

Evaluation of the Results of Type I Endoscopic Tympanoplasty with Underlay Composite Cartilage Graft

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Abstract

Background: The diagnosis of chronic otitis media implies a permanent abnormality of the pars tensa or pars flaccida, most likely a result of earlier acute otitis media, negative middle ear pressure, or otitis media with effusion.

Objectives: The aim was to compare the pre- and post-operative hearing status and to evaluate the hearing improvement at 3 and 6 months and to study the outcome of graft uptake at 3 s.

Materials and Methods: A total of 34 patients with pars tensa tympanic membrane perforation without any ossicular abnormality were studied during the study period of 2 years using analysis of graft uptake after tympanoplasty surgery with underlay composite cartilage graft and post-operative pure tone audiometry and air-bone gap (ABG).

Results: Most of the patients in our study were from the age group of 25–34 years (44.1%) with female: male ratio of 2.4:1. Majority (97.1%) were found to have a successful graft uptake at 3 months after tympanoplasty and a failure rate of 2.9%. The degree of hearing loss reduced gradually from 36.90 ± 6.92 dB to 25.49 ± 8.69 dB at 6 months postoperatively.

Conclusion: Composite cartilage graft tympanoplasty is an effective procedure for closure of tympanic membrane perforations, especially in large perforations.

Key words: Cartilage, Graft, Perforation, Tympanoplasty, Underlay

INTRODUCTION

Chronic mucosal diseases of middle ear cleft or chronic suppurative otitis media has been traditionally defined as a chronic inflammation of the middle ear and mastoid usually associated with perforation of the tympanic membrane and otorrhoea.^[1]

Tympanoplasty is now an established surgery for tympanic membrane perforation. The principal aims of

tympanoplasty are to create an intact tympanic membrane and to restore functional hearing.^[2] Since the introduction of tympanoplasty, a wide variety of graft material has been used for the closure of perforation: Skin, fascia lata, temporalis fascia, vein, perichondrium, and duramater.^[3]

The ideal grafting material used for tympanic membrane closure should meet certain criteria namely, low rejection rate, sufficient quantity, good tensile strength, conductive properties similar to that of tympanic membrane and easy availability. Membranous grafts like temporalis fascia and perichondrium meet these criteria and result in closure of tympanic membrane perforation in 95% of ears with normal ventilation. However, in situations such as recurrent perforation, total perforation, and chronic mucosal dysfunction or severe atelectatic tympanic membrane, fascia and perichondrium may undergo atrophy and results in graft re-perforation.^[4,5] In these cases, many surgeons have

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used cartilage as a grafting material because of its increased stability and resistant to negative middle ear pressure.^[3]

There have been many adaptations to cartilage tympanoplasty techniques,^[6] most of which are composite cartilage perichondrium (CCP) graft.^[7] CCP grafting can be divided into palisade techniques and one piece graft techniques. One piece graft techniques appear to have considerably higher acoustic and mechanical property.^[8] Tragal cartilage perichondrium serves to be an ideal graft material for tympanic membrane as tragal cartilage being composed of collagen type II which is physiologically similar to the nature of tympanic membrane.^[9]

The study was conducted to evaluate the outcome of composite cartilage graft in pars tensa perforations as an underlay technique in endoscopic type I tympanoplasty.

MATERIALS AND METHODS

This was a prospective study conducted in 34 patients of 13–45 years of age regardless of sex with a perforation in pars tensa of tympanic membrane attended the outpatient department under the Department of Otorhinolaryngology, Regional Institute of Medical Sciences, Imphal, Manipur, India, from September 2017 to August 2019. Patients unwilling to give informed written consent, marginal perforation, evidence of cholesteatoma, obvious ossicular deformity, sensorineural hearing loss, and patients with complications of COM were excluded from the study. Informed written consent was obtained from all the participants.

Study variables such as age, sex, area of residence, pre-operative pure tone audiogram, and air-bone gap (ABG) were used. Outcome variables were assessed by status of graft uptake, post-operative pure tone audiometry (PTA), and ABG at 3 and 6 months.

All the patients underwent routine ENT evaluation in addition to general medical examination, ear findings were noted with emphasis on size, site and margin of perforation, state of drum, remnants, status of middle ear mucosa, presence or absence of ear discharge and tuning fork tests, and PTA including ABG.

After pre-operative evaluation, patients underwent endoscopic Type I tympanoplasty with underlay composite cartilage graft under general anesthesia. Tragal cartilage with perichondrium was harvested by giving an incision on the posterior face of tragus. The incision was closed with 4–0 non-absorbable suture. After the removal of perichondrium from one side, the perichondrium cartilage composite graft was cut into strip. The margin

of the perforation was freshened using a sickle knife or an angled pick. Using a drum knife, a curvilinear incision was made about 5 mm lateral to the annulus. The incision ideally extended between the 12-O' clock, 3-O' clock, and 6-O' clock positions in the left ear and 12-O' clock, 9-O' clock, and 6-O' clock positions in the right ear. The tympanomeatal flap was slowly elevated away from the bone of the external canal and bony annulus.

Continuity of the ossicles was checked by round window reflex test and direct palpation. Provided the remaining anatomy of the middle ear is intact, few gel foam placed into the mesotympanum area and subsequently the perichondrium cartilage composite graft was placed using the underlay technique, with the cartilage toward the tympanic cavity and perichondrium toward the external auditory canal. The annulus was placed back into position posteriorly and the vascular strip carefully moved into its anatomic place. Gelfoam was placed over the drum remnant graft, the external canal was filled with antibiotic ointment impregnated cotton gauze. Mastoid bandage was placed to provide light pressure and protection.

After the surgery, the patients were called for follow-up at 21 days for inner pack removal and to check the neotympanum. Then, at 3 months, the patients were called for follow-up to check graft uptake by 0° endoscopy and hearing improvement by PTA. Again at 6 months, patients were called to check hearing improvement and the condition of the graft.

Data collected and entered into IBM SPSS Statistics 21 for Windows (IBM Corp. 1995, 2012). Descriptive statistics such as frequency, percentages, mean, and standard deviation were used for data presentation. Paired *t*-test was used to compare between two means and $P < 0.05$ was taken as statistically significant. Further, an ethical approval was obtained from the Institutional Research Review Board of RIMS.

RESULTS

A total of 34 patients who attended the ENT department in our hospital during the study period were taken.

Out of 34 patients, the mean age of the patients was 31.35 ± 17.64 years with a minimum of 15 years and maximum of 44 years. Majority of the patients were in the age group of 25–34 years [Table 1]. Gender distribution showed a female preponderance with a female: male ratio of 2.4:1 [Table 2]. More than half (64.7%) of the patients were from rural area while the remaining 35.3% were from urban area [Table 3].

Majority (97.1%) were found to have a successful graft uptake at 3 months after tympanoplasty and a failure of rate 2.9% [Table 4]. The degree of hearing loss reduced gradually from pre-operative PTA threshold 36.90 ± 6.92 dB to 28.33 ± 6.58 dB and 25.49 ± 8.69 dB at 3 and 6 months, respectively [Table 5] and was found to be statistically significant ($P < 0.05$).

There was a significant difference in the ABG at 3 and 6 months post-operative period as compared to pre-operative ABG [Table 6] and this difference was found to be statistically significant ($P < 0.05$).

DISCUSSION

Patients undergoing composite cartilage tympanoplasty in 15–45 years age group were included according to inclusion and exclusion criteria of the study. A total of 34 patients who attended ENT department in our hospital during the study period were taken.

In our study, graft uptake was seen in 33 (97.1%) patients and failure in 1 (2.9%) patient. This finding was found to be consistent to the study conducted by Tyagi BS

et al.^[10] where out of 55 cases, graft uptake was found in 52 (96.36%) and failure in 3 (3.64%) cases. In the study conducted by Chhapola *et al.*^[9] at 6 month after surgery, out of 61 patients, graft uptake was seen in 60 (98.36%) and failure in 1 (1.63%).

The pre-operative average hearing threshold was 36.90 ± 6.92 dB and post-operative average hearing threshold at 3 and 6 months is obtained as 28.33 ± 6.58 dB and 25.49 ± 8.69 dB, respectively. This finding was found to be similar with the study conducted by Cicek MM *et al.*^[11] where average hearing threshold at pre-operative and post-operative was obtained as 34.3 ± 13.31 and 26.2 ± 14 dB, respectively.

Mean pre-operative ABG was 16.37 ± 2.17 dB and mean post-operative ABG at 3 and 6 months is 7.44 ± 2.89 dB and 5.9 ± 3.02 dB, respectively. This finding was found to be consistent to the study conducted by Albirmawy OA.^[12] where the mean pre-operative ABG was 26.62 ± 1.73 dB and the mean post-operative ABG was 10.95 ± 2.12 dB. Thus, in their study, mean ABG was decreased by 14.67 ± 2.10 dB.

Temporalis fascia has been regarded as the ideal graft material for tympanoplasty. However, various studies have shown that it often does not seem to withstand the negative middle ear pressure in the post-operative period. The ideal grafting material for tympanic membrane closure should have certain properties, namely, low rejection rate, good tensile strength, conductive properties similar to that of tympanic membrane, and easy availability.^[4,5]

It has also been revealed that cartilage graft has long-term survival and also remains alive with its rigidity and resist against retraction even in Eustachian tube dysfunction. The incorporated cartilage would give it the necessary stiffness and mechanical stability to avoid retraction. Furthermore, it

Table 1: Age distribution of the patients (n=34)

Age group (years)	No. of patients	Percentage
15–24	7	20.6
25–34	15	44.1
35–45	12	35.3
Total	34	100.0

Table 2: Gender distribution of the patients (n=34)

Gender	No. of patients	Percentage
Male	10	29.4
Female	24	70.6
Total	34	100.0

Table 3: Area of residence (n=34)

Area of residence	No. of patients	Percentage
Urban	12	35.3
Rural	22	64.7
Total	34	100.0

Table 4: Graft status of the patients studied at 3 months (n=34)

Status of graft	No. of patients	Percentage
Uptake	33	97.1
Failed	1	2.9
Total	34	100.0

Table 5: Pre-operative and post-operative PTA

PTA threshold	No. of patients	dB HL* Mean±SD
Pre-operative	34	36.90±6.92
Post-operative at 3 months	34	28.33±6.58
Post-operative at 6 months	34	25.49±8.69

*dB HL: Hearing loss in decibels

Table 6: Pre-operative and post-operative air-bone gap

Air-bone gap	No. of patients	dB HL* Mean±SD
Pre-operative	34	16.37±2.17
Post-operative at 3 months	34	7.44±2.89
Post-operative at 6 months	34	5.9±3.02

has a low metabolic rate and good acceptance in the middle ear. Because of the stiff nature of the cartilage, it could reduce the vibratory properties of neotympanum. However, adequate thinning of the cartilage seems to overcome this problem.^[13] The advantages of composite cartilage grafts are as follows: It can be obtained easily with cosmetically acceptable incision, has its own blood supply, easy to shape, low metabolic rate, no extra cost, and low extrusion rate.^[9]

In our study, we found a satisfactory results in terms of graft uptake and hearing improvement with the use of a composite cartilage graft as an underlay Type I tympanoplasty.

The present study had some limitations. All the patients were from same examination center, so selection bias could not be excluded. Sample size was small and some of the patients did not come for follow-up. Studies involving a large population are required to obtain more conclusive results.

CONCLUSION

In the present study, graft uptake was observed in majority of the patients with failure rate of 2.9%. Significant hearing improvement was observed in the follow-up at 3 months and further at 6 months. Hence, it can be concluded that the success of tympanic membrane closure at tympanoplasty using composite cartilage graft is satisfactory in terms of graft uptake and hearing improvement. Perichondrium is a tough graft material showing good revascularization. The incorporation of cartilage in perichondrium as a composite would counteract negative middle ear pressure. This is of paramount importance in poor Eustachian tube function and in ear with a large perforation. Moreover, cartilage perichondrium is easy to harvest and readily available at the site of surgery.

ETHICAL APPROVAL

Ethical approval obtained from the research ethics board committee.

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