International Journal of Otorhinolaryngology and Head and Neck Surgery
Mohan NS et al. Int J Otorhinolaryngol Head Neck Surg. 2023 Oct;9(10):800-804
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20232898

Original Research Article

Functional and anatomical outcomes following cartilage myringoplasty

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Received: 25 March 2023
Revised: 31 August 2023
Accepted: 11 September 2023

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ABSTRACT

Background: Myringoplasty using cartilage graft is being popular in recent years because of its better graft uptake and optimal hearing outcome. Thickness plays an important role in achieving optimal hearing outcome and although studies have shown 0.5 mm thickness to give better hearing results, concrete studies are lacking.
Methods: A prospective study was conducted in the department of otorhinolaryngology at a tertiary-referral-hospital in North-Karnataka; India between January-December 2019, on 25 patients of chronic otitis media; mucosal inactive or quiescent with conductive hearing loss and intact ossicular chain who underwent cartilage myringoplasty using conchal cartilage of 0.5 mm thickness. Follow-up was done at 3, 4½ and 6 months postoperatively to assess graft uptake. Hearing assessment was performed at the end of 6 months postoperative period with pure-tone audiometry.
Results: The preoperative mean pure tone average was 33.64±9.42 dB which improved to 22.56±7.41 dB at 6 months. At 3 months and 4½ months, there were 21casess (84%) of complete graft uptake, 3 cases of partial graft uptake (12%) and one case of total graft rejection (4%). Whereas, at 6 months postoperative period complete graft uptake was seen in 22 cases (88%) with 1 case of total rejection (4%) and 2 cases of partial uptake (8%).
Conclusions: Cartilage myringoplasty using 0.5 mm thickness conchal cartilage offers good hearing outcome in addition to significant graft uptake. As the conchal cartilage can be easily harvested from the site of incision for the surgery it can be an important primary alternative to temporalis fascia.

Keywords: Myringoplasty, Cartilage Tympanoplasty

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a highly prevalent middle ear disease that consists of tympanic membrane (TM) perforation together with a chronically inflamed mucosa.[1] Mucosal type of CSOM can further result in ossicular erosion, myringosclerosis and tympanosclerosis. The surgical treatment of CSOM primarily aims at eradication of the disease process and reconstruction of the hearing mechanism. Myringoplasty is the surgical repair of the TM.[2] Wullstein classified tympanoplasties, with myringoplasty being classified as a type I tympanoplasty.[3]

Temporalis fascia remains the most commonly used graft material for TM reconstruction with a success rate of 93 to 97% in primary tympanoplasties.[4]Recently, the use of cartilage grafts in myringoplasty has become popular. Cartilage grafts have shown better graft uptake and optimal audiological outcome. However, there are controversies regarding the effect of thickness of cartilage graft used in TM reconstruction on hearing outcome. In 1997, Zahnert et al reported that the ideal acoustic thickness of cartilage should be approximately 0.5 mm instead of full thickness of 0.7 to 1 mm to achieve better audiological outcome. In addition, the study found that thickness of more than0.5mm resulted in reduced vibration amplitudes.[5] Aslıer et al did a prospective study

in 2018 to evaluate the sound energy absorbance characteristics of cartilage grafts in patients who underwent type I cartilage tympanoplasty.[6] They found that graft material, graft thickness, cartilage surface area ratio and elapsed time after surgery affected the course of sound energy absorbance as evidenced by wideband tympanometry.[7] Studies have proved cartilage graft to be an alternative to temporalis fascia with at par regarding audiological outcome and graft uptake. Hence, the present study was undertaken to assess hearing outcome and graft uptake following cartilage myringoplasty using 0.5 mm thickness conchal cartilage.

METHODS

A prospective study was conducted in the department of otorhinolaryngology at a tertiary referral hospital in North Karnataka; India from January to December 2019 on 25 patients (Permissive error of 20 with a p of 56 and q of 44) of chronic otitis media (COM)-mucosal, inactive or quiescent with conductive hearing loss. Convenience sampling method was used. It was considered inactive when the ear was dry for more than 6 months; quiescent when the ear was dry between 3-6months. All the patients underwent cartilage myringoplasty using conchal cartilage of 0.5 mm thickness. Patients with sensori-neural hearing loss, mixed hearing loss, ossicular discontinuity, and active ear discharge were excluded from the study. The study was conducted after obtaining the ethics committee clearance from the institute (PGS/126/2018-2019). Valid informed written consent was taken from all the subjects. The study was registered under clinical trials registry-CTRI/2020/11/029194 (Indian council of medical research).

Preoperatively, pure tone audiometry (PTA) was performed and pure tone average and air-bone gap (ABG) were deduced. All the cartilage myringoplasties were performed by a single surgeonunder general anaesthesia. Conchal cartilage was harvested from the same incision site and was sliced to 0.5mm thickness using a cartilage slicer. As the thickness of the cartilage graft used was smaller, no slot or groove was made to accommodate handle of malleus. Graft was placed over the handle of malleus by underlay technique.

Patients were followed up regularly in the outpatient unit. Graft uptake at 3 months, 4½ months, and 6months post-operatively were observed with an otoscope and 0-degree endoscope. The uptake was considered complete when the graft was totally covering the perforation, partial when there was varying degrees of residual perforation and total rejection when the cartilage graft was totally extruded.

PTA was performed at 6 months postoperatively and the pure-tone-average was calculated for the frequencies of 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Pre and postoperative ABG was also compared.

Statistical analysis

All the data was entered into the SPSS version 20.0 computer software and the results were presented in tables and figures. Chi-square test was used for testing relationships between categorical variables. Dependent t test (also called the paired t test) was used to compare the means of two related groups to determine statistical significance.

RESULTS

The study included 25 patients who underwent cartilage myringoplasty with a mean age of 23.19±9.12 years. Majority of the patients (64%) were females. Out of 25 cases, 5 patients (20%) had bilateral COM and the remaining 20 patients (80%) had unilateral disease. Fourteen cases (56%) were in quiescent stage of COM and 11 (44%) cases were inactive. Majority of the patients i.e.,13 cases (52%) had a large central perforation involving more than 50% surface area of pars tensa. Medium (25% to 50% surface area) and small (<25% surface area) sized central perforations constituted 11 (44%) and 1 (4%) cases respectively.

Hearing outcome following cartilage myringoplasty: The mean pre-operative pure-tone-average was 33.64±9.42 dB and at 6 months postoperatively it improved to 22.56±7.41 dB with a p=0.0001 which was statistically significant (Table 1). Average ABG improved from a pre-operative ABG of 28.08 to 15.48 dB postoperatively with an average closure of 12.6 dB.

Graft uptake following cartilage myringoplasty is shown here (Figure 1).

At 3 months and 4½ months postoperatively, complete graft uptake was observed in 21 cases (84%), partial uptake in 3 cases and total rejection in one case. At 6 months postoperatively, there was complete graft uptake in 22 cases (88%) and partial uptake in 2 cases and total rejection in one case (Figures 2-3).

Table 1: Hearing outcome following cartilage myringoplasty based on pure tone average.

Treatment period	Mean	SD	Mean diff.	SD diff.	% of change	Paired T	P value
Preoperative	33.64	9.42	11.08	8.97	32.93	6.1780	0.0001
Six months post operative	22.56	7.41					

Figure 1: Good graft uptake.

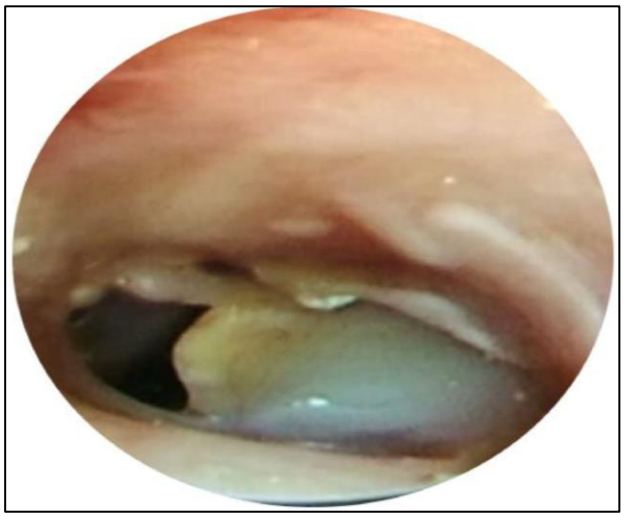

Figure 2: Graft rejection-partial.

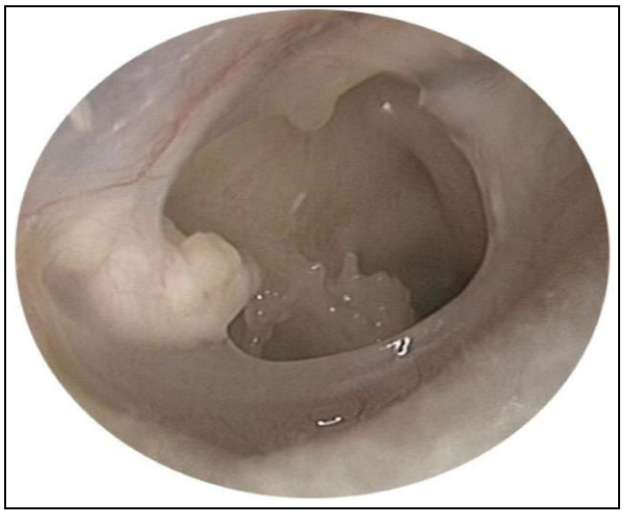

Figure 3: Graft rejection-total.

DISCUSSION

Myringoplasty is one of the common otological procedures that is aimed to restore hearing in a perforated TM. Temporalis fascia is the most commonly used graft material for myringoplasty. Causes of failure in myringoplasty using temporalis fascia graft are Eustachian tube dysfunction, bilateral disease, revision surgery, large and anterior perforation, tympanosclerosis, and retraction pocket. In the last decade, however there has been an increasing interest in using cartilage grafts as the primary alternative in myringoplasty.[7] The major advantages of cartilage are its stiffness and bradytrophic metabolism, which makes it particularly suitable for difficult conditions, such as subtotal perforations, adhesive otitis and revision cases.[7] The cartilage graft is also characterized by its resistance to resorption, retraction and negative pressure in the middle ear, its connection to the surrounding tissue and its suitable elasticity for sound transmission.[7] Cartilage is formed mainly of type 2 collagen which is having higher tensile strength compared to type 1 collagen in temporalis fascia.[8] Postoperative otitis media with effusion might be challenging to diagnose along with the difficulty of inserting a grommet after cartilage myringoplasty.[9,10]

Conchal cartilage as graft material

In the present study, conchal cartilage of 0.5 mm thickness was preferred to close TM perforation. Conchal cartilage can be harvested abundantly from the concha without causing cosmetic deformity to the ear which may be seen in the case of tragal cartilage. Conchal cartilage is preferred because of its increased stability, pliability, and resistance to negative middle ear pressure. Additionally, it is easy to harvest, less harvest time and the graft uptake will have minimal scarring.[11]

Significance of thickness of cartilage graft used

Thickness of normal TM is 0.1 mm and the graft material used for TM reconstruction should have similar thickness for better audiological outcome. Zahnert et al reported that cartilage graft of thickness less than 0.5 mm has the same acoustic properties as the normal TM.[5] Tragal and conchal cartilage were compared to see which was better and there was no statistical difference between these cartilage grafts.[5] Lee et al did a study to determine the optimal graft thickness for cartilage myringoplasty in patients with different sizes of TM perforations using finite element analysis. From their study it was concluded that the optimal thickness of a cartilage graft for myringoplasty to be 0.1-0.2 mm for medium and large TM perforations. Cartilage of less than 1.0 mm thickness for small perforations, is a good compromise between mechanical stability and low acoustic transfer loss.[12] In 2018 Aslıer et al did a prospective case-control study on "sound energy absorbance characteristics of cartilage grafts used in the type 1 tympanoplasty" and the higher absorbance ratios at 250-750 Hz range were obtained in patients with 0.4 mm cartilage graft thickness.[6]

Hearing outcome following cartilage myringoplasty

There was statistical significance in hearing outcome found at 6 months postoperative period with average ABG closure of 12.6 dB. Studies have reported an ABG closure ranging from 9.9 to 10.27 dB using sliced cartilage of thickness 0.5 mm on a sample size of 50 and 30 respectively.[7] A study by Gamra et al using unmeasured sliced cartilage reported an ABG closure of 14 dB on a sample size of 90.[13] Similarly, yet another study by Bhardwaj et al using full thickness cartilage graft (n=20) showed an ABG closure of 14.98 dB.[11] Another study by Nemade et al using full thickness cartilage graft (n=48) showed an ABG closure of 19.8dB.[14] The difference in the results between studies could be influenced by various factors like the surgical technique, size and site of perforation, thickness of the cartilage used, the type of cartilage used (Conchal/tragal) etc.

Graft uptake following cartilage myringoplasty

Present study showed graft uptake of 88% at 6 months postop period which is comparable with meta-analysis performed by Jalali et al involving 37 articles comparing cartilage with temporalis facia tympanoplasty which showed an overall graft integration rate of 92%.[4] Other studies too have reported similar graft uptake rates.[15,16]

Difficulties encountered and limitations of the study

Slicing of the cartilage was not difficult but placing the sliced graft was a concern as 0.5 mm thickness cartilage used to curl up which is also reported by Zahnert et al.[5] Lower sample size and short-term follow-up were the limitations.

Literature study

The mean age of the patients ranged from 19.3 years to 48.8 years and the sample size varied from 13 to 115 patients. Among the 7 articles apart from the present study only 1 series used sliced cartilage of thickness 0.5 mm or less and the rest were using full thickness cartilage. The follow up period ranged from 3 months to a maximum of 24 months. Graft uptake ranged from76.9% to 97.7% in full thickness cartilage. On the other hand, the uptake was 92% in the myringoplasties performed using cartilage graft of thickness 0.5 mm or less. Hearing outcome in terms of ABG closure ranged from 5.2 dB to 19.8 dB in full thickness cartilage, while it was 9.9 dB in myringoplasties performed using cartilage graft of 0.5 mm/ less thickness. Present study comprising 25 patients of cartilage myringoplasty using 0.5 mm thickness cartilage graft showed graft uptake of 88% and ABG closure of 12.6 dB at 6 months follow-up period (Table 2).

Table 2: Literature study of cartilage myringoplasty.

Author, (Year)	No of patients (N)	Mean age (Years)	Thickness of cartilage used	Follow up period (Months)	Level of evidence	Graft uptake (%)	Hearing outcome (ABG closure in dB)
Gamra et al,[16] 2008	90	29	FT	24	4	97.7	14
Yegin et al,[9] 2016	115	33.45	FT	6	1	91.3	7.51
Abdelhameed et al,[8] 2016	50	19.3	$\leq$ 0.5 mm	12	4	92	9.9
Nemade et al,[20] 2017	48	34.3	FT	3	4	95.8	19.8
Kim et al,[21] 2018	13	48.8	FT	10.9	4	76.9	5.2
Bhardwaj et al,[11] 2019	20	-	FT	6	2	-	11.41
Erden et al,[22] 2020	39	32.7	FT	6	4	89.7	12.1
Present study	25	23.12	0.5 mm	6	4	88	12.6

Abbreviations: ABG-Air bone gap, dB-decibel, FT-full-thickness,

CONCLUSION

Cartilage myringoplasty using 0.5 mm thickness conchal cartilage offers good hearing outcome in addition to significant graft uptake. As the conchal cartilage can be easily harvested from the site of incision for the surgery it can be an important primary alternative to temporalis fascia.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Mohan NS, Mushannavar AS, Gadag RP, Dandinarasaiah M. Functional and anatomical outcomes following cartilage myringoplasty. Int J Otorhinolaryngol Head Neck Surg 2023;9:800-4.