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Comparative study of cartilage tympanoplasty with temporalis fascia tympanoplasty

Raghav Mehta*, Pradeep Patidar, Mohit Punjabi, Mukesh Dagur, Sudhanshu Pandey

Department of ENT, R.U.H.S. College of Medical Sciences, Jaipur, Rajasthan, India

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***Correspondence:**
Dr. Raghav Mehta,
E-mail: drraghavmehta@rediffmail.com

ABSTRACT

Background: The aim of our study is comparison of effectiveness of cartilage (conchal or tragal) tympanoplasty with temporalis fascia tympanoplasty in terms of graft uptake and audiological outcomes. Help of following databases were taken: MEDLINE, emedicine, Google scholar, and the PubMed.
Methods: We studied the outcome of two different type of graft material (cartilage and temporalis fascia). Who underwent type 1 tympanoplasty at department of otorhinolaryngology, RUHS College of Medical Sciences, Jaipur from November 2015 to November 2018. Total 80 patients were divided in two groups, 40 patients underwent cartilage grafting while 40 patient's tympanoplasty was done using temporalis fascia graft.
Results: The successful graft uptake rate for the fascia group was 90%, and that for the cartilage group was 97.5%. Though initial audiological improvements were better in fascia graft group, long term results were similar in both groups.
Conclusions: The use of cartilage tympanoplasty has similar outcomes to temporalis fascia grafting for audiological purpose. But successful uptake rate is better for cartilage as it is elastic, more resistant to resorption and retraction from more negative middle ear pressure.

Keywords: Cartilage, Temporalis fascia, Tympanoplasty

INTRODUCTION

Since the introduction of tympanoplasty by Zollner and Wullestein, temporalis fascia has been the standard graft.[1,2] Though various graft materials like peri-chondrium, periosteum, vein, cartilage and other fasciae have been tried the Temporalis fascia has stood the test of time. Cartilage was first used by Utech in 1959 and in recent years especially with advent of endoscopic tympanoplasty it is becoming the graft of choice for many.[3,4]

Cartilage specially sliced cartilage has statically shown similarities to temporalis fascia in regards to hearing outcomes and the rigidity of the cartilage leads to less resorption and theoretically less failure rates.

The aim of our study is to compare the sliced cartilage tympanoplasty to conventional tympanoplasty in regards to failure rate and hearing outcome.

METHODS

The present study was conducted at the department of otorhinolaryngology, RUHS College of Medical Sciences, Jaipur from November 2014 to November 2017. There were total of 80 patients, 40 of cartilage and 40 of temporalis fascia tympanoplasty followed over a

period of 2 years with regular otoscopic and audiometric evaluation.

Randomized controlled trials (RCTs) and retrospective studies comparing cartilage and temporalis fascia tympanoplasty was done. Help of following databases were taken: MEDLINE, emedicine, Google scholar, and the PubMed. Statistical comparisons were made using one-way analysis of variance, the chi-square test, and the t-test for independent samples. The results were assessed within 95 per cent reliance, and at a significance level of $p<0.05$.

Inclusion criteria

Patients who had dry ear for at least 4 weeks, conductive hearing loss with good cochlear reserve, undisturbed ossicular integrity and tubotympanic disease were included.

Exclusion criteria

Patients with atticoantral disease, sensorineural hearing loss and ossicular discontinuity were excluded.

All patients were operated by post aural route in 40 cases temporalis fascia was harvested and in other 40 cases tragal/conchal cartilage was taken. Tragal/conchal cartilage was sliced while keeping perichondrium attached on one end on one side, this part was slipped under posterior canal wall flap and the cartilage was slipped under the handle of malleus stabilized by medicated gel foam.

Both pre and post-operative audiometry was done after one week, 4 weeks and then 12 weeks in all the cases also audiometric evaluation was on each visit. The results were recorded in a tabulated form and analyzed regularly.

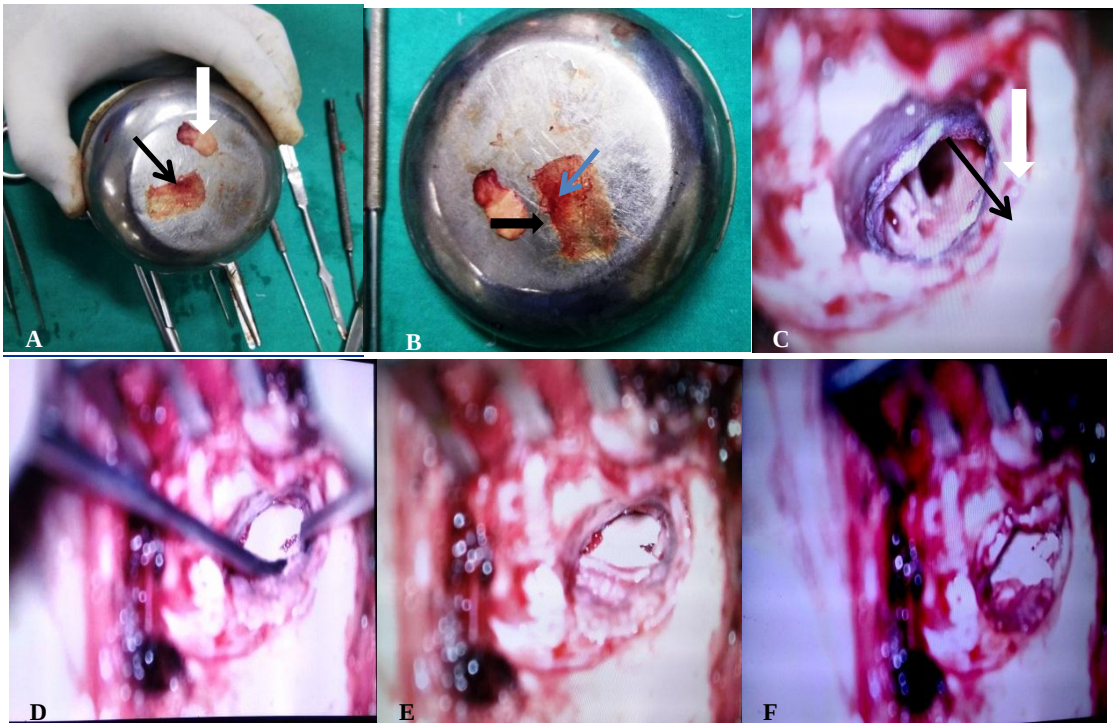

Figure 1: Surgical procedure of cartilage tympanoplasty, (A) harvesting of conchal cartilage (white arrow) and temporalis fascia (black arrow), (B) making a notch (black arrow) in superior part of cartilage for accommodation of handle of malleus. Perichondrium is left attached to one end of cartilage (blue arrow), which will be tucked behind posterior tympanomeatal flap, (C) after freshening of tympanic membrane remnant margin of subtotal perforation. Handle of malleus (black arrow), eustachian tube (white arrow), (D) placement of cartilage after trimming the edges to shape it in oval shape in accordance with tympanic membrane. Middle ear cavity and eustachian tube is filled with gelfoam prior to it, (E) after repositioning of tympanomeatal flap, (F) small crevice is filled with small pieces of cartilage (white arrow).

RESULTS

All the cases were followed with an audiometry at 4 weeks and 12 weeks and then at 6 months along with regular otoscopic examination. Analysis was done on following points such as overall outcome in regards to graft uptake, hearing results in various frequencies at 4, 12 weeks and at 6 months respectively and outcome on basis of proper uptake visually.

Graft uptake

In our study 39 (97.5%) patients out of 40, in cartilage tympanoplasty group have shown successful uptake of

graft and 1 cartilage extrusion was seen. While only 36 patients (90%) out of 40, were successful in temporalis fascia graft uptake and 4 (10%) were failures (Table 1).

Hearing results in term of frequency

Hearing results are evaluated in terms of air bone gap in standard 250 KHz, 500 KHz, 1000 KHz and 2000 KHz. at 4 weeks, 12 weeks and 6 months post-operatively (Table 2).

In cartilage tympanoplasty group: at 4 weeks, average air-bone gap (ABG) was 25 dB, which reduced to 17.5 dB at 12 weeks. At 6 month follow up ABG improved further with average of 11.67 dB.

In temporalis fascia group: in this group average ABG at 4 week and 6 week was 12.5 dB. And slight improvement was noted at 6 month with average ABG of 10dB.

It is evident that hearing outcome is slightly better in temporalis fascia graft group in initial post op period. But on long term the overall hearing results are similar. And patient's subjective experience dictates the same.

Otoscopic examination

The group in which cartilage tympanoplasty was done, no medialization or lateralization of graft was seen. The uptake appeared proper with no retraction pockets. However, in the temporalis fascia group 2 cases showed medialization and retraction pockets, while there was 1 case of lateralization of graft (Table 3).

Table 1: Comparison with regards to graft uptake (n=40).

Graft uptake	Cartilage tympanoplasty	Temporalis fascia tympanoplasty
	N (%)	N (%)
Successful	39 (97.5)	36 (90)
Failure	1 (2.5)	4 (10)

Table 2: Hearing results in term of frequency.

Frequency (Hz)	Cartilage tympanoplasty (Average ABG)			Temporalis fascia tympanoplasty (Average ABG)		
	4 weeks	12 weeks	6 months	4 weeks	12 weeks	6 months
500	30 dB	15 dB	10 dB	15 dB	10 dB	5 dB
1000	25 dB	20 dB	15 dB	10 dB	15 dB	15 dB
2000	20 dB	20 dB	10 dB	15 dB	10 dB	10 dB
Average ABG in dB	25 dB	18.3 dB	11.6 dB	13.3 dB	11.6 dB	10 dB

Table 3: Otoscopic examination.

Otoscopic examination (at 12 weeks)	Cartilage tympanoplsty	Temporalis fascia tympanoplsty, N (%)
Medialization/retraction	0	2 (5)
Lateralization	0	1 (2.5)
Total	0	2+1=3 (7.5)

DISCUSSION

Tympanoplsty i.e., correction of tympanic membrane perforation with graft material, is traditionally been done by using temporalis fascia graft material. But in recent years understanding of physiology and pathology of middle ear cleft is drastically improved with technical advancement in surgical methods. Various grafts have been tried for tympanoplasty time to time with varying results. Cartilage, harvested from tragus or cymba/cavum concha, has been used. Cartilage is used for tympanoplasty in certain specific type of perforation with middle ear pathologies like, subtotal/total perforation, tympanosclerosis, retractions/ atelectasis/ adhesive otitis media, persistent eustachian tube dysfunction/ patency expressed in negative preoperative valsalva test, B/L COM, revision surgery. So these will be absolute candidates for cartilage tympanoplasty.

Though many surgical variations using cartilage has been described in literature with variable success rate in terms of cartilage graft uptake and audiological outcome, but mainly two techniques, palisade and cartilage/ perichondrium island flap are popular.

Utech was the first to begin using it in the 1950s.[1] Others, such as Salen and Goodhill, began using cartilage for repairing portions of the TM; however, Heermann was the first to establish the use of cartilage and the palisade technique for chronic middle ear disease.[1] In general, the overall success rate of tympanoplasty has been approximately 80%. Two of the 3 RCTs show similar

results between cartilage and fascia tympanoplasty both morphologically and audiologically.[2,3] Yang et al reported a success rate of more than 90% and 80% for anatomical and hearing outcomes in their review comparing cartilage and fascia. They state that there were no significant differences between the two groups in anatomical or hearing outcomes.[4] In another study, Jiang et al. reported significantly better anatomical results with cartilage graft.[5] Cartilage strips were named palisades by Heermann et al.[6]

Cartilage differs from traditional graft material, such as fascia and perichondrium, primarily due to its increased thickness. This might suggest an increased rigidity, with resulting conductive hearing loss; however, several studies have demonstrated that hearing results are no different than with fascia.[1,7,8] Moreover, it is precisely this increased thickness and rigidity that makes cartilage an ideal graft material capable of resisting the resorptive and retracting forces of continuous eustachian tube dysfunction. Zahnert et al. looked at the acoustic transfer characteristics of cartilage of varying thickness and its resistance when exposed to fluctuations of atmospheric pressure. Tragal and conchal cartilage were compared; however, there was no statistical difference between these 2 types of cartilage. They concluded that to achieve better hearing results, the ideal thickness of palisades should be about 0.5 mm instead of the full thickness of 0.7–1 mm.[9] This argument is supported by a clinical study conducted by Kazikdas et al. They detected a higher graft uptake rate in the palisade cartilage group (95.7%) than in the fascia group (75%) in a comparative study in a homogenous group of patients. The cartilage strip thickness used was as thin as 0.5 mm. This was statistically not significant but close to the significant level (p=0.059).[10]

However, in 2009 and 2010, Aarnisalo et al used laser and stroboscopic holography to study the thickness of the cartilage and the connection of the cartilage with the bone annulus; they discovered that palisades have no effect on the transmission of sound vibration.[11] The status of the opposite ear has been widely studied as a prognostic factor for tympanoplasty success. Because eustachian tube function is usually symmetrical, the status of the contralateral ear may predict success of tympanoplasty when localized mucosal disease is not present.[12]

Some authors compared the 2 graft materials in children alone. Because, in the pediatric group, the eustachian tube function has a significant role on the success of myringoplasty. Two of these studies show better morphological outcome with the use of cartilage when compared with fascia grafts.[12,13] This result is significant because in the pediatric population eustachian tube dysfunction creates the negative pressure in the middle ear cavity, which can cause retraction of the tympanic membrane with resultant failure of myringoplasty. The effect of this negative pressure can be counteracted by the use of cartilage, which is more stiff and resilient when compared with temporalis fascia. The main concern is that cartilage due to its stiffness can reduce hearing outcomes post operatively. However, certain studies performed in pediatric and adults do not support this claim. Thus, it would seem a sensible option to use cartilage in the pediatric population.

In our review it is shown that cartilage graft is more successful in morphological or anatomical outcomes. We postulate that stiffness of cartilage may have a role in resistance against retraction and provide stability and a reduced failure rate. And we also found no significant difference in hearing outcomes between the 2 grafts. This could be explained by the fact that the perforated ear drum has reduced surface area for sound transmission, thus resulting in conductive hearing loss. And that reduced tympanic membrane surface area is again increased by cartilage or fascia graft. This will result in improved hearing provided that proper technique and caution is used in use of cartilage.

CONCLUSION

The use of cartilage tympanoplasty has similar outcomes to temporalis fascia grafting for audiological purpose. But successful uptake rate is better for cartilage as it is elastic, more resistant to resorption and retraction from more negative middle ear pressure.

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