2±6.48 dB respectively. There was no statistically significant difference in the graft take up rate and postoperative hearing improvement between the two groups ( $p \geq 0.05$ ).

**Conclusions:** Cartilage with perichondrium can be considered as an alternative to more traditional grafting material for tympanic membrane reconstruction.

**Keywords:** Cartilage-perichondrium graft, Temporalis fascia graft, Type I tympanoplasty

### INTRODUCTION

Tympanoplasty is a common procedure for Otolaryngologists and many grafting materials have been proposed since its introduction in 1950 by Zoellner and Wullstein.<sup>1,2</sup> Different materials have been used in literature for closure of tympanic membrane perforation with variable results. This includes temporalis fascia, fascia lata, vein graft, periosteum, perichondrium,

cartilage, fatty tissue, skin etc. Temporalis fascia still remains the most commonly used graft material with 93-97% success rate in tympanoplasty.<sup>3</sup> However the success rate tended to decrease in situations such as recurrent perforation, total perforation, chronic mucosal dysfunction or severe atelactatic tympanic membrane.<sup>4</sup> The stiffness and mechanical stability of the cartilage graft have obvious benefits in reducing retraction of the tympanic membrane, but it was unclear whether the

increase in stiffness and mass would compromise the sound conduction properties of the tympanic membrane.<sup>5</sup> Concerns that the stiffness and mass of cartilage grafts may adversely affect hearing have not been substantiated in clinical outcome reports.

The present study was undertaken to compare the results of tympanic membrane repair in chronic otitis media – mucosal type by using two different graft materials.

In the first group (Group A) temporalis fascia was used as graft material and in the second group (Group B) cartilage with perichondrium was used.

## METHODS

This prospective study comprised of 64 patients of chronic suppurative otitis media, mucosal type who presented to ENT outpatient department of a tertiary care centre between December 2012 to October 2014. The research protocol was approved by the institutional ethics committee. Patients between 16-55 years age, having chronic otitis media, mucosal type in quiescent or inactive stage were selected for the study. Patients having mixed/ sensory-neural hearing loss, focus of infection in nose or throat and chronic otitis media – squamosal type were excluded from the study.

All selected cases underwent detailed ENT and systemic examination. Tuning fork test, pure tone audiometry and otomicroscopy were performed in all patients. On otomicroscopy, tympanic membrane findings with respect to perforation size, site, anterior rim, condition of middle ear mucosa were noted. Size of the central perforations was divided as small, moderate and large. The patients selected for surgery were randomly grouped into two groups;

Group A – Temporalis fascia graft (n=34)

Group B – Perichondrium cartilage graft (n=30)

All 64 patients were subjected to type I tympanoplasty. Most of the patients were operated under local anesthesia with intravenous sedation. General anesthesia was used in non-co-operative and anxious patients.

### *Harvesting the graft*

In group A, temporalis fascia was harvested via the post-auricular approach by using the classical technique (Figure 1).

In group B, tragal cartilage was used as the graft material. To avoid a visible scar, a skin incision was made on the medial aspect of the tragus (Figure 2). A cut was given on the cartilage leaving 2 mm of cartilage strip in the dome of the tragus for cosmetic purpose. The cartilage with attached perichondrium was dissected from the overlying skin and soft tissue on both sides by sharp dissection. A

large piece of cartilage with attached perichondrium (15×12 mm) was thus harvested. The perichondrium on one side of the cartilage was removed, leaving perichondrium on other side intact. A perichondrium-cartilage island flap of size slightly greater than that of perforation was prepared. The graft was then thinned in between the jaws of a locally prepared cartilage thinner (Figure 3) by applying pressure with the help of screws. The pressure applied could be adjusted as required by tightening the screws of the jaws. The thickness of the perichondrium-cartilage graft was kept less than 0.5 mm.

### *Method of graft placement*

In group A, temporalis fascia graft was placed by classical underlay technique in all cases. In group B, cartilage perichondrium graft was placed by underlay/over-underlay technique with the cartilage facing the promontory and perichondrium adjacent to the tympanic membrane remnant.

The outcome measures included anatomical success (graft take up), that is, complete closure of tympanic membrane defect after surgery with no evidence of perforation, atelectasis, atrophy, lateralization and otorrhoea after 6 months of surgery and functional success or improvement of hearing after surgery using pure-tone audiometry. Audiometric evaluation was done at 3<sup>rd</sup> and 6<sup>th</sup> month postoperatively. Improvement in the air conduction thresholds and closure of air bone gap was assessed at each follow up.

### *Statistical analysis*

Data was analyzed by using Chi square test. The results were assessed with 95% confidence interval and a P value equal to 0.05 or less was considered significant.

## RESULTS

64 patients of COM mucosal type, inactive stage, in the age group of 16 to 55 years were recruited for the present study. Maximum number of patients were in middle age group i.e. 42.18% (27/64) belonged to 26-35 years age group. Female preponderance was observed in this study with 31.25% males and 68.75% females. They were randomly divided into 2 groups. 34 patients were included in Group A, i.e. temporalis fascia group and 30 patients were included in group B, i.e. cartilage-perichondrium group. In 68.75% (44) patients there was left sided disease while in 31.25% (20) cases right ear was affected. There were no bilateral cases in this series. Patients were also divided according to size of the perforation. Most of the patients i.e. 46 (71.8%) had large sized perforation, while moderate perforation was seen in 13 (20.31%) and small in 5 (7.8%) patients. In all the 64 cases type I tympanoplasty was performed.

Anatomical success in the form of complete graft uptake was seen in 94.11% (32/34) patients in fascia group and

96.66% (29/30) in cartilage group. The failure rate was 5.8% (2/34) in fascia group and 3.33% (1/30) in the cartilage- perichondrium group (Table 1).

**Table 1: Results of tympanoplasty in terms of anatomical success.**

Condition of graft	Temporalis fascia (n=34) (%)	Cartilage (n=30) (%)
Graft take up	32 (94.11)	29 (96.66)
Perforation	02 (5.8)	01 (3.33)
Retraction	05 (14.7)	01 (3.33)
Medialization / Lateralization	0	0

By applying Chi square test, it was found to be statistically non-significant (p=1.000 NS, Chi square value 0.2318).

In the fascia group, the pre and post-operative mean ABGs were 26.44±6.55 dB and 11.47±6.50 dB respectively and the postoperative gain was 14.97±6.8 dB. In the cartilage with perichondrium group, pre and post-operative mean ABG were 28.3±5.86 dB and

13.2±6.48 dB respectively. The post-operative gain was 15.46±5.55 dB in the cartilage group (Table 2). The functional success rate in cartilage group was slightly higher than the fascia group but was statistically non-significant (p>0.05).

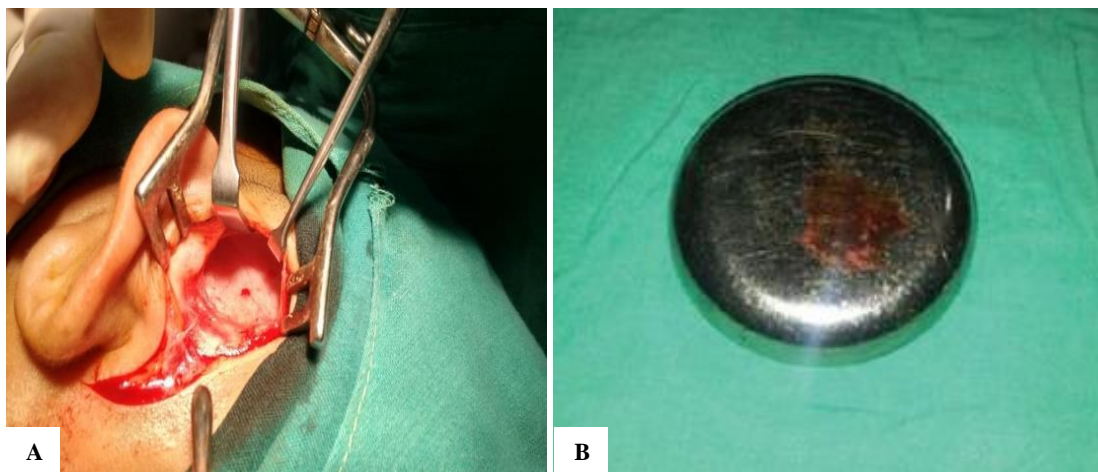
**Table 2: Results of tympanoplasty in terms of functional success.**

Air bone gap (ABG)	Temporalis fascia group	Cartilage group
Preoperative mean ABG	26.44±6.55 dB	28.3±5.86 dB
Postoperative mean ABG	11.47±6.50 dB	13.2±6.48 dB
Postoperative gain	14.97±6.8 dB	15.46±5.55 dB

No major complications were observed. There were only 2 (5.8%) cases of wound infection in fascia group and 1 (3.33%) patient developed perichondritis in cartilage group which was treated successfully with appropriate antibiotics.

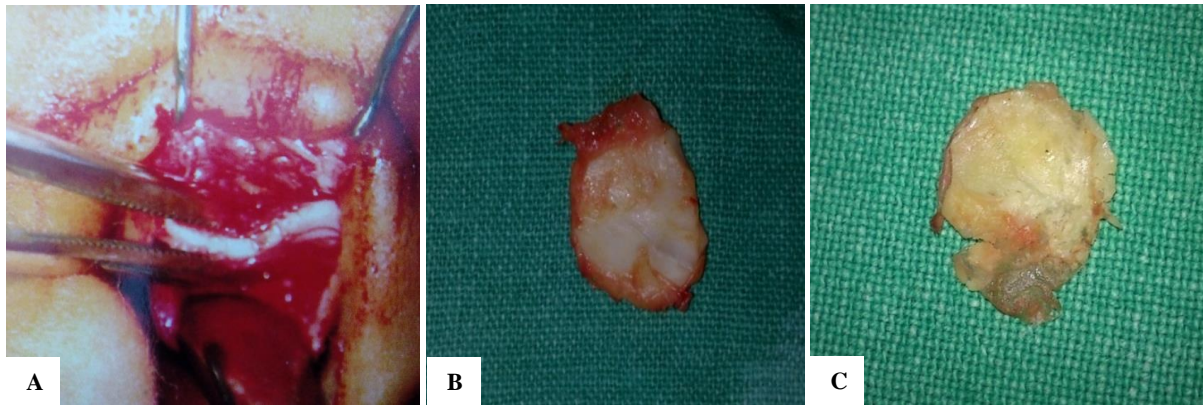
**Table 3: Comparison with other studies.**

Studies	Anatomical outcome		Functional outcome mean ABG gain	
	Temporalis fascia group (%)	Cartilage group (%)	Temporalis fascia group	Cartilage group
Khan et al <sup>19</sup>	94.01	98.5	24.12±2.71dB	24.28±2.79dB
Vashishth et al <sup>20</sup>	83.33	90	13.24±6.58dB	21.67±6.73dB
Demirci et al <sup>21</sup>	84	92	13.1±9.6dB	12.1±6.8dB
Onal et al <sup>22</sup>	65	92.3	11.63±3.47dB	14.49±3.59dB
Yung et al <sup>5</sup>	84.2	80	13.63 dB	12.60 dB
Yegin et al <sup>8</sup>	65	92.1	9.43 dB	9.57 dB
Present study	94.11	96.66	14.97±6.8dB	15.46±5.55 dB

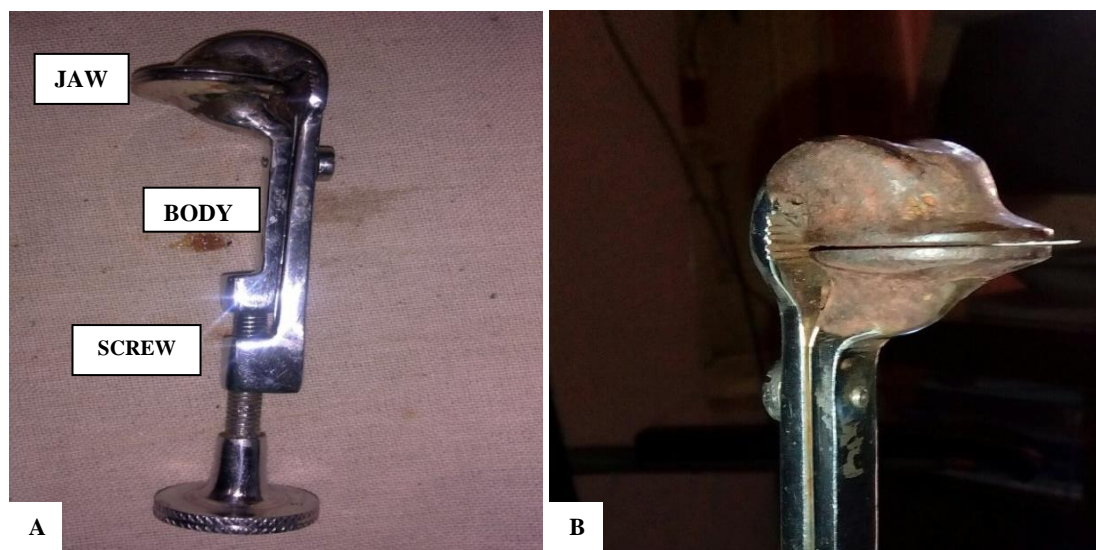


**Figure 1 (A and B): Temporalis fascia.**





**Figure 2: A → Harvesting tragal cartilage graft, B → cartilage with perichondrium graft, C → cartilage graft after thinning.**



**Figure 3 (A and B): Cartilage thinner.**

## DISCUSSION

The success rate of tympanoplasty in general is quite high, irrespective of the graft material. A variety of graft materials have been used over time for repairing tympanic membrane perforation.<sup>6</sup> Mortiz in 1950 reported the first closure of tympanic membrane perforation, utilizing the pedicled skin flap. Temporalis fascia as a grafting material was first considered by Heerman. Goodhill visualized the idea of grafting tragal cartilage and perichondrium.<sup>7</sup> Other autologous graft materials used were fat, conchal or septal cartilage, vein and fascia lata. However, there is no consensus on the selection of graft material for tympanoplasties, it depends entirely on surgeons experience and preferences.<sup>8</sup>

Certain criteria's which an ideal grafting material used for tympanic membrane repair should meet includes easy availability, good tensile strength, sufficient quantity, low rejection rate and functionally similar to the tympanic membrane. Temporalis fascia is the most preferred

grafting material owing to its translucency, low metabolic rate, anatomic proximity and suppleness. However graft displacement, improper placement, atrophy and re-perforation of the graft have been noticed in case of total perforation, chronic mucosal dysfunction and Eustachian tube dysfunction leading to atelectasis of graft.<sup>9</sup>

The past decade has seen a renewed interest in the use of cartilage as an alternative to more traditional grafting material for tympanic membrane reconstruction. Cartilage can be thought of in special situations like Eustachian tube dysfunction, pediatric tympanoplasty, atelectatic drum and revision cases. The nourishment of cartilage is by diffusion with the help of perichondrium. Thus perichondrium should be intact on one side for its viability. Sufficient nourishment of the grafted material is ensured because cartilage and chondrocytes are bradytrophic tissues.

The advantage of cartilage graft is that it retains its rigid quality and resists resorption and retraction even in the

milieu of continuous eustachian tube dysfunction making it an ideal reconstructive material for certain middle ear pathologies. Cartilage contributes minimally to an inflammatory tissue reaction and is well incorporated in tympanic membrane layers. The greatest advantage of cartilage has been thought to be its very low metabolic rate, receive its nutrition by diffusion and it can resist deformation from pressure ventilation.<sup>10</sup> However there are concerns that cartilage stiffens the tympanic membrane and may adversely affect the hearing results. Gerber et al in his study mentioned that replacing a large portion of tympanic membrane with cartilage would add stiffness and/or mass that would affect individual frequencies, but not significantly impact averaged audiometric data such as air-bone gap.<sup>11</sup>

Cartilage can be inserted either as full thickness strips (palisade technique) or as a single plate of different sizes and shapes (island technique). Overbosch (1971) used cartilage of thickness 0.2-1 mm and first described a microslic technique to improve the acoustic properties of the reconstructed tympanic membrane.<sup>12</sup> The placement of the cartilage also determines the influence of its stiffness on the acoustic behaviour of the reconstructed tympanic membrane. If the cartilage strips or plates are suspended in between the osseous annular rim, the acoustic transfer characteristics of the tympanic membrane are determined by the stiffness. For optimal acoustic transfer behavior, the cartilage should be cut as thin as possible.<sup>13,14</sup> Cartilage slices <0.5 mm thickness is similar to the tympanic membrane in their acoustic properties. In a normally ventilated middle ear, a cartilage plate of thickness <0.5 mm possesses sufficient mechanical stability and low acoustic transfer loss.<sup>15</sup> In aerated middle ear, thinner cartilage plates can be used (0.1–0.3 mm). However, in cases of tubal dysfunction, the stiffer cartilage plates of 0.5 mm layer thickness may be more advantageous from a mechanical point of view. Temporalis fascia and perichondrium alone often fails as graft material for tympanic membrane reconstructions because of their low mechanical stability and tendency to atrophy over the years.

In present study, we used cartilage thinner to reduce the thickness of the graft to  $\leq 0.5$  mm. Cabra et al used the method called cartilage palisade that cut the cymba conchae cartilage into strips with full thickness and positioned them in an underlay fashion described by Eavey. There was statistical difference between cartilage and temporalis fascia in morphological success both within 6, 12 and 24 months. However there was no difference in the aspect of air conduction threshold and air-bone gap.<sup>16</sup> Mauri et al compared cartilage tympanoplasty described by Lubtanca-Neto that was different from original report of Eavey with underlay temporalis fascia tympanoplasty. The morphological success and hearing results showed no significant difference between cartilage and temporalis fascia.<sup>17</sup> Gierak et al achieved 93.3% graft take up in fascia group and 88.2% for cartilage group.<sup>18</sup>

In the present study we could achieve anatomical success of 94.11% for fascia group and 96.66% for the cartilage with perichondrium group which was statistically non-significant. There was no difference in the hearing improvement between the two groups comparable with other studies (Table 3).<sup>5,8 19-22</sup>

## CONCLUSION

Cartilage with perichondrium has high anatomical and functional success rate in type I tympanoplasty comparable to that of temporalis fascia. It can be used as a suitable alternative to the more traditional temporalis fascia technique provided that the graft is appropriately thinned out. It can be the preferred graft in circumstances with negative middle ear pressure and in large perforations. As it is more rigid, and more resorption and retraction resistant, may provide better success rate.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Tadke K, Ghorpade R, Lahane V, Mundada PS. Impact of type of graft material on outcome of tympanoplasty: a comparison between temporalis fascia and cartilage with perichondrium. *Int J Otorhinolaryngol Head Neck Surg* 2018;4:1301-6.