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Comparative study of type I tympanoplasty using temporalis fascia and tragal cartilage with perichondrium as graft material

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ABSTRACT

Background: Temporalis fascia and cartilage are the most commonly used graft materials, though contradictory reports are available in literature as regards their efficacy. The purpose of this study was to compare graft acceptance and auditory outcomes of tympanoplasty using cartilage versus temporalis fascia as graft material.
Methods: This prospective study included 40 consecutive cases of chronic otitis media in a tertiary care centre randomised in two groups of 20 patients each to be subjected to tympanoplasty using either tragal cartilage-perichondrium or temporalis fascia graft from January 2011 to November 2012. Graft uptake rates and subjective as well as objective hearing improvement at 2 months and 6 months postoperative follow-up were compared.
Results: The mean age of presentation was 34.4 years (range 15-60 years). At 2 months post operatively, the graft uptake was better with tragal cartilage group (95%) than temporalis fascia (90%), while at the end of 6 months graft uptake was better with temporalis fascia (75%) compared to tragal cartilage (70%). Hearing improvement was better for tragal cartilage group compared to the temporalis fascia group at both 2 months and 6 months follow-up. The subjective improvement in hearing at the end of 6 months was also better for tragal cartilage- perichondrium group than the temporalis fascia group.
Conclusions: Both temporalis fascia and tragal cartilage–perichondrium are suitable graft materials for tympanoplasty. Graft uptake was superior with temporalis fascia, while hearing improvement was better with tragal cartilage- perichondrium, although the results were not statistically significant.

Keywords: Tympanoplasty, Graft acceptance, Hearing improvement, Tragal cartilage, Temporalis fascia

INTRODUCTION

Majority of tympanic membrane perforations undergo spontaneous closure. In most of the cases with persistent perforation, medical treatment is not sufficient and such patients need to undergo surgical correction i.e. tympanoplasty. Different surgical approaches, surgical techniques and graft materials are in practice, of which temporalis fascia has been most commonly used.[1,2] Cartilage-perichondrium composite grafts are also considered to be one of the best materials for myringoplasty especially in cases of large perforations more than 50% of the tympanic membrane area, anteriorly placed perforations, adhesive otitis media, and recurrent perforations.[3,4] However, acceptance of routine reconstruction of the tympanic membrane with cartilage has been hampered by concerns regarding compromise in hearing improvement with its use.

The present study was undertaken to compare the graft uptake results as well as hearing improvement in patients undergoing primary tympanoplasty using either

temporalis fascia versus tragal cartilage with perichondrium as graft material.

METHODS

Patient population and evaluation

This prospective study was conducted on 40 consecutive patients of chronic inactive mucosal otitis media, admitted in the Department of Otorhinolaryngology in a tertiary care centre at Amritsar, India for tympanoplasty with or without cortical mastoidectomy from January 2011 to November 2012. Pre operative assessment included a detailed history, clinical and audiological evaluation, supplemented with suitable radiological investigations when indicated to exclude squamous otitis media, suspected ossicular pathology, eustachian tube dysfunction, and sensorineural hearing loss. Patients with history of previous surgery were excluded. After the approval of Institutional Review Board and written informed consent from the patient, these patients were randomised into 2 groups of 20 patients each into Group I and Group II, to be reconstructed using temporalis fascia or tragal cartilage- perichondrium graft respectively.

Surgical procedure

Patients were operated under general or local anaesthesia. The decision between choosing transcanal approach or post-auricular approach was made based on the preoperative examination with a microscope. Temporalis fascia was harvested by a standard post auricular approach and placed by an underlay technique in all patients belonging to Group I.

In patients of Group II, tragal cartilage was harvested along with the perichondrium attached on one side, leaving 2 mm of cartilage at the dome for cosmetic purposes. The cartilage graft was placed by either the cartilage shield or butterfly technique. In the inlay butterfly technique, the graft size was taken 2 mm wider in diameter than the perforation and a 1mm deep groove was created along the circumferential border of the cartilage disc allowing the cartilage flanges to spring open. This groove was engaged with the anterior rim of the perforation so that the medial flange was medial to the tympanic membrane with the perichondrium facing laterally and the rest of the graft was manipulated into place with a dissector or needle and the. In the cartilage shield technique, a V- shaped notch was created in the cartilage to accommodate the malleus handle and the graft was placed medial to tympanic membrane remnant. In both techniques of cartilage tympanoplasty, the perichondrium was draped onto the lateral bony canal wall to be covered by the tympanomeatal flap.

The following parameters were evaluated: graft uptake, subjective improvement in hearing, and air-bone gap (A-B Gap) closure. Successful graft uptake was defined as full, intact healing of the graft without residual perforation. Objective hearing improvement was assessed by the A-B gap closure. For this, the A-B Gap was first calculated by noting the mean air-bone gap at 500, 1,000, 2,000 Hz for each patient. The A-B gap closure i.e. the difference in the pre-operative and post-operative AB gap was then calculated for each patient individually at 2 months and 6 months post-operatively. Subjective improvement in hearing was also noted.

Post operative care and follow-up

Patients were given water precautions and cautioned against vigorous nose blowing. Sutures were removed one week after surgery. Antibiotic steroid-containing drops were started on 5th postoperative day after ear pack removal.

For the first month, the patient was followed up weekly, then at 2 months and then at 6 months for clinical examination. Tuning fork tests (Rinne's , Weber's and A.B.C) using 256, 512 and 1024 Hz tuning forks and pure tone audiometry (by Proton Sx–5D Clinical Diagnostic Audiometers) were done at 2 and 6 months post operatively.

Statistical analysis

At the end of the study, decoding of the groups was done and the results were analysed statistically, using Chi Square Test and Student t-test, using SSPS III software. P value of less than 0.05 was considered significant and less than 0.001 as highly significant.

RESULTS

The present study was conducted on 40 consecutive patients of chronic mucosal otitis media. The mean age of presentation was 34.4 years (range 15-60 years). Majority i.e. 26 (65%) were females, while 14 (35%) were males. Twenty seven (67.5%) patients had unilateral disease and 13 (32.5%) had bilateral chronic otitis media. The tympanic membrane perforations were categorized according to the size into either ≤3 mm or >3 mm. Among the 40 patients, 14 (35%) patients had perforation ≤3 mm and 26 (65%) patients had perforation of size >3 mm. Both Group I and Group II were comparable in respect to the above characteristics (Table 1). The tympanic membrane was reconstructed using temporalis fascia by underlay technique in all 20 patients belonging to Group I. Among the patients in Group II, 12 (60%) patients were reconstructed using the inlay butterfly technique, while 8 (40%) were reconstructed using the cartilage shield technique.

Graft uptake

The overall rate of graft uptake in the present series was 72.5%. The rate of re-perforation was 22% (8 patients). On evaluation at 2 months postoperatively, 18 (90%) patients of Group I had graft uptake, while 19 (95%)

patients of Group II showed graft uptake. Among the patients in Group II, 11 of the 12 (91.7%) patients with inlay butterfly technique had graft uptake, while all 8 patients with cartilage shield technique had graft uptake (Table 2).

Table 1: Comparative characteristics of group I (temporalis fascia) and group II (cartilage – perichondrium).

Characteristic	Group I	Group II
Mean age (years)	38.3	30.5
M:F	6:14	8:12
Perforation size ≤3 mm	6	8
Perforation size >3 mm	8	12

Table 2: Graft uptake results on follow-up at 2 months and 6 months according to technique of tympanoplasty.

Group (n)	Uptake at 2 months (%)	Uptake at 6 months (%)
Fascia (n=20)	18 (90)	15 (75)
BT (n=12)	11 (91.7)	10 (83.3)
CS (n=8)	8 (100)	4 (50)
Total (n=40)	36 (90)	29 (72.5)

Fascia: Temporalis fascia; BT: Inlay Butterfly technique; CS: Cartilage shield technique.

At 6 months postoperative evaluation, 15 (75%) and 14 (70%) of patients exhibited graft uptake in Group I and Group II respectively. Among Group II, 10 (83.3%) patients with inlay butterfly cartilage had graft uptake, while only 4 (50%) patients with cartilage shield graft had graft uptake.

On further analysis according to size of the perforation, the overall rate of graft uptake in perforations <3mm was 85.7% % at 2 months postoperatively with 12 of 14 cases exhibiting graft uptake, and 64.3% at 6 months postoperatively with 9 of 14 cases showing graft uptake. Among the 26 cases with perforation size >3mm, the rates of graft uptake at 2 and 6 months follow-up were 96.2% and 76.9% respectively, with 25 of 26 cases showing graft uptake at 2 months and 20 of 26 cases showing graft uptake at 6 months follow-up.

Of the 14 cases with perforation with size <3 mm, 6 were reconstructed with temporalis fascia (Group I), with uptake seen in 5 (83.3%) and 4 (66.7%) cases at 2 months and 6 months respectively. The remaining 8 cases were reconstructed using tragal cartilage (Group II), with uptake seen in 7 (87.5%) and 5 (62.5%) cases at 2 months and 6 months respectively. Fourteen of the 26 cases with perforation size >3 mm were reconstructed with temporalis fascia (Group I), with graft uptake seen in 13 (92.9%) and 11 (78.6%) cases at 2 and 6 months respectively. Of the remaining 12 cases reconstructed using tragal cartilage (Group II), 12 (100%) and 9 (75%) cases showed graft uptake at 2 and 6 months respectively (Table 3). This difference in the rates of graft uptake as per size of perforation in Group I and Group II were not statistically significant.

Table 3: Graft uptake results on follow-up at 2 months and 6 months according to size of perforation.

Graft uptake	Perforation size ≤3 mm (n=14)			Perforation size >3 mm (n=26)		
	n	2 months (%)	6 months (%)	n	2 months (%)	6 months (%)
Group I	6	5 (83.3)	4 (66.7)	14	13 (92.9)	11 (78.6)
Group II	8	7 (87.5)	5 (62.5)	12	12 (100)	9 (75)

Table 4: AB gap closure.

AB gap closure	Group I	Group II	Intergroup significance
AT 2 months	11.41±8.288	14.98±9.915	NS
AT 6 months	10.49±9.069	11.55±8.173	NS

Data: Mean±SD, NS – Non significant (p>0.05)

Hearing improvement

Thirty five of the total 40 cases (87.5%) showed subjective hearing improvement, with 17 (85%) and 18 (90%) of cases in Group I and Group II respectively.

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 Group I was 24.63 ± 9.903 and 28.20±9.161, which were comparable statistically. The closure in air-bone gap in Group I was 10.49 ± 9.069 at 2 months and 11.41±8.288 at 6 months postoperatively. In patients of Group II reconstructed using tragal cartilage, the closure in air-bone gap was 11.55±8.173 and 14.98±9.915 at 2 and 6 months postoperative follow-up respectively (Table 4). This difference in hearing improvement in the two groups was however not statistically significant.

DISCUSSION

Tympanoplasty is a term used to describe reconstruction of the tympanic membrane and sound conducting mechanism of the ear. Since its first description in 1952

by Wullstein and Zollner various materials have been used for tympanoplasty.[5,6] The most popular and widely used graft materials are temporalis fascia and tragal cartilage. Temporalis fascia is considered superior with respect to the rate of graft uptake, probably due to its low basal metabolic rate. Also, it is easily available in sufficient quantity, can be harvested through the same incision, and is adequately firm with thickness comparable to that of the normal tympanic membrane.[7] Cartilage with perichondrium can be obtained from the tragus or concha, and is preferred by some surgeons due to its easy technique, minimal scarring and no significant postoperative morbidity. It is preferred especially in cases of large or anteriorly placed perforations or those with associated Eustachian tube dysfunction.[8] However, the hearing improvement is considered to be inferior to that obtained by temporalis fascia.

The present study was designed to evaluate graft uptake results and hearing improvement while using either Temporalis Fascia via underlay technique versus Tragal Cartilage with perichondrium by either inlay butterfly or cartilage shield technique in Type I Tympanoplasty. The two groups were statistically comparable, and gender was not a confounding factor for comparison of two groups.

Graft uptake

In our study, the overall rate of graft uptake was 72.5%. At 2 months, there was 95% graft uptake with Tragal cartilage with perichondrium and 90% with Temporalis fascia. This difference was not statistically significant. At the end of 6 months, the results were slightly better with Temporalis fascia with 75% graft uptake as compared to 70% with Tragal cartilage, although there was no statistically significant difference. The rate of re-perforation was 22% (8 patients). The results were consistent with those of Zulkifal Awan et al, who also showed a success rate of 75% with temporalis fascia graft. [9] A study by Kalcioglu et al in 2009 showed a graft survival rate of 86.1% in the fascia group and 95% in the cartilage group among 307 patients.[10] The lower results in our study may be attributed to the smaller sample size.

Among the cartiage-perichondrium group, though the uptake rates with cartilage shield technique were superior to those of inlay butterfly technique with 100% and 91.7% uptake respectively, at 6 months the uptake rate was superior with the inlay butterfly technique with 83.3% uptake compared to 50% uptake with cartilage shield technique. Maurya et al also demonstrated a graft uptake rate of 92.7% with butterfly cartilage group.[11]

Hearing improvement

In the present study, each patient was taken as his own control (preoperative AB gap) and the mean was taken for the difference in AB gap i.e. the AB gap closure. In our study, 47.5% (19 out of 40) patients showed a post operative AB gap of less than or equal to 10 dB. The AB gap closure at 2 months post operative was 11.55±8.173 dB for the Tragal cartilage- perichondrium group, as compared to 10.49±9.069 dB for the Temporalis fascia group. At 6 months, the AB gap closure was 14.98±9.915 dB for Tragal cartilage- perichondrium as compared to 11.41±8.288 dB for Temporalis fascia group. Thus, the hearing improvement was better for Tragal cartilage group both at 2 months and 6 months as compared to Temporalis fascia group. The comparison of the AB gap and the pure tone average scored between both techniques also showed no significant differences.

It should be pointed out that in our study the hearing improvement increased with time, which can be explained by the gradual process of healing and post operative stabilisation of the neo-tympanic membrane. Most studies arbitrarily define the improvement of hearing as cut –off point or mean of audiometric parameters with very different values and times. Therefore we must be careful when assessing these figures.

Contrary to the above results, some authors suggest that though cartilage may be good for graft stabilisation, hearing results are often inferior to those with temporalis fascia.[12] Zahnert and colleagues had postulated that the thickness of the cartilage graft in cartilage tympanoplasty should be less than 0.5 mm for it to achieve acoustic properties similar to the normal tympanic membrane.[13] However, the thinning of the cartilage graft, normally in the range of 0.7 to 1 mm, results in inevitable twisting of the cartilage making reconstruction more difficult.

Recent studies have however showed promising results with full-thickness cartilage tympanoplasty, similar to our results.[14,15] A study by Chen et al conducted on 102 patients using cartilage-perichondrium composite graft in 79 patients undergoing tympanoplasty showed the preoperative AB gap to be 41.66±10.22 dB and postoperative AB gap to be 26.86 ± 8.92 dB.[16] In a study by Zhang et al, though early hearing improvements in temporalis fascia group were better than that of cartilage–perichondrium composite grafts, there was no significant difference 1 year after surgery.[17]

Our study also recorded the subjective improvement in hearing at the end of 6 months in 35 of 40 (87.5%) patients. Though the results were better for tragal cartilage- perichondrium group than the temporalis fascia group, there was no statistically significant difference.

CONCLUSION

Thus, to conclude, both temporalis fascia and tragal cartilage with perichondrium are acceptable graft materials for successful closure of tympanic membrane perforations. The overall graft uptake appeared to be better with temporalis fascia, while the hearing improvement was better with tragal cartilage-

perichondrium. However, none of the results were statistically significant.

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