Original Article

Temporalis Fascia Versus Conchal Cartilage in Revision Type 1 Tympanoplasty

Hamza Elshafee Ahmed, Ahmed Abdel Aleem[1] and Caroleen Mounir Tawfik[2]

Department of Otorhinolaryngology, [1]Faculty of Medicine, Assiut University, [2]Assiut Police Hospital, Egypt

ABSTRACT

Objective/ Hypothesis: The primary goal of successful tympanoplasty is to creat a well-aerated closed middle ear (ME) cavity following disease removal. Temporalis fascia and cartilage are the most frequently used autografts due to their accessibility and favorable biological properties. Recurrent tympanic membrane (TM) perforation is considered a high-risk perforation. This study compared temporalis fascia and conchal cartilage grafts in revision type-1 tympanoplasty regarding graft uptake, hearing outcomes, and complications.

Study Design: Prospective comparative study.

Patients and Methods: This study included 26 adult patients (≥18 years) with recurrent, safe-type TM perforations and a history of recurrent tympanic membrane perforation at least six months prior. Patients were randomly divided into two equal groups (n=13). Group A underwent revision tympanoplasty using temporalis fascia graft; group B received Conchal cartilage graft. All patients were followed for six months. Outcomes assessed included graft take, pre- and post-operative pure tone average (PTA), air-bone gap (ABG), and complications.

Results: Both groups showed statistically significant improvement in post-operative PTA and ABG compared to pre-operative values ($p < 0.001$). There was no statistically significant difference between the two groups in hearing outcomes. Graft failure occurred in two cases in the fascia group and none in the cartilage group, though the difference was not statistically significant. No deterioration in bone conduction thresholds or notable donor-site morbidity was observed.

Conclusion: Temporalis fascia and Conchal cartilage grafts offer comparable results in type-1 tympanoplasty for recurrent TM perforations in terms of healing and hearing restoration.

Key Words: Conchal cartilage, revision tympanoplasty, temporalis fascia, TM grafting.

Received: 09 May 2025, **Accepted:** 19 July 2025

Corresponding Author: Caroleen Mounir Tawfik, MSc, Department of Otorhinolaryngology, Assiut Police Hospital, Egypt, **Tel.:** +2 012 0604 5590, **E-mail**: caroleenmounir@gmail.com

ISSN: 2090-0740, 2025

INTRODUCTION

The primary goal of successful tympanoplasty is to create an aerated self-cleaning closed ME cavity after total removal of disease. Numerous graft materials have been used for TM grafting. The temporalis fascia and cartilage are the most commonly used graft materials for this purpose[1]. One can expect graft take in more than 90% of primary cases. The rate of graft take in revision cases is generally less[2,3,4,5].

Temporalis fascia is composed of irregularly arranged elastic fibers and fibrous connective tissue. For this reason, its postoperative dimensions are unpredictable[6]. This might be important especially in large and anterior perforations where little graft support is present. Cartilage on the other hand is firmer than fascia and has a more constant shape[8]. Both graft materials have good tensile strength and low metabolic requirements. They both resist infection too[9]. They are readily available at the site of tympanoplasty incision, easy to harvest, shape and utilize to reconstruct TM defects.

The purpose of this study is to compare temporalis fascia and Conchal cartilage in grafting recurrent TM perforation in terms of healing and hearing outcome.

PATIENTS AND METHODS

This study was conducted in the Otolaryngology Department of Assiut University Hospital, Egypt, between March 2022 and February 2024. A total of 26 patients with recurrent TM perforation were included. The required sample size was calculated using G*Power 3 software[9].

Eligible participants were adults aged 18 years or older with a recurrent, dry, safe-type TM perforation, provided that at least six months had passed since their

DOI: 10.21608/ejentas.2025.382968.1844

previous ear surgery. Exclusion criteria included patients younger than 18 years, those with unsafe perforations (e.g., cholesteatoma), those requiring ossicular chain reconstruction, and patients lost to follow-up.

Ethical approval for the study was granted by the Institutional Review Board (IRB) of Assiut University (IRB Approval No. 17101737). Written informed consent was obtained from all participants after explaining the study's purpose and procedures. Participants were assured of their right to withdraw at any time without any consequences.

Study Scheme

Patients were randomly assigned into 2-groups, A and B with 13-patients each.

In group (A): Patients underwent revision myringoplasty using temporalis fascia graft.

In group (B): Patients underwent revision myringoplasty using conchal cartilage graft.

Before surgery, full history was taken from all patients and complete ENT examination (including nasal, nasopharyngeal, and oto-endoscopy) was done. The site and size of TM perforation and the status of ME mucosa were recorded. The size of TM perforation was estimated subjectively. An endoscopic still picture of the TM with the perforation was obtained and visual assessment was done by the authors. Perforation was considered small, medium, large or subtotal when affecting < 25%, 25-50%, 50-75% or > 75% of the TM respectively.

Pure tone audiometry was done prior to surgery and at 6-months post-operatively. Pre-operative and post-operative bone conduction threshold (BC) as well as pure tone average (PTA) at frequencies 500, 1000, 2000 & 4000 hertz were aslo recorded. The mean pre-operative and post-operative air-bone gap (ABG) were calculated according to the American Academy of Audiology guidelines 2002[10].

Surgical technique

All procedures were performed under general endotracheal anesthesia using a post-auricular approach. The incision was made just behind any previous scar and extended to the soft tissues over the mastoid.

Group A – Temporalis Fascia Graft (TFG)

A suitable portion of the remaining temporalis fascia was harvested, cleaned of muscle fibers, and compressed in a graft presser until used (Figure 1).

Fig. 1: Harvested temporalis fascia graft cleaned and pressed for later use.

Group B – Conchal Cartilage Graft

An approximately 8 mm circular piece of conchal cartilage was harvested with the perichondrium preserved on the convex side. A groove was created in the upper portion of the cartilage to accommodate the handle of the malleus, and the posterosuperior portion was thinned to avoid impingement on the incudo-stapedial joint (Figures 2 A,B).

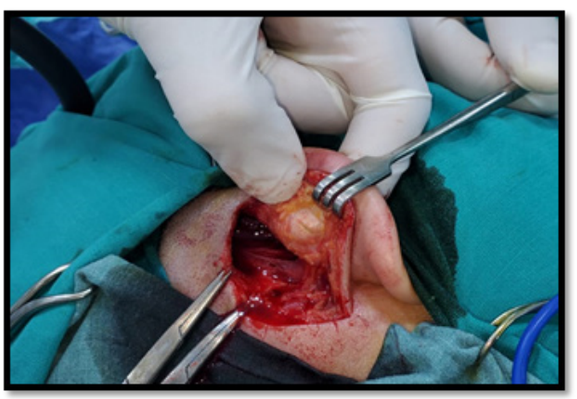

Fig. 2A: Conchal cartilage with perichondrium on the convex side

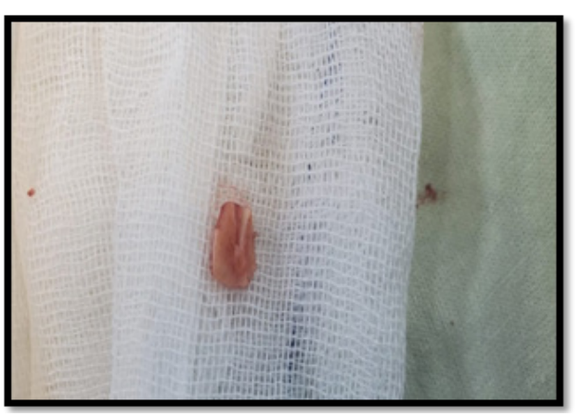

Fig. 2B: Groove created for malleus handle

Field exposure & graft Placement (Both Groups)

A Palva flap was elevated, and the vascular strip was dissected and everted. The retractor was applied & microscope was brought to the field. The edge of the perforation was trimmed. The tympano-meatal flap was elevated, and the ME was inspected. Ossicles were evaluated for continuity and mobility. Any adhesions between the TM and ME mucosa were sharply dissected.

- Group A: The ME was packed with small pieces of gelatin sponge, and the compressed fascia graft was inserted over the handle of malleus and under the TM remnant.

- Group B: The cartilage graft was trimmed, inserted with the concave side toward the promontory, and the groove aligned with the handle of malleus.

In both groups, the tympano-meatal flap was repositioned, and the medial part external auditory canal (EAC) was packed with gelatin sponge. The vascular strip was repositioned, and the Palva flap and skin incision were sutured. The lateral EAC was packed with Vaselinized gauze, and external dressing was applied.

Follow-up

Amoxicillin-clavulanic acid 1gm/12 hours was given for 1 week. Patients were discharged next day and were asked to come-back for follow up at 1week, 2 weeks, 1month, 3 months and 6 months.

Stiches were removed at 1 week. Pack was removed at 2 weeks and steroid-containing antibiotic ear drops were given twice daily for 2 weeks. At 1 month, the EAC was cleaned from gelatin sponge and granulations (when present) were cauterized using diluted chromic acid. Endoscopic examination of the ear was done at 3 months to check for graft take. At 6 months, the graft take was assessed and audiologic evaluation was done.

Outcome measures

Graft integration at six months was considered the primary indicator of surgical success (healing outcome), while a postoperative air-bone gap (ABG) of ≤ 20 dB was considered as the successful hearing outcome. Conversely, persistent TM perforation, a postoperative ABG > 20 dB, or a deterioration of BC threshold by ≥ 15 dB were considered criteria for failure. Healing and hearing outcomes were compared between the two groups. In addition, any complications or donor site morbidity were recorded and analyzed.

Statistical analysis

Data were collected and analyzed using Statistical package for social science version 20 (2011) (IBM-SPSS Inc., Chicago, IL, USA). Appropriate tests were used. A *P-value* was considered significant when it is < 0.05.

RESULTS

The mean age- in years- of patients in group A was 33.77 ±11.42 (range 18-48.4) and in group B was 27.46 ± 9.22 (range 19.5-45.7). There were 8 males and 5 females in both groups.

There were 2 diabetic and 2 hypertensive patients in group A and one diabetic and 1 hypertensive patients in group B.

There was no statistically significant difference between the 2 groups in terms of nasal morbidity (Number of patients with allergic rhinitis, deviated nasal septum and turbinate hypertrophy). Surgery was in the right ear in 8 patients in group A and 9 patients in group B.

The perforation was present in the inferior half of the TM in all patients in both groups, and it was affecting the antero-superior part (along with the inferior half) in 2 patients in group B.

In group A, 2 patients had large perforation, the rest had small to medium-sized ones. In group B, all patients had small to medium-sized perforation. In both groups, the majority of patients had medium-sized perforation.

At the time of surgery, ME mucosa was edematous in 2 patients, polypoid in 1 and normal in 10 patients in group A. In group B, ME mucosa was normal in all patients with the exception of 1 patient who had mucosa with tympanosclerosis.

(Table 1) showed that graft take was achieved in all patients in cartilage group and in about 85% in the fascia group. The difference between 2 groups -however- was statistically insignificant.

Table 1: Graft take at 6 months in the 2 groups:

Graft take	TFG (*n*= 13)		Cartilage (*n*= 13)		*P-value*
	No.	%	No.	%	
Taken	11	84.6%	13	100.0%	0.480
Broken	2	15.4%	0	0.0%	

(Table 2) showed that there was a statistically significant improvement in the mean PTA after surgery in both groups, the difference between the 2 groups –however- was statistically insignificant.

Table 2: Mean pre and post-operative PTA & mean PTA changes in the 2 groups:

PTA	TFG (*n*= 13)	Cartilage (*n*= 13)	*P-value*[1]
Pre-operative:			
Mean ± SD	44.04 ± 6.73	44.81 ± 10.98	0.959
Median (Range)	41.3 (35.0-53.8)	41.3 (27.5-62.5)	
Post-operative:			
Mean ± SD	30.42 ± 5.83	29.71 ± 8.90	
Median (Range)	31.8 (17.5-37.5)	27.5 (22.5-52.5)	0.129
P-value[2]	0.001*	0.002*	
PTA improvement:			
Mean ± SD	13.77 ± 7.37	14.50 ± 5.33	0.738
Median (Range)	12.5 (3.8-25.0)	15.0 (7.5-25.0)	

Mann-Whitney Test Wilcoxon Signed Ranks Test

(Table 3) showed that the mean post-operative ABG was significantly better than the mean preoperative value in both groups with no statistically significant difference between the 2 groups.

Table 3: Mean pre & post-operative ABG and mean ABG changes in the 2 groups:

ABG	TFG (*n*= 13)	Cartilage (*n*= 13)	*P-value*[1]
Pre-operative:			
Mean ± SD	26.25 ± 6.52	29.04 ± 7.99	0.341
Median (Range)	25.0 (16.3-37.5)	26.3 (18.8-45.0)	
Post-operative:			
Mean ± SD	11.81 ± 6.18	13.92 ± 4.86	
Median (Range)	13.8 (1.3-21.3)	12.8 (5.0-22.3)	0.520
P-value[2]	0.001*	0.001*	
A B G improvement: Mean ± SD	14.44 ± 7.45	15.12 ± 6.05	0.504
Median (Range)	13.8 (5.0-32.5)	15.0 (5.0-26.3)	

Mann-Whitney Test Wilcoxon Signed Ranks Test

There were 2 cases with post-operative ABG> 20 dB (one in each group). Both of them had taken graft. The one belonging to the fascia group improved by only 5 dB to end up with an average of 21.25 dB ABG. The other one however improved by 22 dB to end up with 22.5 dB ABG.

No significant deterioration of the bone conduction threshold was recorded in any patient.

Discoloration of the skin of the concha due to extravasated blood was noticed in 4 patients in the cartilage group. It was absorbed within 2 weeks. Other than that no significant donor site morbidity was reported.

DISCUSSION

Myringoplasty is considered successful when it results in complete closure of the tympanic membrane perforation and a postoperative air-bone gap of 20 dB or less, without any significant deterioration in bone conduction threshold. According to the literature, this outcome is achievable in approximately 90% of cases. Recurrent TM perforation, among other factors, is considered a high-risk perforation. Therefore, less favorable results are typically expected in revision myringoplasty compared to primary procedures[2,3,4,5,11,12].

To improve outcomes in both primary and revision tympanoplasty, various surgical techniques and modifications have been studied. Several growth-enhancing agents have also been evaluated to maximize graft success[13,14,15]. Among these graft materials, cartilage comes as the most widely used graft for recurrent TM perforations, with numerous studies documenting its effectiveness.

In this study, we compared the anatomical and functional outcomes of underlay type-1 tympanoplasty using temporalis fascia graft and conchal cartilage graft in cases of recurrent TM perforation.

Graft take was achieved in all patients in the cartilage group and in 11 out of 13 cases (85%) in the TFG group (Table 1). The difference between the two groups was not statistically significant. Both techniques also yielded comparable results in mean (PTA) reduction (14 dB vs. 14.5 dB) and mean ABG improvement (14.4 dB vs. 15.1 dB) (Tables 2,3). Our findings are consistent with other studies and systematic reviews comparing fascia and cartilage in both primary[11,18,19,20,21] and revision[4,12,22] type-1 tympanoplasty, which generally have reported similar results.

There were four unsuccessful cases in this study. Two patients experienced graft failure—both from the TFG group—and other two cases failed to achieve a ABG ≤ 20 dB postoperatively despite successful graft take (one in each group). Analysis of the graft-failure cases revealed no risk factor incommon except that both had large perforations and a history of allergic rhinitis. One of these patients also had edematous middle ear (ME) mucosa during surgery, while the other was diabetic and on oral hypoglycemic agents.

The two cases with unsatisfactory hearing outcomes had medium-sized perforations. One of them had middle ear tympanosclerosis, which may have impaired sound conduction.

CONCLUSION

Both temporalis fascia and conchal cartilage are excellent graft materials for revision type-1 tympanoplasty. One can reasonably expect a graft take rate of approximately 90% and an average PTA improvement of 14 dB. Creating a groove in the cartilage graft to accommodate the manubrium of the malleus together with thinning the cartilage over the incudo-stapedial joint may help to minimize any negative effect on ossicular chain mobility caused by cartilage mass. The fact that the majority of patients in both groups had small to medium-sized perforation and we did not test Eustahcian tube function weakened the study. It would be better if the comparison focused on large TM perforation and ears with poor Eustachian tube function. Nonetheless, larger-scale prospective trials with longer follow-up periods are needed to provide high-quality evidence and better-evaluate long-term outcomes.

CONFLICT OF INTEREST

There are no conflict of interests.

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