Original Article

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Outcome of endoscopic cartilage tympanoplasty in anteriorly extended tympanic membrane perforation

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ABSTRACT

Background: The study was conducted to assess hearing improvement and graft uptake rate in patients with an anteriorly extended tympanic membrane perforation who underwent endoscopic cartilage tympanoplasty. **Aim**: The study aims to assess the efficacy of endoscopic cartilage tympanoplasty in repairing an anteriorly extended tympanic membrane perforation. **Methods**: A total of 135 patients aged between 10 and 63 years with an anteriorly extended tympanic membrane perforation were included in this study. Patients with an active middle ear disease and ossicular abnormality were excluded. Pure-tone audiometry was performed preoperatively at 500, 1000, 2000, and 4000 Hz, and the air-bone gap (ABG) for each frequency was determined. The patients underwent endoscopic cartilage tympanoplasty utilizing the tragal cartilage with its perichondrium after separation. Graft uptake rate and hearing gain by ABG reduction were assessed 3 months after the procedure. Data analysis was carried out with SPSS version 22. **Results**: We studied 71 females and 64 males. Preoperative ABG at 500, 1000, 2000, and 4000 Hz were 25 ± 4, 23.5 ± 4, 23.6 ± 4, and 23.9 ± 3, respectively. Postoperative hearing gains for the above frequencies were 16.4 ± 3, 16.1 ± 4, 14.7 ± 4, and 15.6 ± 4, respectively. Graft uptake rate was 91.8% with complete closure of perforation and only 8.2% with residual tiny perforation that looked like a slit. **Conclusion**: Endoscopic cartilage tympanoplasty is an effective method for the improvement of hearing and the repair of challenging anteriorly extended tympanic membrane perforation.

Keywords: endoscopic cartilage tympanoplasty, anterior tympanic membrane perforation, hearing gain

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INTRODUCTION

Perforated eardrums are a common problem and may occur at any age, affecting both sexes. However, the problem has a slight male predominance. The exact incidence may be difficult to estimate because many perforations heal unnoticed.[1]

There could be multiple reasons for tympanic membrane (TM), most commonly trauma and infection, and any part of the membrane may be subjected to perforation, with the anterior and subtotal perforations being the most difficult sites to heal even after reconstruction. This difficulty in healing could be attributed to many reasons, including insufficient vascular supply, inadequate visualization due to the prominent anterior wall, and diminished graft stability, which results in low graft uptake rate, blunting, and failure.[2]

Tympanoplasty is primarily designed for reconstruction of TM and/or ossicular chain and aims at the eradication of the associated middle ear pathology.[3] Since its introduction in the early 1950s, the operative microscope was the most common tool used during operations till the early 1990s, when the otoendoscope was introduced as an aid or the sole tool for otological surgeries at first and then for tympanoplasty procedures.[4–6]

Many graft materials are used for sealing the eardrum, including vein, fat, skin, perichondrium, and periosteum, but the most popular one is temporalis fascia, cartilage with or without its attached perichondrium, which is increasingly used for reconstruction because of its strength and efficacy in postoperative healing.[7] Endoscopic cartilage tympanoplasty is used to overcome the limitations that can occur when performing microscopic operations, as it facilitates better visualization and manipulation in the difficult areas because of the inclusion of a strong viable graft; this increases the success of surgery.

MATERIALS AND METHODS

A prospective study was carried out at Basra Otology Center from January 2019 to December 2021. Patients of both sexes, aged between 10 and 65 years, who suffered from inactive chronic suppurative otitis media with a dry anteriorly extended TM perforation were included. Patients with active middle ear disease, cholesteatoma, ossicular chain fixation or dislocation, and sensorineural hearing loss were excluded.

The patients underwent a complete clinical ear, nose, and throat (ENT) examination. TM was examined using a 4-mm, 0-degree rigid Hopkins rod endoscope.

For the purpose of the study, the TM perforation was classified into partial and total perforation:

1. Partial anterior perforation: any perforation located anterior to the handle of malleus.
2. Partial posterior perforation: any perforation located posterior to the handle of malleus.
3. Total perforation: any perforation that involves most of TM and extends anteriorly and posteriorly in relation to the handle of malleus.

In this study, perforations of categories 1 and 3 were included, while category 2 was excluded.

Pure-tone audiometry was conducted to measure air-bone gap (ABG) for frequencies of 500, 1000, 2000, and 4000 Hz.

Endoscopic tragal cartilage tympanoplasty was performed as follows:

Under general anesthesia, the ear canal was cleaned using 10% Betadine and then physiological saline. Then, the ear canal was injected with Xylocaine with 1% adrenaline solution (1:100000) at the area of the vascular strip and packed with a 1:1000 adrenaline-soaked cotton ball. The tragal cartilage was harvested by making a 2-cm incision at the posterior wall of the tragus. Skin was elevated from both sides of the tragus. A sufficiently large piece of cartilage with its perichondrium was harvested. Perichondrium was separated from both sides of the tragal cartilage to obtain one piece of cartilage and one piece of perichondrium. Refreshment of the edge of TM performed. A posterior tympanomeatal flap was made by incising the external auditory canal, using a flag knife at 12 and 6 o'clock. Both incisions were connected to each other by a circumferential incision at a distance of 1 cm from the tympanic annulus, using a Rosen knife. The tympanomeatal flap was elevated, and the middle ear mucosa was incised. TM was separated from the lateral process and the handle of malleus by sharp dissection with a sickle knife and then was shifted anteriorly. A meticulous endoscopic middle ear examination was conducted, and the mobility of the ossicular chain was checked. The tragal cartilage was reshaped according to the state of perforation and a small notch was made in it to house the handle of malleus.

The tragal cartilage was inserted into the middle ear and was located over the handle of malleus and under the TM remnant and annulus. The perichondrium was spread over the cartilage, using an underlay technique. The tympanomeatal flap was repositioned and the external canal was packed with small pieces of gel foam soaked with antibiotics.

Postoperatively, the patients were kept on an injectable antibiotic for 1 week, and then an antibiotic eardrop

was prescribed for another week. The patients were followed up at 1 week, 3 weeks, and 3 months after the procedure.

Three months after the surgery, the patients were reassessed for the rate of graft uptake and the degree of hearing improvement. The taking up of the graft was considered failed if there was any residual or recurrent perforation. The hearing status was reassessed by measuring the ABG at frequencies of 500, 1000, 2000, and 4000 Hz.

Data were analyzed using SPSS version 22. A P value of 0.01 was considered significant.

RESULTS

A total of 135 patients were included in our study. The age of the studied groups ranged from 10 to 65 years (mean 33 ± 7 years). The most common age group was 10–20 years (26.8%), followed by 21–30 (23%) and 31–40 years (23%). The least common age group was more than 60 years (2.2%). Out of 135 patients, 64 (47.4%) were male and 71 (52.6%) were female (Table 1).

A total of seventy-two (53.3%) patients presented with right-side perforation, while 63 (46.7%) patients presented with left-side perforation. Anterior perforation was observed in 86 (63.7%) patients, while subtotal perforation was observed in 49 (36.3%) patients (Table 2).

As summarized in Table 3, the mean values of preoperative ABG were 25 ± 4 dB, 23.5 ± 4 dB, 23.6 ± 4 dB, and 23.9 ± 3 dB, while that of postoperative ABG were 8.5 ± 3 dB, 8.5 ± 3 dB, 7.5 ± 3 dB, and 7.8 ± 2 dB at frequencies of 500, 1000, 2000, and 4000 Hz, respectively. As a result, the mean values of hearing gain at the mentioned frequencies were 16.4 ± 3 dB, 16.1 ± 4 dB, 14.7 ± 4 dB, and 15.6 ± 4 dB, respectively. The difference between the pre- and postoperative ABG mean was highly significant (P value = 0.00).

Three months after the procedure, intact TM was observed in 124 (91.8%) patients, while perforated TM was observed in 11 (8.2%) patients; Out of these 11 patients, 7 (5.1%) had previously anterior perforation and 4 (3.1%) had previously subtotal perforation. All reperforations were very small, and most of them were slit-like and positioned at the anterior rim of the TM. The difference between the success and failure rates was highly significant (P value = 0.00) (Table 4).

Table 1: Age and gender distribution

Age (yr)	Male	Female	Total
10–20	22 (16.4%)	14 (10.4%)	36 (26.8%)
21–30	12 (8.9%)	19 (14%)	31 (22.9%)
31–40	13 (9.6%)	18 (13.4%)	31 (23%)
41–50	10 (7.4%)	8 (5.9%)	18 (13.3)
51–60	6 (4.4%)	10 (7.4%)	16 (11.8%)
> 60	1 (0.7%)	2 (1.5%)	3 (2.2%)
Total	64 (47.4%)	71 (52.6%)	135 (100%)

Table 2: Perforation side and site of distribution

Side	Anterior	Subtotal	Total
Right	51 (37.7%)	21 (15.6%)	72 (53.3%)
Left	35 (26%)	28 (20.7%)	63 (46.7%)
Total	86 (63.7%)	49 (36.3%)	135 (100%)

Table 3: Means of ABG and hearing gain

State	ABG at 500 Hz mean	ABG at 1000 Hz	ABG at 2000 Hz	ABG at 4000 Hz
Preoperative	25 ± 4	23.5 ± 4	23.6 ± 4	23.9 ± 3
Postoperative	8.5 ± 3	8.5 ± 3	7.5 ± 3	7.8 ± 2
Hearing gain	16.4 ± 3	16.1 ± 4	14.7 ± 4	15.6 ± 4
P value	0.00	0.00	0.00	0.00

ABG: air-bone gap

Table 4: Success and failure rate of tympanoplasty

Site of perforation	Intact TM	Non-intact TM	Total	P value
Anterior	79 (58.6%)	7 (5.1%)	86 (63.7%)	0.00
Subtotal	45 (33.2%)	4 (3.1%)	49 (36.3%)	0.00
Total	124 (91.8%)	11 (8.2%)	135 (100%)	0.00

TM: tympanic membrane

DISCUSSION

Owing to its popularity in the otology field, tympanoplasty is a matter of discussion for many surgeons and researchers in the ENT department. Our study introduced two important factors: first, the use of an endoscope in tympanoplasty and its role in the success of surgery and, second, the use of the tragal

cartilage with its perichondrium as the main graft material.

In this study, females outnumbered males. The same trend was observed in the study by Cavaliere et al.[8]

The use of an endoscope for tympanoplasty was an important factor in the success of the operation, as it provided good visualization of difficult areas during middle ear procedures, such as the anterior recess, with an additional examination tool for areas hard to be seen by microscope, such as sinus tympani and epitympanic or supratubal recesses. These factors led to a high success rate of surgery. This finding is in accordance with studies by Özgür et al.[9] and Kaya et al.[10]

The use of the tragal cartilage with its perichondrium as the main grafting material led to a high success rate of tympanoplasty (91.8%) in this study. This finding is in accordance with many studies with success rate of more than 90%, such as the studies conducted by Dornhoffer,[11] Khan and Parab,[12] Gamra et al.,[13] and Aidonis et al.[14] This trend could probably be attributed to the strength of the cartilage material and its resistance to repeated infections. In contrast, in the study by Lin et al.,[15] the success rate for cartilage tympanoplasty was only 87%.

Cartilage conduction hearing has been a matter of debate among researchers. However, in our study, the reduction in ABG was found to be statistically significant between preoperative and postoperative audiological assessment. This is nearly compatible with the studies by Cavaliere et al.,[8] Özgür et al.,[9] Kaya et al.,[10] Dornhoffer,[11] Khan and Parab,[12] and Aidonis et al.[14]

In contrast, some studies concluded that there was no statistically significant hearing gain between preoperative and postoperative ABG for the cartilage tympanoplasty group and temporalis fascia tympanoplasty group, such as in the studies by Gamra et al.,[13] Gerber et al.,[16] and Kirazli et al.[17]

Although the most common age group in our study was 10–20 years, it included a good number of pediatric age groups (> 10 years) with a high overall success rate, even though in this age group the onset of upper respiratory tract infection was greater than in the adult group. The finding is in accordance with the result of the study by Friedman et al.[18]

CONCLUSIONS

Repair of anterior TM perforation is one of the most difficult situations in otological surgery because of the overhang of the anterior external canal wall and the presence of the Eustachian tube and proximity to the bony tympanic annulus. Various surgical methods have been proposed in the extant literature to repair such perforations. We found that endoscopic tympanoplasty using a tragal cartilage graft is an effective method for improving hearing and repairing of challenging anteriorly extended TM perforation.

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