

Original Research Article

DOI: <http://dx.doi.org/10.18203/issn.2454-5929.ijohns20201676>

A comparative study of post-operative outcomes in type 1 tympanoplasty using tragal chondroperichondrial shield graft and temporalis fascia graft

Pradeep Kumar Muniasamy, Dharanya Gopalakrishnan Srinivasan*, Prabu Velayutham, Nishanth Savery, Balasubramanian Krishnaswami, Ramkumar Vellikannu

Department of Otorhinolaryngology, Sri Venkateshwara Medical College Hospital and Research Centre, Puducherry, India

Received: 09 March 2020

Revised: 18 April 2020

Accepted: 20 April 2020

*Correspondence:

Dr. Dharanya Gopalakrishnan Srinivasan,

E-mail: natural.dharanyasrinivasan@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Type 1 tympanoplasty is the reconstruction of perforated tympanic membrane with an intact and mobile ossicular chain. Among various autologous graft materials, temporalis fascia and tragal chondroperichondrium are commonly used, having their own merits and demerits. In our study, we have compared the results and postoperative outcomes of tympanoplasty using temporalis fascia and tragal chondroperichondrium.

Methods: This prospective comparative study included 60 cases of chronic suppurative otitis media - tubotympanic disease (CSOM-TTD) in a tertiary care centre. They were randomised into two groups of 30 patients each and were subjected to tympanoplasty using either tragal cartilage-perichondrium (group 1) or temporalis fascia graft (group 2) from November 2017 to May 2019. Objective hearing improvement at 1st, 3rd and 6th month postoperative follow-up and graft uptake rate at 3rd month were compared.

Results: Incidence of cases was more in the age group between 31-45 years age group (53.3%). Graft uptake rate was 96.6% for temporalis fascia group and 83.33% for tragal group (p value=0.194). Preoperative air-bone (AB) gap in group 1 was found to be 25 ± 4.09 dB which improved to 11.73 ± 2.21 dB at 6 months and in group 2, it was 25.7 ± 3.94 dB which improved to 14.06 ± 3.68 dB at 6 months. Mean improvement in hearing for tragal group (13.27 dB) was better than temporalis fascia group (11.64 dB) (p value <0.001).

Conclusions: Both temporalis fascia and tragal chondroperichondrium are suitable graft materials for tympanoplasty, although graft uptake was clinically better with the use of temporalis fascia.

Keywords: Air-bone gap, Graft uptake, Tympanic membrane, Ossicular chain, CSOM-TTD

INTRODUCTION

Chronic suppurative otitis media (CSOM) is an important cause of preventable hearing loss, particularly in the developing world. It is one of the most common ear diseases encountered in developing countries due to poor socio-economic standards, poor nutrition, lack of health

education and unhygienic habits. The global burden of illness from CSOM involves 65–330 million individuals with draining ears, 60% of whom suffer from significant hearing impairment.¹

CSOM, which is a chronic inflammation of mucoperiosteal lining of middle ear cleft may be of

mucosal or squamous type based on the pathology, especially the type of perforation and presence of cholesteatoma. The mucosal type of CSOM typically presents with central perforation in tympanic membrane and conductive hearing loss with or without ear discharge. It is the result of an incompletely resolved acute otitis media or trauma.

Mucosal type of CSOM results in mild to moderate conductive hearing loss. It is due to the tympanic membrane perforation leading to decrease in effective vibratory surface area in the membrane and/or exposure of round window to sound waves with or without ossicular chain disruption. The hearing loss produced is about 30 dB but may reach a maximum of 60 dB provided that the cochlea is intact.²

The definitive treatment for chronic suppurative otitis media (mucosal type) is myringoplasty or tympanoplasty. Type 1 tympanoplasty, which is equivalent to myringoplasty is the surgical reconstruction of tympanic membrane with an intact and mobile ossicular chain using a graft. A wide range of autologous graft materials have been used over time in repairing the tympanic membrane perforations. It includes temporalis fascia, perichondrium, fascia lata, duramater, cartilage, vein and fat. Each of the graft material has its own advantages and disadvantages over the other. The ideal characteristics of a grafting material should include easy availability, good tensile strength, sufficient quantity, low rejection rate and function similar to that of the tympanic membrane.

The common graft materials used for type 1 tympanoplasty are temporalis fascia, tragal perichondrium and fascia lata.¹ Temporalis fascia is the most preferred grafting material due to its translucency, low metabolic rate, easy availability in sufficient quantity, anatomic proximity, thickness similar to tympanic membrane and suppleness. However, graft displacement, improper placement, atrophy and reperforation of the neotympanum have been noticed with temporalis fascia. Also, chronic mucosal dysfunction and eustachian tube dysfunction leads to atelectasis of the temporalis fascia graft.³ Tragal chondroperichondrium graft being tougher and easily neovascularized would theoretically work well in these conditions as the incorporated cartilage will provide mechanical stability and necessary stiffness to avoid retraction and reperforation.¹ To assess the success or failure of tympanoplasty in restoring the hearing level, several techniques have been devised amongst which pure tone audiometry is a simple, effective, widely available and economic method.

The aim of the study was to assess and compare the anatomical and functional outcomes between the two groups of adults undergoing type 1 tympanoplasty using two different types of grafts (temporalis fascia and tragal chondroperichondrial shield graft) with regard to successful closure of the perforations and hearing

improvement as measured by the graft acceptance rate, the improvement in hearing outcomes and the air-bone gap closure after type I tympanoplasty using tragal perichondrium and temporalis fascia graft.

METHODS

The study was a prospective comparative trial conducted in the department of otorhinolaryngology of a tertiary hospital in the period between November 2017 and May 2019. Informed consent was taken from all the patients who participated in the study. Approval from the Institute Research Council and Ethics Committee were obtained. Patients of age group between 15 and 45 years with chronic suppurative otitis media - tubo tympanic disease (CSOM-TTD) - inactive stage with conductive hearing loss with intact ossicular chain, normal eustachian tube function and a good cochlear reserve were included in the study. Patients with Chronic suppurative otitis media - atticointral disease (CSOM-AAD), CSOM with sensorineural hearing loss, CSOM in active stage, history of previous tympanomastoid surgery, foci of sepsis in nose, paranasal sinus, nasopharynx and oropharynx, adhesive otitis media, atelectatic otitis media, CSOM TTD with tympanosclerosis in middle ear cavity and uncontrolled systemic illness were excluded from the study.

A total of 60 patients were clinically evaluated by taking detailed history and clinical examination including tuning fork test. Once the diagnosis of CSOM-TTD was confirmed, otoendoscopy and examination under microscope (EUM) were performed. Diagnostic nasal endoscopy was done to rule out any septic foci in nose and nasopharynx. Pure tone audiometry (PTA) and X-ray mastoid was taken (laws lateral oblique view). Routine blood investigations and urine tests were done for the purpose of anaesthesia and to know the general condition of the patient. Pre anesthetic fitness was obtained. Septic foci in the nose or in the throat were treated if present before ear surgery. Patients were divided into two groups comprising of 30 patients in each group. The cases were selected randomly using a periodic random number to avoid a bias in selection of cases.

In group A, tympanoplasty was performed with trans canal technique using tragal chondroperichondrium and in Group B, tympanoplasty was performed using post auricular approach with temporalis fascia graft and the results were observed. Patients were operated under general or local anaesthesia. Local infiltration was done with 2% lignocaine with 1:2,00,000 adrenaline. Tympanic membrane was visualized and the edge of perforation was freshened by using sickle knife and the rim was removed using cup forceps. A U-shaped incision was made in the bony canal skin, starting superiorly at 12 O' clock position and extending posteriorly and inferiorly to end near 4 o'clock position anteriorly. The tympanomeatal flap was elevated up to the fibrous annulus and middle ear entered using sickle knife. The

handle of malleus was skeletonised and round window reflex was checked and continuity of ossicular status confirmed. In group A, the temporalis fascia graft was placed by using underlay technique by placing it under the remnant of tympanic membrane with fibrous annulus and anchored under the handle of malleus. In group B, the tragal perichondrium was dissected from both sides and thinned with a hand press while the cartilage was sized and shaped properly to entirely replace the tympanic membrane. Reshaped cartilage was kept at malleus level through underlay technique and the perichondrium was kept lateral to cartilage graft and medial to tympanic membrane perforation. Gel foam soaked with antibiotic was placed in the external canal. Periosteum, subcutaneous tissue and skin were sutured and mastoid dressing was done.

Patients were kept admitted for 3 days after surgery with intravenous antibiotics and analgesics and then discharged with oral antibiotics, analgesics on need, decongestants and antihistamines for one week. Patients were advised not to cough, strain, or sneeze and keep ear dry. Post aural or tragal suture removal was done on the 7th post-operative day. The gel foam in the external auditory canal was not disturbed for 3 weeks. Antibiotic ear drops were given to facilitate dissolution of gel foam and to promote healing. At 21st post op day, external ear canal pack was removed and otoendoscopy was done. Patient was re-evaluated with otoendoscopy for complete graft uptake at 3 months. Any residual dried gel foam in ear canal was cleared by gentle suctioning. PTA was repeated at 1st, 3rd and 6th month post op period to assess the improvement in hearing. Complete epithelialization of the margins of the perforation with the graft with or without minimal congestion was considered as complete uptake of graft. Success of tympanoplasty was determined by graft uptake, closure in air-bone (AB) gap and hearing improvement.

Statistical Analysis was done by statistical package for social sciences (SPSS version 22.0) statistical analysis software. Continuous variables such as age, PTA were analysed with paired and unpaired t test. Categorical variables such as gender, laterality of the disease and graft uptake were analysed with the chi-square test and fisher exact test. Statistical significance was taken as $p < 0.05$. Sixty patients were recruited and data collected was internally compared, tabulated, analysed and interpreted by using descriptive and inferential statistics based on the formulated objectives of the study.

RESULTS

A total of 60 patients were recruited and randomised into tragal chondroperichondrium group (group 1) and temporalis fascia graft group (group 2), with 30 in each group. The baseline characteristics like age, gender and laterality of the disease between the two groups were comparable. The mean age was 32.5 years with 10% in the age group of <20 years, 26.7% between 21 to 30 years and 63.3% in the age group of 31 to 45 years. Of the 60 patients, 38 (63.3%) were females and the remaining 22 (36.7%) were males. Both the groups had 11 males and 19 female patients. Left side ear disease was seen in 33 patients (55%) and right-side pathology in the remaining 27 patients (45%) (Table 1).

In our study, the preoperative air-bone gap in the tragal graft group was 25 ± 4.09 dB and in the temporalis fascia graft group, it was 25.7 ± 3.94 dB, which was comparable statistically. The post-operative AB gap at 1 month for tragal chondroperichondrium group was 20.73 ± 3.56 dB when compared to 22.2 ± 3.46 dB in temporalis fascia group (p value=0.084). The mean hearing gain was better in the tragal chondroperichondrium group when compared to the temporalis fascia group (4.27 dB vs. 3.2 dB; p value >0.05).

Table 1: Comparison of baseline characteristics between the two groups.

Characteristics	Tragal chondroperichondrium graft (%)	Temporalis fascia graft (%)	*P value
Age groups (in years)			
≤ 20	5 (16.6)	1 (3.3)	0.09
21-30	9 (30)	7 (23.3)	
31-45	16 (53.3)	22 (73.3)	
Gender			
Males	11 (36.7%)	11 (36.7)	0.99
Females	19 (67.3%)	19 (67.3)	
Ear involvement			
Left CSOM-TTD	20 (66.7%)	13 (43.3)	0.071
Right CSOM-TTD	10 (33.3%)	17 (56.7)	
Pre-operative AB gap			
16-20 dB	6 (20)	4 (13.3)	0.076
21-25 dB	9 (30)	11 (36.7)	
26-30 dB	13 (43.3)	11 (36.7)	
31-35 dB	2 (6.7)	4 (13.3)	

*Unpaired t test; CSOM TTD - Chronic suppurative otitis media - tubotympanic disease, AB gap - air-bone gap.

Table 2: Comparison of pre-operative and post-operative PTA (AB gap) between the two groups at 1st month, 3rd month and at 6 months.

PTA (AB gap) distribution	Tragal group	Temporalis group	*P value
Mean±SD pre-operative	25±4.09	25.7±3.94	0.076
Mean±SD post-operative; 1 month	20.73±3.56	22.2±3.46	0.084
Mean±SD post-operative; 3 months	16.2±2.36	18.23±2.87	0.001
Mean±SD post-operative; 6 months	11.73±2.21	14.06±3.68	0.001

*Unpaired t test; PTA - Pure tone audiometry, AB gap - Air-bone gap, SD - Standard deviation.

Table 3: Comparison of hearing improvement (pure tone average - threshold) in the study groups from baseline to 1st month.

S. no.	Parameter	Tragal group		*P value	Temporalis group		*P value
		0 month	1 month		0 month	1 month	
1.	PTA (AB gap) (mean±SD)	25±4.1	20.7±3.6	>0.05	25.7±3.9	22.2±3.5	>0.05
2.	PTA threshold (mean±SD)	35±6.1	30.7±5.1	0.095	35.7±6.2	32.2±5.9	0.025

*Paired t test; PTA - pure tone audiometry, AB gap - air-bone gap, SD - standard deviation.

Table 4: Comparison of hearing improvement (pure tone average - threshold) in the study groups from baseline to 3rd month.

S. no.	Parameter	Tragal group		*P value	Temporalis group		*P value
		0 month	3 months		0 month	3 months	
1.	PTA (AB gap) (Mean ±SD)	25±4.1	16.2±2.4	<0.0001	25.7±3.9	18.2±2.9	<0.0001
2.	PTA Threshold (Mean ±SD)	35±6.1	26.2±4.4	<0.0001	35.7±6.2	28.2±4.9	<0.0001

*Paired t test; PTA - pure tone audiometry, AB gap - Air-bone gap, SD - Standard deviation.

Table 5: Comparison of hearing improvement (pure tone average - threshold) in the study groups from baseline to 6th months.

S. no.	Parameter	Tragal group		*P value	Temporalis group		*P value
		0 month	6 months		0 month	6 months	
1.	PTA (AB gap) (Mean±SD)	25±4.1	11.7±2.2	<0.001	25.7±3.9	14.1±3.7	<0.001
2.	PTA threshold (Mean±SD)	35±6.1	21.7±3.2	<0.0001	35.7±6.2	24.1±3.5	<0.0001

*Paired t test; PTA - pure tone audiometry, AB gap - air-bone gap, SD - standard deviation.

Table 6: Comparison of graft uptake at 3rd months in temporalis group vs tragal group.

Graft uptake status - 3rd months	Temporalis group	Tragal group	*P value
Graft uptake +ve	28 (93.3)	24 (80)	0.194
Graft uptake -ve	2 (6.7)	6 (20)	

*Chi square test.

At 3 months post-operative period, PTA was repeated which revealed AB gap closure of 16.2±2.36 dB for the tragal group and 18.23±2.87 dB for the temporalis group (p value <0.001). The AB gap closure for tragal chondroperichondrium group and temporalis fascia group were 11.73±2.21 dB and 14.06±3.68 dB respectively (p value <0.001) at 6 months post-surgery. It was observed that there was a statistically significant difference in

mean hearing at 3rd and 6th month between these two groups (Table 2).

In the tragal group, mean pre-operative PTA threshold was 35±6.09. At the end of 1st month post-surgery, it was 30.73±5.06 and 26.2±4.36 at the end of 3rd month. At the end of 6th months, it had improved to 21.73±3.21. In the temporalis fascia group, mean Pre-operative PTA

threshold was 35.7 ± 6.24 which became 32.2 ± 5.86 post-surgery at the end of 1st month. At the end of 3rd month, it was 28.23 ± 4.87 and at the end of 6th months, it had improved to 24.06 ± 3.46 . There was a significant statistical difference in mean pure tone average threshold between two groups at 3 months and 6 months, the tragal group better than temporalis group. There was no significant difference in mean PTA threshold at the end of 1st month (Tables 3-5).

Out of 60 cases in our study, 52 cases showed successful graft uptake. The graft uptake in the temporalis fascia group was 93.33% and in the tragal chondroperichondrium it was 80% at the end of 3rd months follow-up. The temporalis fascia graft showed better graft uptake when compared to the tragal cartilage graft in the post-operative period, though this was not statistically significant; p value 0.194 (Table 6).

Six patients in the tragal cartilage group developed complications over 3 months follow-up which included four cases of reperforation, one case of graft rejection and a case of adhesion. In the temporalis fascia group, one patient had adhesions and one patient had blunting. There were no cases of reperforation or graft rejection in the temporalis fascia group.

DISCUSSION

This study was undertaken to compare the graft uptake rate and hearing improvement between tragal chondroperichondrium graft and temporalis fascia graft in patients with CSOM TTD. A total of 60 patients were recruited and randomised to tragal chondroperichondrium group and temporalis fascia group with 30 in each group. Graft uptake rates in the first three months and the objective hearing improvement at 1st, 3rd and 6th month postoperative follow-up between two groups were compared.

The baseline characteristics like patient age groups, gender, laterality of ear involvement and pre-operative hearing impairment between the two groups were comparable. The age range of patients with CSOM recruited in this study was between 15 to 45 years. The mean age of all the patients included in our study was 32.45 years. In the study done by Najeeb et al, mean age of patients with CSOM was 32.45 and in the study done by Nermade et al, the mean age was 34.3 years which is similar to our study.^{4,5} This shows that CSOM is common in the age group of 20 to 40 years.

In our study, 38 patients were females and 22 were male patients (M:F=1:1.7). Various studies have shown that CSOM commonly affects females than males. In the study by Basak et al, females were affected 1.8 times more commonly than males with CSOM.⁶ Kiran et al, in their study stated that female patients (n=48) were affected more in their study when compared to male (n=32) patients.⁷

Objective assessment of hearing improvement was done by calculating the closure of air-bone gap postoperatively in both groups. The preoperative air-bone gap in tragal chondroperichondrium group was 25 ± 4.09 dB and in the temporalis fascia group, it was 25.7 ± 3.94 dB, both of which were statistically comparable. It was observed that there was significant difference in mean hearing in the post-operative period at 1st, 3rd and 6th month between these two groups. The AB gap closure at the end of 1st month for tragal chondroperichondrium group was 20.73 ± 3.56 dB when compared to 22.2 ± 3.46 dB in the temporalis fascia group. Mean hearing gain was higher in the tragal chondroperichondrium group which yields 4.27 dB while the temporalis fascia group had a mean hearing gain of only 3.2 dB at 1st month.

At 3 months, PTA was repeated which revealed AB gap closure of 16.2 ± 2.36 dB in the tragal group as compared to 18.23 ± 2.87 dB in the temporalis group. According to Sood et al, the hearing improvement was better for tragal cartilage group at 3 months.⁸ Kiran et al, also observed in their study that hearing improvement was better with tragal chondroperichondrium graft with an air bone gap of <20 dB after 3 months.⁷

In a study conducted by Sharma et al, the mean AB gap after 3 months postoperatively improved in tragal chondroperichondrium group from 36.38 ± 6.10 dB to 18.13 ± 5.84 dB. Similarly, in temporalis fascia group, it improved from 28.73 ± 5.82 dB to 15.23 ± 8.14 dB. The mean hearing gain in the tragal group was 18.25 dB and it was 13.5 dB in temporalis fascia group which showed statistically significant difference in both the groups (p <0.001). They concluded that composite tragal chondroperichondrium graft delivers an excellent audiologic outcome comparable to temporalis fascia graft where medialization of graft is expected.⁹

At 6 months postoperatively, patients were reviewed and a PTA done showed Air Bone gap closure of 11.73 ± 2.21 dB for tragal chondroperichondrium group and 14.06 ± 3.68 dB for temporalis fascia group. The difference was statistically significant. Hence, it revealed that there was a consistent hearing improvement in the tragal chondroperichondrium group when compared to the temporalis fascia group.

In the study by Hameed et al., the post-operative gain in air conduction threshold was up to 21-30 dB in 70% patients in temporalis fascia group and in 60% patients in tragal chondro perichondrium group.¹⁰ Kshitij et al, observed that the mean hearing gain in air conduction threshold in the temporalis fascia group was 9.36 dB and it was 10.92 dB in the tragal chondro perichondrium group.¹¹ In our study, the hearing improvement improved with time, which is due to the gradual process of healing and post-operative stabilisation of the neo-tympanic membrane.

In our study, out of 60 cases, 52 cases showed successful graft uptake. The graft uptake in the temporalis group was 93.33% and it was 80% in the tragal chondroperichondrium group. Temporalis group had intact graft in 93.33 % at the end of 3rd months. In tragal cartilage group, the graft uptake at the end of third month was 80%. Although there were clinically significant differences in graft uptake rates between the two groups at different time points, this difference was not found to be statistically significant. In our study, the tragal cartilage group showed more complications when compared to the temporalis fascia group. At the end of 3 months, 6 patients developed complications in the tragal cartilage group of which four developed reperforation, one developed graft rejection and one had adhesions. In the temporalis fascia group, one patient had adhesions and one had blunting.

Sood et al. in his study concluded that the graft uptake was better with tragal cartilage (95%) than with temporalis fascia (90%) at 2 months post operatively, while at the end of 6 months, graft uptake was better with temporalis fascia (75%) than with the tragal cartilage group (70%).⁸ Rakesh et al, conducted a similar study in which they stated that the graft uptake rate was good for both with slightly better take-up rates for temporalis fascia than for tragal chondroperichondrium.¹²

Hameed et al, studied on 20 patients to evaluate the comparative efficacy of temporalis fascia and tragal perichondrium and stated that temporalis fascia group achieved a graft uptake of 90% and a satisfactory hearing improvement in 76%. Tragal chondro perichondrium group achieved a success rate of 80% graft uptake and 75% hearing gain.¹³ Dabholkar et al, in his study stated that the post-operative graft uptake rate with temporalis fascia was 84% and for tragal chondro perichondrium, it was 80%. Temporalis fascia achieved a satisfactory hearing improvement in 76% while tragal perichondrium achieved 75% hearing gain.¹⁴

In contrary, in the study done by Kumar et al., it was concluded that graft uptake rates were better with the tragal cartilage with perichondrium in comparison with temporalis fascia and hearing results were almost equivalent with both techniques.¹⁵ Although the utilization of cartilage as a grafting material in middle ear surgery is not a new concept, a renewed interest for its use has increased exponentially in the last decade.¹⁶ It can be used as an alternative to more traditional grafting materials for tympanic membrane reconstruction or attic wall reconstruction.¹⁷

Tragus is a small pointed eminence in pinna which can be used as a grafting material with or without its perichondrium. It can be used for middle ear reconstruction in order to support the tympanic membrane against the ossicular replacement prosthesis. Tragal cartilage also serves as a landmark for facial nerve in parotid gland surgery.¹⁸ Tragal chondroperichondrium

is preferred especially in cases with a higher risk of failure, such as recurrent or total perforations and atelectatic tympanic membranes. Successful reconstruction has been observed in approximately 90% of these cases using them.¹⁹

Cartilage grafts offer the advantage of higher mechanical stability in cases of Eustachian tube dysfunction; adhesive otitis media and subtotal/total perforation of tympanic membrane whereas fascia and perichondrium offer better acoustic quality.²⁰

They can be placed as a large thin piece or as palisading cartilage fragments. The use of tragal cartilage is more preferred and facilitates otologists as there are no major inconvenience in harvesting the tragus.²¹

An important advantage that is offered by harvesting tragal chondroperichondrium as a grafting material is that the incision on the posterior side of the tragus is inconspicuous thus aiding in better cosmesis even when large amount of material is harvested.²²

Based on the above evidences, we observed that hearing improvement was better with tragal chondroperichondrium. Graft uptake rate was better in temporalis fascia group than in tragal chondroperichondrium group.

CONCLUSION

Both temporalis fascia and tragal chondroperichondrium are suitable graft materials for tympanoplasty. Although both these graft materials can be effectively used for tympanic membrane reconstruction, temporalis fascia plays a slight superior role than tragal chondroperichondrium in terms of graft uptake whereas hearing improvement was better with tragal chondroperichondrium. Tragal chondroperichondrium provide alternate and viable autograft material in cases with a higher risk of failure, such as recurrent or total perforations and atelectatic tympanic membranes.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Herman MK. Tang: The perforated ear drum: To repair or not. *Hong Kong J Online.* 1989;11:124-5.
2. Milewski C. Composite graft tympanoplasty in the treatment of ears with advanced middle ear pathology. *Laryngoscope.* 1993;103:1352-6.
3. Dornhoffer JL. Cartilage tympanoplasty. *Otolaryngol Clin North Am.* 2006;39:1161-76.
4. Najeib T. Temporal Fascia Versus Tragal Perichondrial Graft in Myringoplasty and Tympanoplasty. *Int J Otorhinolaryngol.* 2019;5(1):15.

5. Nemade SV, Shinde KJ, Naik CS, Qadri H. Comparison between clinical and audiological results of tympanoplasty with modified sandwich technique and underlay technique. *Braz J Otorhinolaryngol.* 2018;84(3):318-23.
6. Basak B, Gayen GC, Das M, Dhar G, Ray R, Das AK. Demographic profile of CSOM in a rural tertiary care hospital. *IOSR J Pharm.* 2014;4(6):43-6.
7. Kiran RB. Tragal Perichondrium vs. Temporalisfascia in Myringoplasty: A Comparative Study. *Sch J App Med Sci.* 2017;5:2752-5.
8. Sood AS, Pal P, Singla A. Comparative study of type I tympanoplasty using temporalis fascia and tragal cartilage with perichondrium as graft material. *Int J Otorhinolaryngol Head Neck Surg.* 2018;4(3):789.
9. Sharma N, Sharma P, Sharma P, Gourav K, Goyal VP. Comparison of otological and audiological outcome of type-I tympanoplasty using composite tragal perichondrium and temporalis fascia as graft. *Int J Otorhinolaryngol Head Neck Surg.* 2018;4(5):1182.
10. Hameed GS, Prasad BD, Babu PR. A Comparative Study of Temporalis Fascia versus Tragal Perichondrium as Graft in Repair of Tympanic Membrane Perforation. *Indian J Med Alli Sci.* 2015;3(3):150.
11. PatilK, Baisakhiya N, Deshmukh PT. Evaluation of different graft material in Type I tympanoplasty. *Indian J Otol.* 2014;20:106-14.
12. Rakesh K, Rajesh KS, Yogesh AGE. Comparative study of Underlay Tympanoplasty with Temporalis Fascia and Tragal Chondroperichondrium. *IOSR-JDMS.* 2014;(13):89-98.
13. Hameed GS, Prasad BD, Babu PR. A Comparative Study of Temporalis Fascia versus Tragal Perichondrium as Graft in Repair of Tympanic Membrane Perforation. *Indian J Medn Alli Sci.* 2015;3(3):150.
14. Dabholkar JP, Vora K, Sikdar A. Comparative study of underlay tympanoplasty with temporalis fascia and tragal perichondrium. *Indian J Otolaryngol Head Neck Surg.* 2007;59:116-9.
15. Kumar A, Narayan P, Narain P, Singh J, Porwal PK, Sharma S, et al. Comparative study between result of temporalis muscle fascia and tragal cartilage perichondrium as a graft material in type 1 tympanoplasty. *Int J Otorhinolaryngol Head Neck Surg.* 2018;4:565-8.
16. Aidonis I, Robertson TC, Sismanis A. Cartilage shield tympanoplasty: a reliable technique. *Otol Neurotol.* 2005;26:838-41.
17. Eviatar A. Tragal perichondrium and cartilage in reconstructive ear surgery. *Laryngoscope.* 1978;88:1-23.
18. Witt RL, Weinstein GS, Rejto LK. Tympanomastoid suture and digastric muscle incadaver and live parotidectomy. *Laryngoscope.* 2005;115:574-7.
19. Williamson PA, Thomas DM, Beasley P. Posterior tragal perichondrium harvesting for myringoplasty. *Clin Otolaryngol Allied Sci.* 1999;24:252-4.
20. Zahnert T, Huttenbrink KB, Murbe D, Bornitz M. Experimental investigations of theuse of cartilage in tympanic membrane reconstruction. *Am J Otol.* 2000;21(3):322-8.
21. Dornhoffer J. Cartilage tympanoplasty: Indications, Techniques and Outcomes in a 1,000-Patient Series. *Laryngoscope.* 2003;113:1844-56.

Cite this article as: Muniasamy PK, Srinivasan DG, Velayutham P, Savery N, Krishnaswami B, Vellikannu R. A comparative study of post-operative outcomes in type I tympanoplasty using tragal chondroperichondrial shield graft and temporalis fascia graft. *Int J Otorhinolaryngol Head Neck Surg* 2020;6:867-73.