

Endoscopic Transcanal Simple Myringoplasty Using Push Through Technique with Cartilage Ring Graft Versus Temporalis Fascia Graft

Original
Article

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ABSTRACT

Objective: Assessment of endoscopic transcanal simple myringoplasty using a push-through technique with cartilage ring graft versus temporalis fascia graft.

Patients and Methods: A prospective comparative study was conducted on 60 patients distributed randomly and equally into two groups. Both groups were subjected to endoscopic transcanal simple myringoplasty using a push-through technique with cartilage ring graft used in group I and temporalis fascia graft used in group II. The degree of improvement of postoperative air-bone gap (ABG) was assessed in both groups. Both groups were compared regarding healing, hearing success, and ABG gain. The correlation between the healing success and size and site of the perforation was assessed.

Results: The present study showed a highly significant ABG improvement in both groups ($p < 0.00001$ for both). There was a non-significant difference between the two groups regarding healing success (83.3% and 80% respectively), hearing success, and ABG gain ($p = 0.739, 0.417, \text{ and } 0.757$ respectively). There was a non-significant correlation between the healing success in both groups and the perforation size ($p = 0.6221$ and 0.3598 , respectively). There was a non-significant correlation between the healing success of the operation in both groups and the perforation site ($p = 0.704$ and 0.516 , respectively).

Conclusion: Both cartilage ring and temporalis fascia grafts resulted in a highly significant postoperative improvement of ABG with comparable results regarding healing and hearing success and ABG gain. Both graft types showed a non-significant correlation between success and site and size of the perforation.

Key Words: Cartilage ring, endoscopic, myringoplasty, push through, temporalis fascia.

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INTRODUCTION

Although Microscopic myringoplasty remains the standard approach for tympanic membrane perforation repair, it has some limitations regarding visualization of the surgical field in some cases like prominent anterior canal wall and anterior quadrant or marginal perforations^[1,2]. These limitations raise the need for invasive procedures like canaloplasty or the postauricular approach^[2]. On the other hand, transcanal endoscopic ear surgery (TEES) has emerged since the 1990s, first as an adjunct to an operating microscope then as an exclusive tool for different otologic surgeries^[3-7]. Endoscopy offered a broader surgical view overcoming the previously mentioned limitations of the microscopic approach like postauricular incision and canaloplasty. It also allowed visualization of some hidden areas of the middle ear cleft with less interference by the external auditory canal curvature^[8-10]. Different graft materials, including composite cartilage perichondrial and temporalis fascia grafts, are available for tympanic

membrane perforation repair using various preparation and placement techniques. This study aimed to compare endoscopic transcanal simple myringoplasty using a push-through technique with cartilage ring graft versus temporalis fascia graft.

PATIENTS AND METHODS:

The current study was a prospective comparative study comparing two graft materials for endoscopic transcanal repair of small and medium-sized tympanic membrane perforation using a push-through technique. Patients of the study were recruited from the Otorhinolaryngology Department, Menoufia University Hospital during the period from January 2019 to July 2020 after approval of the hospital's ethical committee. Informed written consent was taken from every patient before participation in the study.

To be included in the study, patients aged between 18 and 70 years old with an absence of otorrhea at least for three months and lack of inflammation or infection in middle-ear mucosa and mastoid air cells. Patients should have small to medium-sized dry central perforation. Patients with other ear pathologies like cholesteatoma or ossicular disruption, and patients with surgical unfitness like bleeding tendency and uncontrolled systemic diseases were excluded from the study.

All patients were assessed preoperatively by history taking and complete ENT examination. Otoscopic and microscopic examination of the ear was performed for every patient to confirm the site and size of the perforation and state of middle ear mucosa. The perforation site was either small (occupying less than a quadrant of the tympanic membrane) or medium (occupying less than two quadrants of the tympanic membrane). The perforation site was either central, predominantly anterior, or predominantly posterior. Audiological evaluation by pure tone audiometry was done to assess the type and degree of hearing loss with air-bone gap (ABG) measurement. Routine preoperative investigations were done for every patient, including complete blood picture, hepatic, renal, bleeding, and coagulation profiles.

Sixty patients were included in the study and were randomly and equally divided into two equal groups by block randomization method using 30 blocks of two. Each block has 2 patterns, one of them was selected randomly using a computer excel program. Both groups were operated under general anesthesia with endotracheal intubation and subjected to endoscopic transcanal simple myringoplasty using a push-through technique. The grafting material was a cartilage ring in group I and temporalis fascia in group II.

Graft harvesting and preparation:

The cartilage-perichondrium graft in group I was harvested from tragal cartilage. The tragus was injected with 2% lignocaine (to minimize postoperative pain) and 1:100,000 adrenalin drug (to minimize bleeding). An incision was made along the free edge of the tragus, and the subcutaneous tissue was dissected to the lateral border of the cartilage and its perichondrium. The cartilage was then harvested with its attached perichondrium, with the donor site closed using non-absorbable sutures. The perichondrium was left attached to the concave side of the cartilage (Figure 1-A). The graft was approximately 12–15 mm in diameter. A circular piece of cartilage was cut from the center of the cartilage on the convex side using a number 15 scalpel blade or the sharp edge of an ear speculum. The cut circular piece of cartilage was removed with gentle dissection, avoiding laceration of the attached perichondrial sheet. This technique yielded a perichondrial sheet with an attached peripheral cartilage ring

(Figure 1-B). According to the periphery needed, the cartilage ring was trimmed, preserving a good rim of a firm, elastic, and intact cartilage (2–3 mm) with the graft's size a little larger than the membrane tensa size. The temporalis fascia graft in group II was harvested through a 2 cm postaural incision in the temporal region of the scalp after infiltrating with 2% lignocaine (to minimize postoperative pain) and 1:100,000 adrenalin drug (to minimize bleeding). The graft is then dried under a heating lamp (Figure 2) and trimmed to fit the perforation size. The incision for graft harvesting was closed using non-absorbable sutures.

Surgical technique:

Telescopes of 0 and 30 degrees with diameters of 2.7 and 4 mm were used for the endoscopic approach. The perforation margin and anterior annulus were visualized through endoscopy. The perforation margin was circumferentially freshened using a pick or a sickle knife. In group I, cartilage ring graft was pushed through the perforation and placed in an underlay manner medial to the tympanic membrane remnant with the cartilage ring resting in the tympanic sulcus and facing medially and perichondrium facing laterally, leaving the cartilage ring resting in the tympanic annulus and on the medial wall of the middle ear without the need for gel foam packing of the middle ear. In group II, the middle ear cavity was tightly packed with an absorbable gelatin sponge (Pfizer Inc, NY, US) through the perforation. The tubal orifice was plugged with gel foam to prevent the graft's medialization because of negative pressure produced by sniffing. Then the temporalis fascia graft was pushed through the perforation and placed in an underlay manner medial to the tympanic membrane remnant. Absorbable gelatin sponge pledgets soaked with antibiotic drops were placed lateral to the graft in the external auditory canal.

Postoperative care:

The patients were discharged the next morning on a 10-day course of oral amoxicillin-clavulanic acid. At the end of the 10th postoperative day, the Gelfoam was sucked from the external ear canal to avoid a granulomatous reaction. Three weeks later, the patients were encouraged to start doing gentle Valsalva maneuvers. The patients were followed for three months with pure tone audiometry performed for every patient at the end of the follow-up period.

Outcomes:

Successful graft acceptance was defined as full, intact healing of the tympanic membrane without perforation. Assessment of hearing improvement was based on the

audiogram performed at three months postoperative. The ABG closure to within 20 dB was considered as hearing success. ABG gain was defined as the difference between the pre and postoperative ABGs. Results were analyzed by comparing pre and postoperative ABGs in both groups. Both groups were compared regarding healing and hearing success and ABG gain. The healing success of both groups was correlated with the size and site of the perforation

Statistical Analysis:

Data were collected, tabulated, and statistically analyzed using an IBM personal computer with Statistical Package of Social Science (SPSS) version 22, IBM Corp, Armonk, NY, USA. Descriptive statistics for quantitative data were presented as mean (\bar{X}) and standard deviation (SD). Qualitative data were presented as numbers (No.) and percentages (%). Data turned up to be non-normally distributed according to the Kolmogorov-Smirnov test. Mann-Whitney U test was used to compare quantitative data of both groups. Chi-squared (χ^2) and Fisher Exact tests were used to study the relationship between two qualitative variables. Wilcoxon signed-rank test was used to compare preoperative and postoperative quantitative data of each group. A two-sided p-value of (<0.05) was considered statistically significant while a p-value of less than 0.001 was considered statistically highly significant.

RESULTS:

The current study included 60 patients distributed equally as two groups subjected to endoscopic transcanal simple myringoplasty using a push-through technique with cartilage ring graft in group I and temporalis fascia graft in group II. Group I included 19 (63.3%) males and 11 (36.7%) females with a mean age of 29.7 ± 9.88 SD years. Group II included 16 (53.3%) males and 14 (46.7%) females with a mean age of 30.3 ± 10.26 SD years. There was a non-significant difference between the two study groups regarding age, sex, size, and site of the perforation and preoperative air-bone gap (0.912, 0.432, 0.196, 0.548, and 0.992, respectively) (Table 1).

The present study showed a highly significant improvement in the air-bone gap in both groups ($p < 0.00001$ for both) (Table 2). There was a non-significant difference between the two groups regarding healing success (83.3% and 80%, respectively), hearing success, and ABG gain ($p = 0.739, 0.417, \text{ and } 0.757$) (Table 3)

In the current study, there was a non-significant correlation between the healing success in both groups and the perforation size ($p = 0.622$ and 0.36 , respectively) (Table 4). There was a non-significant correlation between the healing success in both groups and the perforation site ($p = 0.704$ and 0.516 , respectively) (Table 5).

Table 1: Demographic and clinical data of both study groups.

Item	Group I (30)		Group II (30)		Statistical Test	P value	
	No	%	No	%			
Gender	Male	19	63.3	16	0.6171.	0.432	
	Female	11	36.7	14			46.7
Size of perforation	Small	12	40	17	1.6685	0.196.	
	Medium	18	60	13			43.3
Site of perforation	Mainly anterior	12	40	10	1.204	0.548	
	Mainly posterior	8	26.7	12			40
	Central	10	33.3	8			26.7
		Mean \pm SD		Mean \pm SD		Mann Whitney U test	
Age		29.7 \pm 9.88		30.3 \pm 10.26		Z= -0.111	0.912
Preoperative ABG		27.17 \pm 4.68		29.33 \pm 4.3		Z = 0.007	0.992

Table 2: Comparison between preoperative and postoperative air bone gap in both study groups:

Group	Preoperative ABG Mean \pm SD	Postoperative ABG Mean \pm SD	Wilcoxon signed rank test	P value
Group I	27.17 \pm 4.68	16.5 \pm 4.76	Z = 5.70679	< 0.00001
Group II	29.33 \pm 4.30	17.83 \pm 5.68	Z= 5.61069	< 0.00001

CARTILAGE RING GRAFT VERSUS TEMPORALIS FASCIA GRAFT

Table 3: Comparison between study groups regarding postoperative outcomes:

Parameter	Group I		Group II		Statistical Test	P value	
	No	%	No	%			
Healing success	+ve	25	83.3	24	80	0.1113	0.739
	-ve	5	16.7	6	20		
Hearing success	+ve	21	70	18	60	0.6593	0.417
	-ve	9	30	12	40		
ABG gain	Mean ± SD		Mean ± SD		Mann Whitney U test	0.31047.	0.757
	11.33333333		10.83333333				
	4.535935697		5.099583035				

Table 4: Correlation between the success of the operation and size of the perforation

Group	Size of perforation	Completely healed	Partially healed	Fisher Exact Test P value
Group I	Small	11	1	0.6221
	Medium	14	4	
Group II	Small	15	2	0.3598
	Medium	9	4	

Table 5: Correlation between the success of the operation and site of the perforation

Group	Size of perforation	Completely healed	Partially healed	Fisher Exact Test P value
Group I	Mainly anterior (12)	9	3	0.704
	Mainly posterior (8)	7	1	
	Central (10)	9	1	
Group II	Mainly anterior (10)	7	3	0.516
	Mainly posterior (12)	11	1	
	Central (8)	6	2	

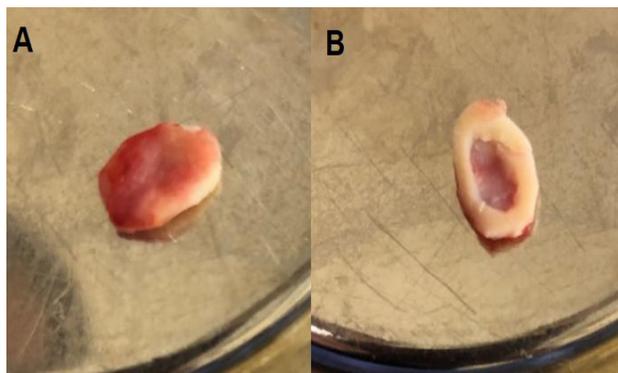


Fig. 1: Cartilage ring graft: A: Perichondrial side, B: Cartilaginous ring side



Fig. 2: Temporalis fascia graft

DISCUSSION

Endoscopic type I tympanoplasty was initially introduced in the 1990s, and the extensive spread of this practice can be easily observed over the last years with variable techniques and graft materials. In the current study, we adopted the endoscopic approach to repair small and medium-sized tympanic membrane perforation. Several studies have compared endoscopic and microscopic tympanoplasty. A meta-analysis conducted by Tseng *et al.*^[12] reported comparable tympanic membrane closure rates and hearing results for endoscopic and microscopic tympanoplasty. Patients receiving endoscopic tympanoplasty had a lower canaloplasty rate and more favorable cosmetic results than those receiving microscopic tympanoplasty. Another meta-analysis conducted by Pap *et al.*^[11] showed that the surgical outcomes of endoscopic type I tympanoplasty in terms of graft healing, postoperative hearing, and operative duration were comparable to microscopic type I tympanoplasty. Regarding cosmetic results, the endoscopic group had more desirable results, mainly due to a significantly lower incidence of canaloplasty. Similarly, Manna *et al.*^[13], in a meta-analysis of outcomes following tympanoplasty and stapes surgery using endoscopic versus microscopic approach, reported that audiological, functional, and complications outcomes were similar, if not superior, for the endoscopic approach to both tympanoplasty and stapes surgery compared to the microscopic approach. Tympanoplasty patients undergoing the endoscopic approach had lower canaloplasty rates, better cosmetic outcomes, and shorter operative durations. This meta-analysis supported the use of endoscopic techniques for tympanoplasty and stapes surgery.

In the current study, we used the push-through technique without raising tympanomeatal flap. Several studies have compared the push-through technique with the traditional tympanomeatal elevation technique. El-Hennawi *et al.*^[14] evaluated 56 patients with small anterior tympanic membrane perforations. Perforations were repaired with an endoscopic push-through technique ($n = 28$) or a microscopic underlay technique ($n = 28$). They found that the endoscopic push-through technique for anterior tympanic membrane perforations was as effective as microscopic underlay myringoplasty, with being less invasive and having less operative duration. Erden and Gülşen^[15] evaluated surgical and audiological outcomes of push-through myringoplasty and microscopic underlay cartilage tympanoplasty in repairing anterior tympanic membrane perforations. They found that push-through myringoplasty yielded shorter operative duration and fewer postoperative complications and morbidity and may serve as an efficient alternative to conventional

microscopic underlay technique in treating anterior tympanic membrane perforations, with comparable graft healing rates and audiological outcomes. Lou^[16] assessed 93 pediatric patients with perforation who underwent myringoplasty. Patients were randomized between cartilage push-through and underlay fascia grafts. They found that endoscopic cartilage push-through and underlay fascia graft myringoplasty had comparable hearing results in pediatric patients; However, they found that the push-through technique without the elevation of a tympanomeatal flap exhibited better long-term graft success rate compared to underlay fascia graft.

In the current study, we compared two graft materials: temporalis facia and cartilage ring grafts. The temporalis facia graft has been considered as a standard graft material for many otologists; however, the use of cartilage tympanoplasty has been evolving over the past years. Several studies have compared cartilage and fascia tympanoplasty with several studies comparing their healing and hearing results. Mohammad *et al.*^[17], in their systematic review, found that tympanoplasty using cartilage with or without perichondrium had a better morphological outcome than tympanoplasty using temporalis fascia. However, there was no statistically significant difference in hearing outcomes between the two grafts. In their meta-analysis, Yang *et al.*^[18] found that tympanoplasty using cartilage grafts had a better graft healing than using temporalis fascia grafts. There were no significant differences between cartilage grafts and temporalis fascia grafts for hearing outcomes. Contrary to the sliced cartilage sub-group, full-thickness cartilage grafts generated better hearing outcomes than temporalis fascia grafts. Jalali *et al.*^[19] conducted a meta-analysis and found that cartilage grafting seemed to show a higher graft integration rate than temporalis fascia grafting. Both cartilage and fascia tympanoplasty provided similar improvements in the hearing outcome postoperatively.

In the current study, we found a comparable healing success rate between cartilage ring and temporalis facia grafts (83.3% and 80%, respectively) with a non-significant difference regarding hearing success or ABG gain. Both graft materials showed a highly significant postoperative improvement of ABG with no significant correlation between the healing success at one hand and the size or site of the perforation on the other hand. Some studies have evaluated the cartilage ring grafts for the repair of tympanic membrane perforation. Debasish *et al.*^[20] proposed using a composite graft of tragal perichondrium supported by a ring of cartilage peripherally for the closure of big central and subtotal perforation by tympanoplasty using underlay technique. They found an overall graft take rate of 93.33%. Albirmawy^[21] evaluated

the anatomical and audiological outcomes of primary type one tympanoplasty performed with a composite cartilage-perichondrium 'ring' graft. He compared these outcomes with the outcomes of temporalis fascia graft in children. He found that cartilage-perichondrium composite ring graft yielded good anatomical and functional results. The anatomical results obtained using this graft were superior to those for temporalis fascia. The ring graft group had equivalent, if not better, postoperative audiometric results than the temporalis fascia group.

Albirmawy^[21] attributed the better surgical outcomes of cartilage ring graft to the fact that the presence of a firm yet malleable peripheral cartilaginous ring fits and stabilizes the graft within the tympanic bony annulus under the tympanic membrane fibrous annulus. This stabilization makes the graft resistant to the retraction by negative middle ear pressure, lateralization, with no blunting. The lack of a large central cartilaginous disc enables the stretched perichondrium to be freely mobile with better compliance. This graft design gave morphological and audiological outcomes similar to the natural tympanic membrane. The limitations of this study included a relatively small sample size. All the cases meeting the inclusion criteria at the otorhinolaryngology outpatient clinic during the study period were included in the study without a preliminary sample size assessment. Another limitation was the short follow up periods of three months. Larger studies with longer follow-up periods are required for better assessment of the anatomical and functional outcomes at a long term scale.

CONCLUSION

The endoscopic transcanal approach with push-through technique is an effective approach for repairing small and medium-sized tympanic membrane perforations. Both cartilage ring and temporalis fascia grafts showed comparable results regarding healing and hearing success and air-bone gap gain with a non-significant correlation between success and site and size of the perforation. Cartilage ring grafts offer a good grafting material that should be considered for endoscopic repair of tympanic membrane perforation.

CONFLICT OF INTEREST

There are no conflicts of interest.

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