

Research Article

A Comparative Study Between Cartilage Graft and Temporalis Fascia Graft in Type 1 Tympanoplasty

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ABSTRACT

Background: Type I tympanoplasty is commonly performed to repair tympanic membrane perforations in chronic otitis media. This study compared the anatomical and functional outcomes of cartilage and temporalis fascia grafts.

Materials and Methods: This prospective comparative study included 80 patients, equally divided into cartilage (Group A) and temporalis fascia (Group B) groups. Graft uptake, hearing improvement, air-bone gap (ABG) closure, operative duration, and postoperative complications were evaluated.

Results: Graft uptake at one and three months was 97.5% in Group A and 90.0% in Group B ($p=0.16$). At three months, hearing gain of 10-20 dB was achieved in 65.0% and 62.5% of patients, respectively ($p=0.78$). Mean ABG closure was 14.0 ± 4.0 dB and 13.6 ± 3.5 dB ($p=0.63$). Complication rates were 2.5% and 10.0%, while mean operative durations were 90 ± 12 and 95 ± 14 minutes, respectively. None of the intergroup differences were statistically significant.

Conclusion: Both graft materials achieved satisfactory outcomes. Cartilage showed numerically higher graft uptake and fewer complications, while hearing improvement remained comparable.

Keywords: Type I Tympanoplasty, Cartilage Graft, Temporalis Fascia, Graft Uptake, Hearing Improvement.

INTRODUCTION

Chronic otitis media (COM) is a common otological condition and an important cause of preventable hearing impairment worldwide. It is characterized by persistent inflammation of the middle ear cleft, frequently associated with tympanic membrane perforation, recurrent ear discharge, and conductive hearing loss [1]. Its prevalence remains particularly high in developing countries due to overcrowding, poor hygiene, malnutrition, recurrent respiratory infections, and limited healthcare access [2,3]. COM is broadly classified into mucosal (tubotympanic) and squamosal (atticoantral) types, with the latter carrying a greater risk of cholesteatoma and associated complications [4,5]. Its pathogenesis is multifactorial, involving Eustachian tube dysfunction, recurrent infections, and persistent middle ear inflammation [6]. Tympanoplasty is an established surgical intervention aimed at

restoring tympanic membrane integrity, achieving a dry ear, and improving hearing. The modern principles of tympanoplasty were introduced by Wullstein and Zollner [7,8]. Type I tympanoplasty (myringoplasty) involves reconstruction of the tympanic membrane in patients with an intact and mobile ossicular chain. Various autologous graft materials have been employed, including temporalis fascia, perichondrium, cartilage, fascia lata, periosteum, and fat [9]. Temporalis fascia has traditionally been the preferred graft material because of its easy availability, flexibility, favourable handling characteristics, and structural resemblance to the native tympanic membrane. It provides satisfactory anatomical closure and postoperative hearing improvement. However, fascia grafts may undergo shrinkage, atrophy, or retraction, particularly in patients with large perforations, poor Eustachian tube function, or persistent

negative middle ear pressure, potentially resulting in graft failure [10]. Cartilage has emerged as an alternative graft material owing to its greater mechanical strength and resistance to deformation. Following its introduction by Salen and Jansen and subsequent developments in cartilage-perichondrium composite grafting by Goodhill, its application in tympanoplasty has expanded considerably [11,12]. Commonly harvested from the tragus or conchal bowl, cartilage provides greater structural stability and is particularly useful in large perforations, revision tympanoplasty, adhesive middle ear disease, and Eustachian tube dysfunction [13]. Its low metabolic requirements and resistance to resorption and retraction contribute to long-term graft stability. Various techniques, including cartilage shield, palisade, island, and cartilage-perichondrium composite grafting, have been developed to optimize surgical outcomes [14]. Despite these anatomical advantages, concerns remain regarding the potential effect of cartilage thickness and rigidity on sound transmission. Increased stiffness may theoretically compromise tympanic membrane vibration compared with the thinner and more flexible temporalis fascia. Nevertheless, previous studies have demonstrated comparable postoperative hearing improvement between both graft materials [15,16]. Several comparative studies have reported superior graft uptake with cartilage, while others have observed no significant differences in functional outcomes between cartilage and temporalis fascia tympanoplasty [17–19].

Considering the persistent burden of COM and the importance of achieving both anatomical closure and satisfactory hearing restoration, comparative evaluation of these graft materials remains clinically relevant. Therefore, the present study was undertaken to compare the anatomical and functional outcomes of cartilage graft and temporalis fascia graft in Type I tympanoplasty.

MATERIALS AND METHODS

This was a prospective, comparative, interventional hospital-based study comparing cartilage graft and temporalis fascia graft in Type I tympanoplasty. The study was conducted in the Department of Otorhinolaryngology at a tertiary care teaching hospital. The study was conducted over 18 months, with postoperative follow-up extending up to six months.

Study Population

Inclusion Criteria: Patients aged 18–60 years with chronic suppurative otitis media (tubotympanic type), a dry ear for at least four weeks, pure conductive hearing loss, and willingness to provide informed consent and comply with follow-up were included.

Exclusion Criteria: Patients with ossicular chain abnormalities, cholesteatoma, active ear discharge, previous ear surgery, uncontrolled systemic illness, immunocompromised states, or sensorineural hearing loss were excluded.

Sample Size

A total of 80 patients were enrolled, comprising 40 patients in each group. The sample size considered a 95% confidence level, 80% power, an anticipated 15% difference in graft uptake, and a 10% dropout allowance.

Study Groups

- Group A (n=40): Type I tympanoplasty using tragal or conchal cartilage graft.
- Group B (n=40): Type I tympanoplasty using temporalis fascia graft.

Study Parameters

Primary Outcomes: Graft uptake assessed through otoscopic/otoendoscopic examination and hearing improvement measured by air-bone gap (ABG) closure on pure tone audiometry (PTA) at one and three months.

Secondary Outcomes: Operative duration and postoperative complications, including graft lateralization, re-perforation, and infection.

Study Procedure

All patients underwent detailed clinical examination, otoscopy, tuning fork tests, PTA, and pre-anaesthetic assessment. Type I tympanoplasty was performed under general anaesthesia using a standardized underlay technique. In Group A, tragal or conchal cartilage was harvested and thinned to approximately 0.5 mm, whereas Group B received temporalis fascia harvested through a postauricular approach. Postoperative antibiotics, analgesics, and aural precautions were advised. Follow-up was scheduled at one week, one month, and three months, extending up to six months.

Data Collection

Demographic characteristics, clinical findings, preoperative audiometry, operative details, graft status, complications, and postoperative hearing outcomes were recorded using a

structured proforma. Audiometric assessments were performed by the same audiologist to ensure consistency.

Statistical Analysis

Data were analysed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean $\pm$ SD or median (IQR), as appropriate. The Chi-square test was used for categorical comparisons and the independent Student's t-test for continuous variables. All tests were two-tailed, with $p < 0.05$ considered statistically significant.

RESULTS

The present prospective comparative study included 80 patients with chronic otitis media undergoing Type I tympanoplasty, equally allocated into Group A (cartilage graft, $n=40$) and Group B (temporalis fascia graft, $n=40$). Demographic characteristics, baseline clinical findings, anatomical graft uptake, postoperative hearing improvement, air–bone gap (ABG) closure, complications, and operative duration were compared between the two groups. The mean age of patients was 35.6 ± 7.3 years in Group A and 36.1 ± 8.2 years in Group B ($p=0.77$). The majority belonged to the 31–40-year age group (37.5% and 32.5%, respectively). Male predominance was observed in both groups (62.5% vs. 55.0%; $p=0.34$). No statistically significant differences were observed in baseline demographic characteristics between the groups (Table 1). Right ear involvement was observed in 55.0% of patients in Group A and 50.0% in Group B ($p=0.65$). Small perforations were the most common in both groups (45.0% vs. 40.0%), followed by subtotal perforations (25.0% vs. 30.0%). Moderate conductive hearing loss (41–55 dB) was the predominant preoperative finding, affecting 55.0% and 57.5% of patients, respectively. The distribution of perforation size ($p=0.89$) and preoperative hearing loss severity ($p=0.91$) was comparable between the groups (Table 2, Figure 1). At one month, successful graft uptake was achieved in 39 patients (97.5%) in Group A compared with 36 patients (90.0%) in Group B. Corresponding graft failure rates were 2.5%

and 10.0%, respectively. These outcomes remained unchanged at three months, with no additional graft failures. Although cartilage graft demonstrated a numerically higher uptake rate than temporalis fascia graft, the difference was not statistically significant at either follow-up interval ($p=0.16$) (Table 3, Figure 2). At one month, hearing improvement of 10–20 dB was observed in 57.5% of patients in Group A and 55.0% in Group B, while hearing gain exceeding 20 dB was achieved in 32.5% and 30.0%, respectively ($p=0.70$). At three months, hearing gain of 10–20 dB was recorded in 65.0% and 62.5% of patients, whereas improvement exceeding 20 dB was observed in 20.0% and 17.5%, respectively ($p=0.78$). Mean ABG closure at one month was 13.2 ± 4.1 dB in Group A compared with 12.4 ± 3.7 dB in Group B ($p=0.67$). At three months, mean ABG closure increased to 14.0 ± 4.0 dB and 13.6 ± 3.5 dB, respectively ($p=0.63$). No statistically significant intergroup differences were observed in postoperative hearing gain or ABG closure at either follow-up interval (Table 4). Successful graft uptake was achieved in all patients with small perforations in both groups (100%). Among patients with moderate perforations, uptake rates were 87.5% in Group A and 75.0% in Group B. For large and subtotal perforations combined, successful graft uptake was observed in 100% of patients in Group A compared with 87.5% in Group B. Although cartilage graft demonstrated numerically higher uptake rates across perforation categories, the reported overall difference was not statistically significant ($p=0.227$) (Table 5, Figure 3). Postoperative complications occurred in one patient (2.5%) in Group A and four patients (10.0%) in Group B. Residual perforation was observed in one patient in Group A and three patients in Group B, while graft lateralization occurred in one patient in Group B. No cases of postoperative infection, facial nerve palsy, vertigo, or tinnitus were reported in either group. The difference in overall complication rates was not statistically significant ($p=0.16$). The mean operative duration was 90 ± 12 minutes in Group A compared with 95 ± 14 minutes in Group B, with no statistically significant difference between the groups ($p=0.09$) (Table 6).

Table 1. Comparison of Demographic Characteristics Between the Study Groups (N=80)

Parameter	Group A: Cartilage (n=40)	Group B: Temporalis Fascia (n=40)	p-value	Statistical Test
Age (years)				

Below 20	2 (5.0%)	1 (2.5%)		
21–30	8 (20.0%)	11 (27.5%)		
31–40	15 (37.5%)	13 (32.5%)		
41–50	8 (20.0%)	7 (17.5%)		
51–60	7 (17.5%)	8 (20.0%)		
Mean age $\pm$ SD	35.6 $\pm$ 7.3	36.1 $\pm$ 8.2	0.77	Independent t-test
Median (IQR)	34 (30–40)	35 (31–41)		
Sex			0.34	Chi-square
Male	25 (62.5%)	22 (55.0%)		
Female	15 (37.5%)	18 (45.0%)		

Table 2. Comparison of Baseline Clinical Characteristics Between the Study Groups

Parameter	Group A (n=40) n (%)	Group B (n=40) n (%)	p-value	Statistical Test
Affected ear			0.65	Chi-square
Right	22 (55.0)	20 (50.0)		
Left	18 (45.0)	20 (50.0)		
Perforation size			0.89	Chi-square
Small	18 (45.0)	16 (40.0)		
Moderate	8 (20.0)	8 (20.0)		
Large	4 (10.0)	4 (10.0)		
Subtotal	10 (25.0)	12 (30.0)		
Preoperative hearing loss			0.91	Chi-square
Mild (25–40 dB)	12 (30.0)	11 (27.5)		
Moderate (41–55 dB)	22 (55.0)	23 (57.5)		
Severe (56–70 dB)	6 (15.0)	6 (15.0)		

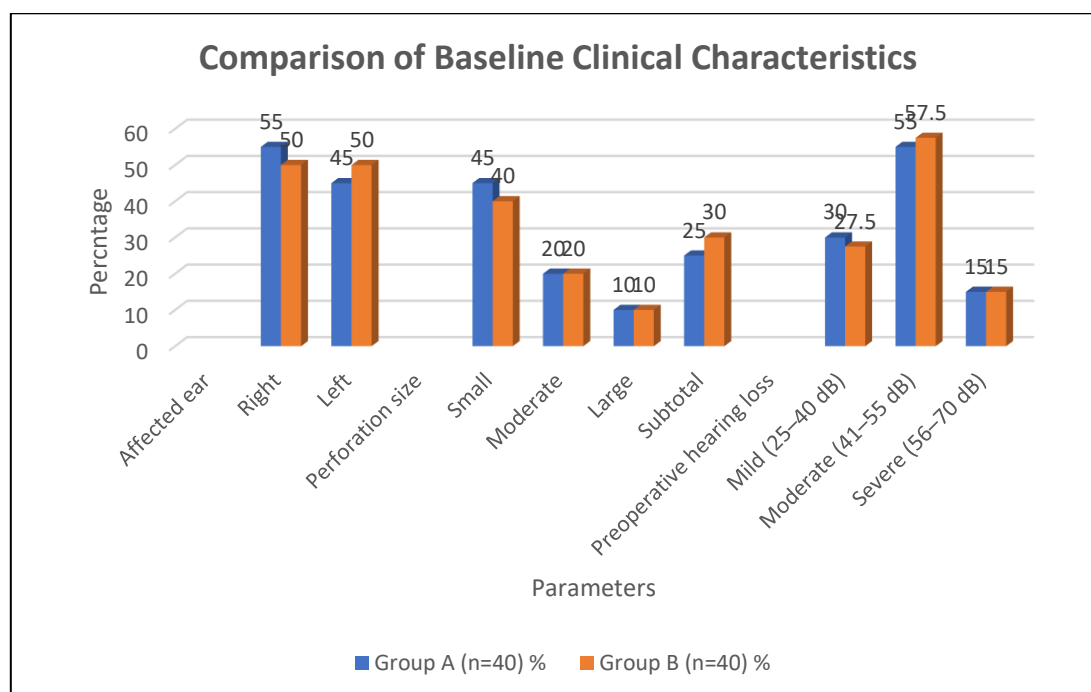


Figure 1. Comparison of Baseline Clinical Characteristics Between the Study Groups

Table 3. Comparison of Anatomical Graft Uptake at Different Follow-Up Intervals

Follow-up / Outcome	Group A (n=40) n (%)	Group B (n=40) n (%)	p-value	Statistical Test
At 1 month			0.16	Chi-square

Successful graft uptake	39 (97.5)	36 (90.0)		
Graft failure	1 (2.5)	4 (10.0)		
At 3 months			0.16	Chi-square
Successful graft uptake	39 (97.5)	36 (90.0)		
Graft failure	1 (2.5)	4 (10.0)		

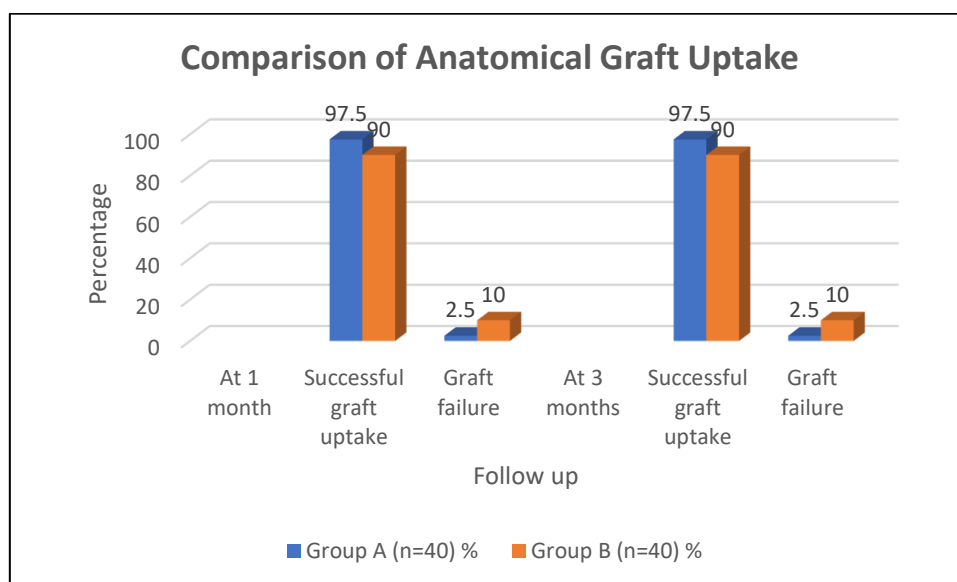


Figure 2. Comparison of Anatomical Graft Uptake at Different Follow-Up Intervals

Table 4. Comparison of Postoperative Hearing Gain and Air–Bone Gap Closure Between the Study Groups

Audiological Parameter	Group A (n=40)	Group B (n=40)	p-value	Statistical Test
Hearing gain at 1 month, n (%)			0.70	Chi-square
Less than 10 dB	4 (10.0)	6 (15.0)		
10–20 dB	23 (57.5)	22 (55.0)		
More than 20 dB	13 (32.5)	12 (30.0)		
Hearing gain at 3 months, n (%)			0.78	Chi-square
Less than 10 dB	6 (15.0)	8 (20.0)		
10–20 dB	26 (65.0)	25 (62.5)		
More than 20 dB	8 (20.0)	7 (17.5)		
ABG closure (Mean ± SD)				
At 1 month (dB)	13.2 ± 4.1	12.4 ± 3.7	0.67	Independent t-test
At 3 months (dB)	14.0 ± 4.0	13.6 ± 3.5	0.63	Independent t-test

Table 5. Comparison of Graft Uptake According to Perforation Size

Perforation Size	Group A: Successful n (%)	Group A: Failure n (%)	Group B: Successful n (%)	Group B: Failure n (%)
Small	18 (100.0)	0 (0.0)	16 (100.0)	0 (0.0)
Moderate	7 (87.5)	1 (12.5)	6 (75.0)	2 (25.0)
Large and subtotal	14 (100.0)	0 (0.0)	14 (87.5)	2 (12.5)
Total	39 (97.5)	1 (2.5)	36 (90.0)	4 (10.0)
p-value	0.227			

χ^2 (Chi-square)	8.15
Chi-square Test	

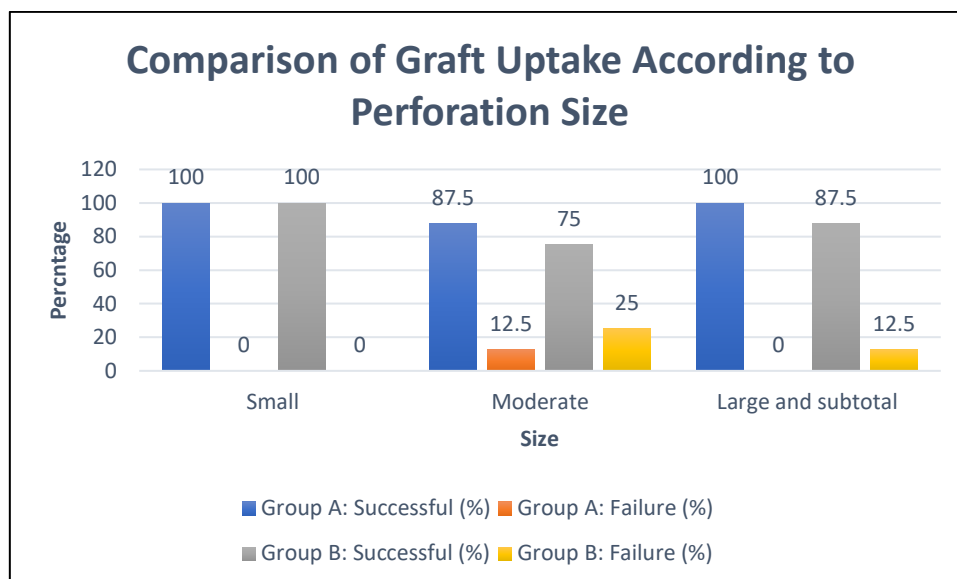


Figure 3. Comparison of Graft Uptake According to Perforation Size

Table 6. Comparison of Postoperative Complications and Operative Duration Between the Study Groups

Parameter	Group A (n=40)	Group B (n=40)	p-value	Statistical Test
Postoperative complications, n (%)			0.16	Chi-square
Graft lateralization	0 (0.0)	1 (2.5)		
Residual perforation	1 (2.5)	3 (7.5)		
Infection	0 (0.0)	0 (0.0)		
Facial nerve palsy	0 (0.0)	0 (0.0)		
Vertigo	0 (0.0)	0 (0.0)		
Tinnitus	0 (0.0)	0 (0.0)		
Total complications	1 (2.5)	4 (10.0)		
Operative duration (minutes)				
Mean $\pm$ SD	90 $\pm$ 12	95 $\pm$ 14	0.09	Independent t-test

DISCUSSION

The present prospective comparative study evaluated the anatomical and functional outcomes of cartilage graft and temporalis fascia graft in 80 patients undergoing Type I tympanoplasty, equally divided into two groups. Both graft materials demonstrated satisfactory anatomical success and hearing improvement, with numerically higher graft uptake observed in the cartilage group. In the present study, males constituted 62.5% of the cartilage group and 55.0% of the fascia group ($p=0.34$). The mean ages were 35.6 ± 7.3 and 36.1 ± 8.2 years, respectively ($p=0.77$). Yegin et al. (2016) [20] similarly reported male predominance (63.6%) and a mean age of 33.67 ± 13.07 years. Agarwal (2022) [21]

observed comparable mean ages of 35.89 ± 9.02 and 36.71 ± 8.45 years in the cartilage and fascia groups, respectively. In contrast, Ozdamar and Sen (2019) [22] reported a younger population (26.0 ± 9.3 years) with female predominance (53%). Venkatesan et al. (2022) [23] and Sarkar et al. (2020) [24] also observed comparable demographic characteristics between treatment groups. Right ear involvement was observed in 55.0% of cartilage cases and 50.0% of fascia cases ($p=0.65$), consistent with Yegin et al. [20] and Ozdamar and Sen [22], who reported comparable disease laterality. Small perforations were most common (45.0% vs. 40.0%), followed by subtotal perforations (25.0% vs. 30.0%; $p=0.89$). Moderate

conductive hearing loss predominated in both groups (55.0% vs. 57.5%; $p=0.91$). Ozdamar and Sen [22] similarly observed comparable baseline perforation characteristics, whereas Nithya et al. (2022) [25] reported variation in postoperative hearing outcomes according to perforation size. Successful graft uptake at both one and three months was 97.5% in the cartilage group compared with 90.0% in the fascia group ($p=0.16$). Comparable findings were reported by Agarwal (2022) [21] (97.14% vs. 91.43%; $p=0.303$), Venkatesan et al. (2022) [23] (96.67% vs. 90.0%), and Sarkar et al. (2020) [24] (92.0% vs. 84.0%; $p=0.384$). Mucha et al. (2023) [26] also observed numerically higher anatomical success with cartilage. Conversely, Ozdamar and Sen [22] reported graft retention rates of 94.9% with cartilage-perichondrium and 97.2% with fascia ($p=0.743$). These findings indicate satisfactory anatomical outcomes with both materials, although cartilage may offer greater resistance to retraction and resorption. At one month, hearing gain of 10–20 dB was achieved in 57.5% of cartilage cases and 55.0% of fascia cases, while gain exceeding 20 dB was observed in 32.5% and 30.0%, respectively ($p=0.70$). At three months, 65.0% and 62.5% achieved 10–20 dB improvement ($p=0.78$). Telang et al. (2018) [27] reported comparable hearing gains of 10.27 and 10.00 dB, respectively. Similarly, Venkatesan et al. [23] observed improvements of 11.17 ± 4.06 and 13.83 ± 8.11 dB. Das et al. (2020) [24] and Yegin et al. [20] also reported comparable functional outcomes. Agarwal [21] demonstrated functional success rates of 80.0% and 85.71%, whereas Nithya et al. [25] reported significantly greater overall ABG closure with fascia (69%) than cartilage (46%). Mean ABG closure at one month was 13.2 ± 4.1 dB with cartilage and 12.4 ± 3.7 dB with fascia ($p=0.67$), increasing to 14.0 ± 4.0 dB and 13.6 ± 3.5 dB, respectively, at three months ($p=0.63$). Yegin et al. [20] reported postoperative ABG values of 14.93 ± 8.69 and 17.60 ± 10.96 dB, while Das et al. [24] observed values of 12.92 ± 6.23 and 14.76 ± 5.6 dB. Similarly, Venkatesan et al. [23] reported ABG closure of 11.50 ± 5.0 and 13.39 ± 7.44 dB, whereas Agarwal [21] observed improvements of 15.19 ± 3.92 and 15.48 ± 3.67 dB ($p=0.719$). These findings support comparable hearing restoration with both graft materials. The overall complication rate was 2.5% in the cartilage group and 10.0% in the fascia group ($p=0.16$). Residual perforation

occurred in one cartilage case and three fascia cases, while graft lateralization was observed in one fascia case. No major complications were reported. Venkatesan et al. [23] similarly reported satisfactory wound healing in 100% and 93.33% of cartilage and fascia cases, respectively. Agarwal [21] observed no significant difference in complications, while Khan et al. (2024) [27] reported graft success rates of 94% and 89%, respectively, without major postoperative morbidity. Graft uptake was 100% for small perforations in both groups. Among moderate perforations, uptake was 87.5% with cartilage and 75.0% with fascia, while large and subtotal perforations demonstrated success rates of 100% and 87.5%, respectively (reported $\chi^2=8.15$, $p=0.227$). Dornhoffer (1997) [15] and Gerber et al. (2000) [16] reported high anatomical success with cartilage grafting. Similarly, Cabra and Monux (2010) [28] and Mohamad et al. (2012) [29] highlighted favourable cartilage graft outcomes, particularly in larger perforations. The greater structural stability of cartilage may explain its numerically higher uptake in extensive perforations. The mean operative duration was 90 ± 12 minutes in the cartilage group compared with 95 ± 14 minutes in the fascia group ($p=0.09$). Venkatesan et al. [23] similarly reported shorter operative time with cartilage (81.33 ± 11.14 minutes) than fascia (97.50 ± 17.16 minutes; $p<0.05$). This difference may be related to easier graft handling and positioning, although operative duration is also influenced by surgical technique and surgeon experience.

CONCLUSION

The present study demonstrated satisfactory anatomical and functional outcomes with both cartilage and temporalis fascia grafts in Type I tympanoplasty. Cartilage graft showed numerically higher graft uptake (97.5% vs. 90.0%) and fewer postoperative complications, although the differences were not statistically significant. Both graft materials achieved comparable postoperative hearing improvement and air–bone gap closure.

Limitations

The study was limited by its relatively small sample size, single-centre design, and non-randomized allocation, which may affect generalizability. Additionally, the short duration of postoperative outcome assessment limited the evaluation of long-term graft stability and hearing outcomes.

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