

Original Article

Outcomes of Hearing in Patients with Temporalis Fascia or Tragal Cartilage Graft in Endoscopic Myringoplasty

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Abstract

Objective: To compare the audiological outcomes and graft uptake rates of temporalis fascia and tragal cartilage grafts in patients undergoing endoscopic myringoplasty.

Methodology: This prospective, comparative, interventional study was conducted at the Pak Emirates Military Hospital in Rawalpindi from December 2024 to August 2025. A total of 114 patients aged 18–45 years with conductive hearing loss undergoing Myringoplasty were enrolled and equally allocated to a temporalis fascia (TF) group (n=57) and a tragal cartilage (TC) group (n=57). Underlay endoscopic Myringoplasty was performed in both groups. The primary outcome was hearing improvement assessed by air–bone gap (ABG), while graft uptake was considered the secondary outcome. Data were analysed using appropriate non-parametric and categorical statistical tests, with $p \leq 0.05$ considered statistically significant.

Results: Baseline characteristics were comparable between the groups ($p > 0.05$). Successful graft uptake was significantly higher in the TC group than in the TF group (96.49% vs. 82.45%; $\chi^2 = 5.961$, $p = 0.015$). The median postoperative ABG was significantly lower in the TF group than in the TC group [8.0 (5.0–10.0) vs. 11.0 (8.5–13.0) dB; $p < 0.001$]. Similarly, hearing gain was significantly greater in the TF group [11.0 (9.0–15.0) dB] than in the TC group [9.0 (6.5–11.0) dB] ($p < 0.001$).

Conclusion: Tragal cartilage grafts provide superior graft uptake, whereas temporalis fascia grafts yield better hearing outcomes following endoscopic myringoplasty.

Keywords: Audiometry, Cartilage Graft, Hearing outcomes, Middle ear pathology, Myringoplasty, Temporalis fascia graft.

Introduction

Myringoplasty refers to the reconstruction of tympanic membrane defects and aims to achieve a stable, dry middle ear while maximising functional auditory restoration.¹ Various graft materials, including temporalis fascia (TF), auricular cartilage, omentum, and ear lobule fat, have been used for this purpose.² Selecting the optimal graft material remains a subject of ongoing debate, balancing anatomical durability against acoustic efficiency. The temporalis fascia is considered the traditional gold-standard graft material for tympanoplasty, offering high success rates (81.1%),³ owing to its similarity to the native tympanic membrane in terms of thickness and acoustic properties. It provides exceptional sound transmission, is easy to harvest through the same surgical incision, integrates well with the eardrum, and survives with a minimal initial blood supply.⁴ However, its lack of structural rigidity makes it susceptible to retraction, medialization, and atrophy, particularly in patients with Eustachian tube dysfunction or negative middle ear pressure.⁵ Consequently, it is considered less suitable for large perforations, atelectatic ears, and revision surgeries, where it is often combined with cartilage to improve mechanical support and long-term stability.⁶

Auricular cartilage, usually harvested from the tragus or concha, is gaining popularity nowadays as a preferred graft material for myringoplasty because of its excellent stability, rigidity, and resistance to resorption and retraction, offering up to 92.1%³ success rate. It maintains its shape even in cases of chronic Eustachian tube dysfunction and negative middle ear pressure, resulting in high graft success rates, particularly in revision surgeries, large perforations, and atelectatic ears.⁷ Moreover, cartilage has low metabolic

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Approval

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requirements, allowing for long-term survival through nutrient diffusion alone.⁸ It is easy to harvest and shape into various graft configurations. Although thicker than the temporalis fascia, it can be thinned or fashioned using techniques such as palisade grafting to preserve favourable acoustic properties while retaining structural support.⁹

Thus, the choice between the two graft materials represents a balance between anatomical success and functional hearing improvement. Given the limited regional evidence comparing these outcomes, the rationale of this study is to collect evidence-based regional data to help surgeons select the most appropriate graft material, optimise surgical outcomes, and reduce revision procedures. This study aimed to compare the audiological outcomes and graft uptake rates of temporalis fascia and tragal cartilage grafts in patients undergoing endoscopic myringoplasty.

Methodology

This prospective non-randomised comparative interventional study was conducted over a period of nine months from 1st December 2024 to 31st August 2025 at the Pak Emirates Military Hospital, Rawalpindi. Ethical approval was obtained from the Institutional Review Board before the commencement of the study. This study was designed and reported in accordance with the TREND guidelines for non-randomised intervention studies. The sample size was calculated using the Fleiss formula to compare two independent groups.

$$n = \frac{\left(Z_{1-\alpha/2} \sqrt{2\bar{P}(1-\bar{P})} + Z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right)^2}{(P_1 - P_2)^2}$$

Assuming a 5% level of significance, 80% study power, and anticipated mean post-procedural air-bone gap (ABG) values of 41.63 ± 9.50 dB and 46.46 ± 8.77 dB,¹ for temporalis fascia and tragal cartilage grafts (adopted from previous literature), respectively, a total sample size of 114 patients was calculated. Participants were recruited using consecutive non-probability sampling methods.

Patients aged 18 years–45 years, of either sex, presenting with conductive hearing loss, and undergoing myringoplasty were included. The age range of 18–45 years was selected to obtain a relatively homogeneous adult population while minimising the potential confounding effects of paediatric middle ear physiology, age-related hearing impairment, comorbidities, and variations in tissue healing that could influence graft uptake and postoperative hearing outcomes. Patients with a history of myringoplasty, sensorineural hearing loss, diabetes mellitus, chronic steroid use, active malignancy, ossicular chain disruption, or active ear infection were excluded from the study.

After providing written informed consent, the eligible participants underwent a baseline assessment. Demographic and clinical variables, including age, sex, laterality of disease, and preoperative ABG, were recorded using pure-tone audiometry (PTA) performed within seven days before surgery. All patients underwent endoscopic myringoplasty. Following enrolment, the participants were alternately assigned to one of the two intervention groups according to the order of recruitment. The first enrolled patient was allocated to the temporalis fascia group (Group-TF), the second to the tragal cartilage group (Group-TC), and subsequent patients were assigned in the same alternating sequence until the required sample size was reached.

In Group-TF, the temporalis fascia was used as the graft material, whereas in Group-TC, tragal cartilage was used. In Group-TC, tragal cartilage with the perichondrium preserved on one side was harvested and used as the graft material. Underlay myringoplasty was performed in both groups. To minimise performance bias, all the participants received standardised preoperative and postoperative care according to institutional protocols. All procedures were performed by consultant ENT surgeons with a minimum of three years' post-fellowship experience. Owing to the nature of the interventions, neither the participants nor the operating surgeons were blinded to the group assignments. However, the audiologist responsible for postoperative pure-tone audiometry and assessment of air-bone gap (ABG) outcomes remained blinded to the graft material used throughout the study period.

The participants were followed up monthly for six months after surgery. During each follow-up visit, the graft status and overall clinical condition were assessed by the primary operating surgeon. At the final six-month follow-up, graft uptake status and postoperative ABG were evaluated using pure-tone. The primary outcome measure was postoperative hearing improvement as determined by ABG, whereas successful graft uptake was considered a secondary outcome.

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 25. The normality of the quantitative variables was assessed using the Shapiro-Wilk test. As age and ABG were not normally distributed, they are presented as median and interquartile range (IQR). Categorical variables are expressed as frequencies and percentages. Within-group comparisons of preoperative and postoperative ABG levels were performed using the Wilcoxon signed-rank test. Intergroup comparison of ABG was conducted using the Mann-Whitney U test. Successful graft uptake between the groups was compared using the chi-square test. Statistical significance was set at $p \leq 0.05$.

Results

A total of 114 participants were enrolled in a 1:1 allocation in each group. Baseline characteristics, including age, sex distribution, laterality of the diseased ear (right or left), and preoperative ABG, were comparable between the groups, with no statistically significant differences ($p > 0.05$), as presented in Table 1.

Table 1: Intergroup comparison of baseline characteristics (n = 114)

Characteristic	TF Group* (n=57)	TC Group** (n=57)	Test of Statistical Significance
Age (Median IQR***)	27.20 (22.0-33.6)	27.20 (22.5-33.8)	Mann Whitney-U = 1607.0 p-value= 0.921
Gender			
Male	32 (56.1%)	24 (42.1%)	Pearson Chi-square=2.246 p-value= 0.134
Female	25 (43.9%)	33 (57.9%)	
Laterality			
Left	28 (49.1%)	27 (47.4%)	Pearson Chi-square=0.35 p-value= 0.851
Right	29 (50.9%)	30 (52.6%)	
Pre-Operative ABG [^]	20.0(15.5-23.5)	20.0(16.0-21.5)	Mann Whitney-U = 1506.0 p-value= 0.499

TF Group*: Temporalis Fascia Group; TC Group**: Tragal cartilage group; IQR***: Q1-Q3; ABG[^]: Air-bone gap

Graft uptake was significantly higher in the TC group than in the temporalis fascia group ($\chi^2 = 5.961$, $p = 0.015$), with Φ (Phi) / Cramer's V = 0.229, indicating a small effect size despite statistical significance (Table II).

Table 2: Anatomical Stability of Graft Material (n= 57 versus 57)

Study Variable	TF Group*	TC Group**	2-sided p-value	Pearson's chi-square value	Effect Size
Successful Graft Uptake	82.45%	96.49%	0.015	5.961	$\Phi = 0.229$

TF Group*: Temporalis Fascia Group; TC Group**: Tragal cartilage group

The postoperative air-bone gap was significantly lower in the temporalis fascia group than in the tragus cartilage group, whereas hearing gain was significantly higher in the temporalis fascia group (both $p < 0.001$), as presented in Table 3.

Table 3: Statistical analysis of Hearing outcome (n=114)

Study Variables		Median (Q1-Q3)		Mann-Whitney U	Z	2-sided p-value
		TF group* (n=57)	TC group** (n=57)			
Post-operative	Air-Bone Gap	8.0 (5.0-10.0)	11.0(8.5-13.0)	845.0	-4.488	<0.001
Hearing Gain		11.0 (9.0-15.0)	9.0 (6.5-11.0)	956.0	-3.801	<0.001

TF Group*: Temporalis Fascia Group; TC Group**: Tragal cartilage group

Discussion

The present study favoured TC in terms of anatomical stability, but auditory restoration was more pronounced in the TF group. The baseline characteristics were comparable between the two groups ($p > 0.05$), including age, sex distribution, laterality of disease, and preoperative audiological assessment, thereby enhancing the internal validity of the study. This reflects that the differences in graft uptake and hearing gain are solely attributable to the material properties of the grafts themselves, rather than confounding factors such as age-related eustachian tube dysfunction or worse baseline hearing in one group.

Our results indicated the superior anatomical stability of the TC graft (96.49%) compared to that of the TF graft (82.45%). These findings are consistent with those of Noor et al., who reported higher graft success rates with TC (96.5%) than with TF (86.2%).¹ Ishfaq et al. recorded 100% success in the TC group versus 72.5% success in the TF group.² The above findings underscore the macronutritional and bradytrophic nature of the TC graft, which

makes it more resistant to infection, negative middle ear pressure, and re-perforation than the thinner, more vascularised, but structurally fragile TF graft.

The present study demonstrated better auditory outcomes in the TF group, as reflected by a lower postoperative air–bone gap (8.0 dB) and greater hearing gain (11.0 dB). Jacob et al. reported postoperative ABG of 17 dB (temporalis fascia) versus 21 dB (cartilage), with corresponding hearing gains of 12 dB and 10 dB, respectively, favouring the use of temporalis fascia for better audiological improvement.³ In their meta-analysis, Chen et al. reported that temporalis fascia (TF) grafts were associated with a significantly smaller mean postoperative air–bone gap ($P = 0.009$).⁴ It highlights that the cartilage is thicker and heavier, increasing the mass and stiffness of the new tympanic membrane. This acoustic impedance selectively dampens sound vibrations, explaining why the lighter and more elastic temporalis fascia group exhibited superior hearing mechanics and sound conduction.⁵ In contrast, Venkatesan et al. found no significant difference in hearing outcomes between TF and cartilage grafts,⁶ and that precise thinning techniques or alternative placement methods (e.g., palisade or slice techniques) can effectively mitigate the acoustic impedance of cartilage.

Contrary to our results, Haq et al. reported higher audiological success in the cartilage group than in the fascia group (96.77% vs. 82.25%).⁷ Interestingly, Ferlito et al.⁸ identified that at short-term follow-up, the TF group showed a slightly lower ABG than the TC group (4.9 ± 0.9 dB vs. 5.3 ± 1.2 dB; $p = 0.04$), whereas at 5 years, the TC group demonstrated superior long-term stability with a significantly lower residual ABG (6.4 ± 2.0 dB vs. 10.0 ± 1.7 dB; $p < 0.001$). This disparity may be attributed to a higher incidence of lateralisation, retraction, or atrophy over time within their TF cohort, which would secondarily degrade hearing outcomes.⁹

Although graft uptake was statistically higher in the tragal cartilage group ($p = 0.015$), the effect size was small (Φ /Cramer's $V = 0.229$), suggesting a weak association between graft material and anatomical success. This raises an important interpretive consideration: statistical significance does not necessarily equate to a large or clinically meaningful effect size. Shakya et al. reported comparable graft uptake rates at 3 years between the perichondrium-reinforced cartilage palisade and fascia groups (94.87% vs. 80.7%; $p = 0.67$); however, at 5 years, graft uptake declined in both groups but remained significantly higher in the cartilage group than in the fascia group (87.17% vs. 66.6%; $p = 0.019$), highlighting the superior long-term durability of cartilage grafts.¹⁰ In practical surgical terms, the difference in success rates may be relatively modest, and temporalis fascia—when used with a meticulous technique and proper case selection—can still achieve high and clinically acceptable closure rates. Therefore, the choice of graft material should not be guided solely by statistical superiority in uptake rates but should also consider functional outcomes, surgical expertise, costs, and tissue availability.

The strength of our study lies in the comparable baseline demographic and audiological equivalence, which minimised confounding, allowing graft material to be evaluated as the primary determinant of outcomes, while reporting effect sizes alongside p-values improved the interpretation of the clinical significance of the findings. The relatively short follow-up period precluded the assessment of long-term graft stability, cartilage graft thickness was not objectively measured, and the single-centre design may limit the generalisability of the findings. Future studies should incorporate longer follow-up periods, objectively assess cartilage graft thickness, routinely report effect sizes alongside p-values, and include multicentre populations to enhance generalisability.

Conclusions

Tragal cartilage grafts achieved superior graft uptake, whereas temporalis fascia grafts provided better hearing outcomes than the other grafts. Therefore, graft selection should be individualised based on the relative importance of anatomical success and audiological improvement.

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