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Original Research Article

Role of cartilage graft in type 1 tympanoplasty: audiological and otologic outcomes

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ABSTRACT

Background: Temporalis fascia is the most commonly used graft material for the tympanic membrane perforations. Due to high failure rate of temporalis fascia in adhesive otitis media, large perforations and advanced middle ear pathology alternate graft materials which are more rigid and resistant to infection are being used. Cartilage graft has shown to be a promising graft material in such cases. The purpose of this study was to evaluate the functional and anatomic results with cartilage graft in type 1 tympanoplasty.
Methods: The present prospective study was conducted among 40 patients of chronic otitis media between 11-60 years of age requiring tympanoplasty in department of ear, nose and throat (ENT) in Government Medical College and Rajindra Hospital, Patiala.
Results: The overall success rate of type 1 cartilage tympanoplasty was 85% in terms of perforation closure and post operative pure tone audiometry (PTA) at 6 weeks was 37.24 and at 12 weeks PTA was 34.27 The p value was <0.001 which was found to be significant. The AB gap closure at 6 weeks post op was 6.79 and at 12 weeks 9.76±2.12 dB.
Conclusions: Based on the results of this study, it can be concluded that cartilage is more effective graft material in high-risk perforations, chronic ET dysfunction than fascia and audiological improvement with cartilage is found to be comparable with temporalis fascia.

Keywords: Cartilage, Graft uptake, ABG

INTRODUCTION

The tympanic membrane plays a significant role in the physiology of hearing and pathophysiology of chronic inflammatory middle ear diseases.[1] Chronic otitis media is defined as chronic inflammation of middle ear and mastoid cavity, which presents with recurrent ear discharge or otorrhoea through a tympanic membrane perforation.[2] The primary objective of doing a tympanoplasty is to reconstruct the diseased tympanic membrane with perforation in chronic suppurative otitis media (CSOM). A successful outcome is determined by an intact, mobile tympanic membrane with good hearing.[3] The most frequently used technique for repair of tympanic membrane perforation is underlay grafting of temporalis fascia. But in cases of subtotal perforations, atelectatic ear, retraction pocket or mastoid surgery long term results of temporalis fascia have been shown to be associated with increased failure rate.[4,5]

To overcome this, cartilage grafts are used with good results. Cartilage being rigid tends to resist resorption, retraction and reperforation even in milieu of eustachian tube dysfunction and is more resistant to infection and negative middle ear pressure. Cartilage contributes minimally to an inflammatory tissue reaction and is well incorporated with tympanic membrane layers, providing firm support to prevent retraction. The greatest advantage of cartilage graft has been thought to be its very low metabolic rate. Cartilage receives its nutrition by diffusion,

is easy to work with because it is pliable, and it resist deformation from pressure changes.[6]

The cymba concha cartilage has an average thickness of 0.8 mm and its concave contour resembles the conical shape of normal tympanic membrane and tragal cartilage has thickness of 1.016 mm.[7]

Out of 23 well defined cartilage tympanoplasty methods, Tos has classified them in six groups: underlay palisade method of Heerman, onlay palisade method, method of broad palisades, method of underlay stripes, method of onlay stripes, and Dornhoffer mosaic cartilage tympanoplasty.[8]

Despite the availability of different methods there is no consensus on aspects such as appropriate thickness and best technique of cartilage tympanoplasty. The choice of technique is determined by surgeons' preference, size of perforation, integrity of ossicular chain and presence of cholesteatoma. Certain factors e. g. location of perforation, middle ear mucosa status (dry or wet), remnant myringosclerosis affect cartilage type 1 tympanoplasty.[9] The perceived disadvantage of cartilage graft is that it creates an opaque tympanic membrane, which could hide a potential cholesteatoma. Following cartilage tympanoplasty, tympanograms are unreliable and usually will reveal a low volume type B curve regardless of middle ear status.[10]

The present study aimed to evaluate the graft success rates and hearing results after cartilage type 1 tympanoplasty.

METHODS

A prospective observational study on 40 cases of clinically diagnosed cases of chronic otitis media was carried out in department of ENT in Government Medical College and Rajindra Hospital, Patiala from December 2017 to November 2019. All cases of safe chronic otitis media were included in the study. The patients in the study group ranged from 11 to 60 years. The study protocol for all procedures was approved by the institutional review board for ethical clearance of Government Medical College and Rajindra Hospital and it was performed in accordance with the code of ethics of the World Medical Association according to the Declaration of Helsinki of 1975, as revised in 2000. The number of ears operated were 40. Only cases in which ossicular chain was intact and no mastoid surgery was performed were included in the study.

In all patients, a detailed history was taken. A thorough clinical examination of ear, nose, throat was done with special reference to ear. Otomicroscopy was done in all cases. Preoperative and postoperative pure tone audiogram was done in all patients. Preoperative investigations included hemogram, bleeding and clotting time, urine for routine, HIV testing and hepatitis B surface antigen test. X-ray Mastoid-Law's lateral view was taken. Written consent was taken in all patients.

All surgeries were done under general anaesthesia. In the post aural approach, conchal cartilage perichondrium graft was used, and in endaural approach, tragal cartilage perichondrium graft was preferred. An incision along the free edge of tragus was given, then cartilage exposed on both its medial and lateral surfaces and then harvested with attached perichondrium. The cartilage perichondrium island graft was prepared by elevating the perichondrium on one side and leaving it attached on the other side. Graft was placed medially with the elevated perichondrium onto posterior canal wall. The middle ear cavity and EAC was packed with absorbable gel sponge. Postoperative follow up was performed at 6 and 12 weeks. Closure of membrane at the end of 3 months was accepted as morphological success. Audiological test was performed at 6 and 12 weeks.

Statistical analysis

Data collected was tabulated in an excel sheet. The means and standard deviations of the measurements were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). Student's paired t test was applied to the collected data to analyze the gain in hearing at various prespecified intervals with confidence interval set at 99.99% with $p<0.01$ considered significant.

RESULTS

The average mean age of the patients in the study group was 34.8 (range, 11-60 years). 22 out of 40 patients were females. Conchal cartilage was used in 34 cases and tragal was used in 6 cases. No post operative complication was noted.

Graft uptake rate was 85% and failure occurred in 15% cases.

Table 1: Cartilage graft uptake.

Graft uptake	Number	Percentage
Present	34	85.0
Failure	06	15.0
Total	40	100.0

Table 2: Postoperative hearing improvement (mean PTA).

Parameters	Mean PTA	SD	P value	Significance
Pre-operative	43.14	5.666		
Post-operative 6 weeks	33.60	4.358	<0.001	HS
Post-operative 12 weeks	29.23	4.385	<0.001	HS

PTA <10 dB gain was seen in 20 patients and 11-20 dB gain was observed in 14 patients.6 patients didn't show any improvement.

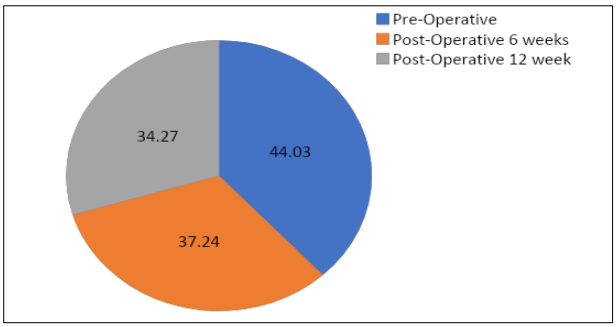

Figure 1: Post operative hearing improvement at 6 and 12 weeks.

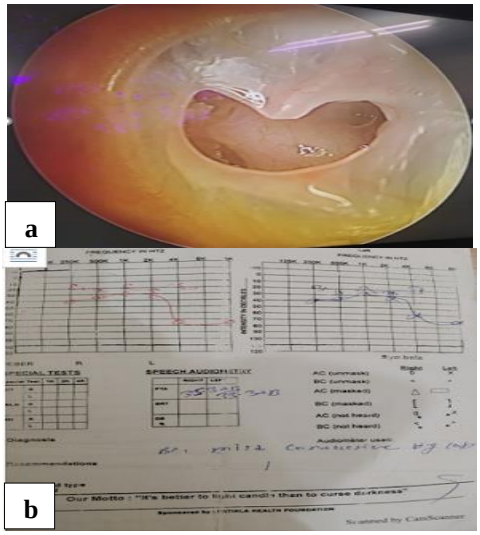

Figure 2: (a) Pre op medium central perforation, and (b) pre op PTA.

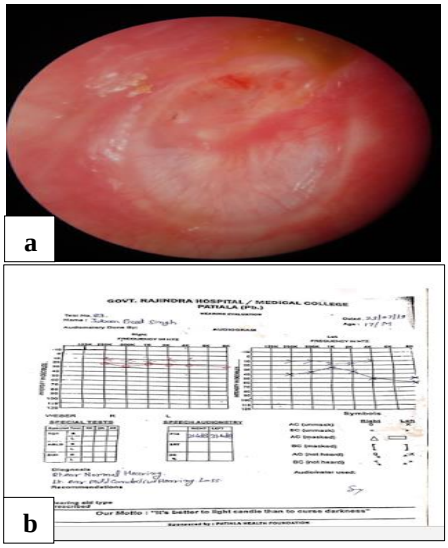

Figure 3: (a) Post op at 12 weeks, and (b) post op PTA at 12 weeks.

DISCUSSION

Cartilage has been successfully used in middle ear procedures for 40 years, and has been shown to be well tolerated with minimal resorption over time.[11]

Various factors like age of the patient, the size and site of perforation, status of middle ear mucosa, surgical experience have all been cited as factors which may influence the surgical outcome.[12]

At our institution, the study was conducted on 40 patients out of which 22 were females and 18 were males and graft uptake was higher in females (95%) as compared to males (72%). This could be due to higher tobacco use by males. Similarly, Lin's study shows success rate of graft in tobacco users was lower (63%) as compared to 93% in non-users.[13]

In our study 11 out of 40 patients were above 40 years of age and higher failure rate was observed in patients above 40 (18%) as compared to 10% in patients below 40 years of age. In a similar study by Starhan et al, the incidence of graft failure was higher in older age group.[14] This could be due to accompanying systemic diseases in elderly patients.

Some studies have shown that localization of perforation affects the graft success more.

Graft uptake rate was higher in anterior perforations (95%) as compared to posterior perforations (85%) in our study. The reason for high graft uptake in anterior perforations is because cartilage being rigid resists resorption and its resistance to negative middle ear pressure prevents medialization and lateralization of graft.[12] In our study graft uptake was 100% in small perforations, 87.5% in medium 85% in large and 80% in subtotal perforations. A study by Onal et al, have also shown better graft uptake in small sized perforations as compared with large perforation.[15] This is probably because of the larger bed that is provided for the graft and there is a good opportunity for the graft to be taken in cases of small and medium sized perforations.[16]

The stiffness and mechanical stability of the cartilage graft have obvious benefits in reducing the retractions of tympanic membrane. Cartilage receives its nutrition by diffusion; it is very easy to work with because it is pliable and resists deformation from pressure variations and become well incorporated in the tympanic membrane.[17]

In our study the success rate was 85% in terms of perforation closure. Graft failure was seen in 15% patients. The failure could be due to inappropriate size of the graft taken or faulty surgical technique or maybe because cortical mastoidectomy was not performed in any patient.

The contribution of mastoidectomy to the success rate of tympanoplasty is still arguable. Some studies advocate that especially in revision tympanoplasty, the success rate of

graft can be increased by adding mastoidectomy.[18] However, there are studies advocating that in tympanoplasty in which cartilage graft is used, adding mastoidectomy does not affect the success rate of the graft and gain in hearing.

The type of failure seen in present study is displacement of graft leading to reperforation. Khan reported the success rate of 98.20% with residual perforation in 2 and recurrent perforation in 2 patients.[19] In a study by Guler et al, the graft uptake rate was 93.5% Ozbek et al reported a graft uptake rate of 100% with cartilage graft.[20,21]

In present study the pre operative mean PTA was 44.03 and post op mean PTA at 6 weeks was 37.24 and at 12 weeks was 34.27. The p value was <0.001 which was found to be significant. The mean hearing gain at 6 weeks post op was 6.79 and at 12 weeks was 9.76±2.12 which is significant. 20 patients had hearing improvement with ABG closure <10 db and 14 patients had ABG closure <20 db at 12 weeks post op.6 patients with graft failure didn't show any hearing improvement.

In a study by Mohammad et al, the mean pre operative PTA-ABG was 26.0±4.4db which improved to 13.8±5 db (p<0.0001) which was highly significant statistically.[22] The percent of reduction of PTA-ABG was about 46.6%.

In a similar study by Sharma et al, the mean AB gap measured pre operatively in cartilage group was 36.38±6.10 dB which improved to 18.13±5.8 dB post operatively.[23] Fascia group showed improvement from 28.73±5.82 to 15.23±8.14. Results were statiscally highly significant and comparable in both cartilage and fascia group in terms of hearing gain after tympanoplasty.

Table 3: Cartilage graft success rate.

S. no.	Study	Year	Graft uptake (%)	Audiological improvement (mean hearing gain) (dB)
1.	Dornhoffer[24]	1997	100	14.3
2.	Boone et al[25]	2004	94.7	12.4±6.5
3.	Ozbek et al[26]	2008	100	10.33±9.5
4.	Khan et al[19]	2010	98.2	7.06±3.39
5.	Albirmaway[27]	2010	9	10.95±2.12
6.	Demirpehlivan et al[28]	2011	97.7	11.82
7.	Yurttas et al[29]	2014	93%	9.69±2.51
8.	Couloigner et al[30]	2018	7	14±10
9.	Present study	2019	85	9.77±2.1

CONCLUSION

Based on the results of this study, it can be concluded that the post operative closure rate of tympanic membrane was high and audiologic improvement was satisfactory with perichondrium cartilage island graft. It can be preferred in reconstruction of tympanic membrane in revision cases because of their resistance to poor feeding, recurring infections, and retractions. The present study has some limitations like small sample size, short follow up period of 3 months.

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

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