Comparison of Hearing Result and Graft Uptake Rate between Temporalis Fascia and Tragal Cartilage in Endoscopic Myringoplasty

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ABSTRACT

Background

There are different methods to repair the perforation of the tympanic membrane. Recently cartilage has been used for the repair and results are comparable to temporalis fascia. For surgical procedure endoscope had added good assistance in middle ear surgery. Though the one hand technique the image quality and results are on par with the use of a microscope.

Objective

To compare the graft uptake rate and hearing results between temporalis fascia and tragal cartilage in endoscopic myringoplasty.

Method

This is a prospective, longitudinal study conducted among 50 patients who underwent endoscopic myringoplasty using temporalis fascia and tragal cartilage with 25 patients in each group. The hearing was assessed by comparing pre with post-operative ABG (Air bone gap) and ABG closure in speech frequencies (500Hz, 1 KHz, 2 KHz, 4 KHz). The status of graft and hearing results was evaluated on 6 months of follow up in both the groups.

Result

Out of total 25 patients enrolled for study in both (temporalis fascia and cartilage) groups, 23 (92%) patients in each group had graft uptaken. The audiological gain in the temporalis fascia group was 11.37±0.32 dB whereas in the tragal cartilage group it was 14.56±1.22dB. The audiological gain between the two groups did not show any statistically significant (p = 0.765). However, the pre and post-operative hearing difference was statistically significant in both temporalis fascia and tragal cartilage group.

Conclusion

Tragal cartilage has similar graft uptake rate and hearing gain when compared with temporalis fascia in endoscopic myringoplasty. Hence, tragal cartilage can be used for myringoplasty whenever required without any fear of deterioration in hearing.

KEY WORDS

Air bone gap, Endoscopic myringoplasty, Temporalis fascia, Tragal cartilage

INTRODUCTION

Recently the endoscopic tympanoplasty is defined as per the principle of minimal invasive surgery. It was started in 1990s and became popular in otology because it provides better optics, magnification, adequate visualization and helps evaluation of the perforation margin.[1-4]

For repair of tympanic membrane perforation, temporalis fascia remains the gold standard and main reference against which other grafts are compared. It has low basal metabolic rate, available in sufficient quantity from same incision. However, its shrinkage can be unpredictable because the gaps between its elastic fibers are filled with connective tissue that shrinks and thickens more than elastic fibers do.[5-7] In contrast, tragal cartilage grafts are preferred in difficult circumstances like poor eustachian tube function, retraction pockets, anterior perforations and revision surgeries.[8-10]

There are limited studies comparing the clinical outcomes of cartilage and fascia in endoscopic myringoplasty in our scenario. So, we want to compare the tragal cartilage with temporalis fascia in endoscopic myringoplasty for hearing outcome and graft uptake.

METHODS

This was a prospective, cohort study conducted from February 27th, 2018 to August 18th, 2020 in the Department of Otorhinolaryngology, Dhulikhel Hospital, Kathmandu University Hospital, Kavre, Nepal. The ethical clearance was obtained from the Institutional Review Board. Informed consent was obtained from the patient before conducting the study. The inclusion criteria were; chronic otitis media mucosal inactive type, age ≥ 18 years, both gender and conductive hearing loss (CHL). Exclusion criteria were; graft failure, revision cases, mixed or sensorineural hearing loss, medical or surgical conditions, or treatment having a chance to influence the outcome.

From the patients included in the study, clinical examinations (general ear, nose, and throat [ENT] examination, microscopic examination of the ear, and tuning fork tests) were performed pre-operatively.

Sample size calculation:

Sample size was calculated using Epi Info version 7.2.

The formula used was:

$N=z^2PQ/d^2$ (Confidence interval =95%),
where z=1.96 and d=5

N=46 (sample size)

Total fifty patients were enrolled in the study. They were randomly divided into two equal groups of 25 patients each. In the first group (Group A), endoscopic myringoplasty was performed using the temporalis fascia whereas in the second group (Group B), endoscopic myringoplasty was performed using the tragal cartilage. All the surgeries were carried out under local anesthesia.

Hearing assessment

For the hearing assessment, pure tone audiogram was performed using the MAICO MA 41 diagnostic audiometer (Germany) in sound treated double room setup was done within 7 days before the operation and 6 months after the operation. The audiological results were reported according to the American Academy of Otolaryngology Head and Neck Surgery (AAOHNS) guidelines.[11] The hearing was assessed by comparing pre with post-operative air bone gap (ABG) and ABG closure in speech frequencies (500 Hz, 1 KHz, 2 KHz, and 4 KHz).

For the surgery

Patient pre-operative preparation

The patients was given oral ciprofloxacin 500 mg 12 hourly from 1 day before surgery and continued till the 7th postoperative day. Since the surgery was performed under local anesthesia, the patients were sedated with pethidine and promethazine intramuscularly as per body weight.

Surgical steps

1. Injection of local anesthetic

In the operating ear, the four quadrants of the external auditory canal around the bony cartilaginous junction were injected with 5 ml of Injection lignocaine with epinephrine (1:2,00,000). The local anesthetic was also infiltrated around the area of the tragus or the temporalis fascia depending upon the graft selected for the surgery.

The rigid Hopkins endoscope (karl storz) 0 degree and 30 degree with 4 mm diameter and 18 cm in length was passed through the transcanal approach to assess the perforation size and site, ossicular chain mobility and the middle ear mucosa.

2. Refreshening the margin of the perforation

The margin of the perforation was then refreshened with the straight needle as shown in fig 1. The handle of the malleus was skeletonized after it was made visible.

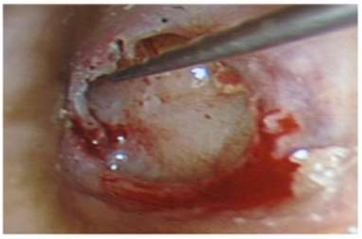

Figure 1. Refreshening the margin of the perforated TM.

3. Elevation of the tympanomeatal flap

The tympanomeatal flap was elevated using the round knife and the Plester flag knife. A lateral circumferential

incision was performed 4-6 mm lateral form the tympanic annulus. The incision was integrated with radial incisions at the 6 o'clock and 12 o'clock positions and then the tympanomeatal flap was elevated (fig. 2). During this step the hemostasis was maintained using the adrenaline soaked cotton ball.

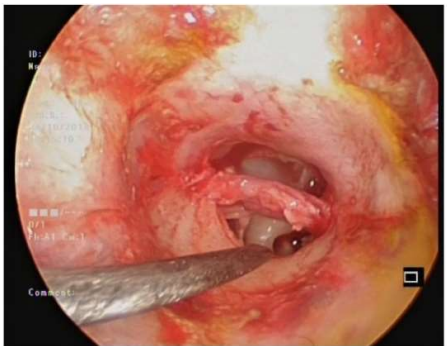

Figure 2. Endoscopic transcanal tympanomeatal flap elevation and access to the middle ear.

Harvesting of the autologous tragal cartilage

The tragal cartilage was obtained during the surgical procedure from the tragus as shown in figure 3. About 2 cm vertical incision was given by a number 15 blade from the incisura terminalis up to intratragal notch which was around 5 mm medial to the tip of the tragus. A single stroke skin incision was given upto the tragus cartilage. The assistant held the tissue with tip of the tragus by non-tooth forceps and maintained a bloodless field. The operating surgeon then dissected the tragal cartilage with the perichondrium with the help of fine tissue cutting scissors. The cartilage along with the perichondrium was than excised and kept upon a silastic graft board for readjusting the shape of the graft. The perichondrium was removed from the cartilage both anteriorly and posteriorly. The skin closure was done using prolene 4/0 by the simple interrupted technique.

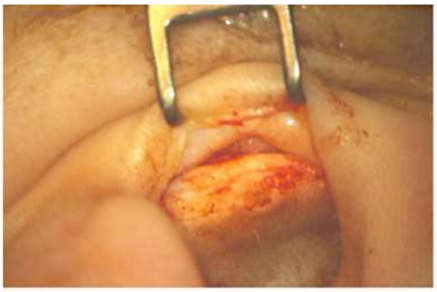

Figure 3. Incision being given over the tragal cartilage to obtain the cartilage graft.

Similarly, some part of the cartilage was removed to make a niche for the handle of the malleus that would snuggly fit in. The cartilage was then placed around the perforated tympanic membrane by first inserting on the anterior end of perforation by mounting on the crocodile forceps. Then the rest of the cartilage was placed in the middle ear using the straight needle (fig. 4). After that the repositioning of the tympanomeatal flap was done.

Harvesting of the temporalis fascia

Temporalis fascia was obtained during the surgical

Figure 4. Placement of the cartilage at the perforation site.

procedure. A separate transverse incision was placed above the pinna on the temporal region by a 15 number blade to obtain graft material from temporalis fascia (fig. 5). After obtaining the graft, it was spread onto a graft spreader and excessive muscle fibres, fat and fibrous tissue were removed. The temporalis fascia graft was then dried with a drier. The graft was then positioned at the perforation site using the underlay technique and the tympanomeatal flap was repositioned.

Figure 5. Incision being given over the temporalis fascia to harvest the fascia graft.

In both cases, the external auditory canal was packed with absorbable gel foam which was soaked in ciprofloxacin ear drops. Packing of the EAC was then done with ribbon gauze soaked in polymyxin B and Bacitracin ointment (Polysporin) and adhesive tape was applied. The temporalis fascia graft harvested site was also covered with dressing tape.

Post-operative care and follow up

All the patients were discharged on the same day of operation. They were prescribed tablet ciprofloxacin 500 mg 12 hourly for 7 days. The ribbon gauge pack and the stitch were removed on the 7th postoperative day. The remaining gelatin sponge was also suctioned on the 7th postoperative day. After that, the patient was prescribed chloramphenicol and dexamethasone ear drop for 6 weeks. The patient was again followed up after 6 weeks for observing the status of the graft and again on 6 months for the hearing result and graft uptake (fig. 6 and 7). A successful myringoplasty was defined as successful acceptance of the graft and intact healing of the TM without perforation, medialization or lateralization within a follow up period of six months from the operation.

Figure 6. **Post-operative view of cartilage graft after 6 months.**

Figure 7. **Post-operative view of temporalis fascia graft after 6 months.**

Data entry and analysis

Data entry was done by using Microsoft excel 2010 and was analyzed using international business machines (IBM) Statistical Package for Social Service version 25 (SPSS 25). Student's t test was used for the comparison of quantitative data with normal distribution between the two groups and the Mann Whitney U test was used for the comparison of variables which did not show normal distribution. Pearson's Chi-Square test and Fischer Freeman Halton test were used for comparing the qualitative data. A p value of less than 0.05 was taken to be statistically significant.

RESULTS

Out of fifty patients enrolled in the study, group A comprised of 25 patients who underwent endoscopic temporalis fascia myringoplasty whereas group B comprised of 25 patients who underwent endoscopic tragal cartilage myringoplasty. There were 19(38%) males and 31 (62%) females in the study.

All the patients in both the study groups came for follow up and no patients were lost in the follow up. The two cases in both the groups were excluded because of graft failure, so only 23 patients were included in both the groups.

Table 1. **Comparison of the sub data of two groups**

Variables	Group A (Temporalis fascia)	Group B (Tragal cartilage)	p value
Age (Years)	30.56±9.85	29.40±8.77	0.662
Gender			
Female	17 (68%)	14 (56%)	0.525
Male	8 (32%)	11 (44%)	
Operated side			
Right	10 (40%)	12 (48%)	0.516
Left	15 (60%)	13 (52%)	
Graft status			
Uptake	23 (92%)	23 (92%)	1.000
Failure	2 (8%)	2 (8%)	
Mean operation time(minutes)	53±6.4	51±3.8	0.987
Mean follow up time (weeks)	24±2.3	24±1.2	0.922

The comparison of sub data of two groups were as shown in table 1. The patients were divided into different age groups. The mean age in group A was 30.56±9.85 years whereas in group B, it was 29.40±8.77 years.

In group A, male patients were 8(16%) and female patients were 17 (34%). So the male to female ratio was 1:2.1 whereas in group B, male patients were 11 (22%) and female patients were 14 (28%). So the male to female ratio was 1:1.2. The mean operation time and mean follow up were also as shown in table 1.

The comparison of ABG and hearing gain (ABG closure) in both group A and B were as shown in table 2.

Table 2. **Comparison of ABG and hearing gain.**

Variables	Pre-operative ABG	Post-operative ABG	p value	Hearing gain (ABG closure)	p value
Group A (n=23)	35.11±8.43	23.78±8.75	0.007	11.33±0.32	0.765
Group B (n=23)	37.82±10.82	23.26±9.60	0.01	14.56±1.22	

DISCUSSION

Myringoplasty is one of the most common surgery performed in otolaryngology. The main purpose of the myringoplasty is to provide a dry ear and restore the hearing loss due to the tympanic membrane perforation. It was first described by Berthhold in 1878. Since then numerous techniques have been developed and various graft materials have been used for repairing the TM perforation.

The use of the endoscope in myringoplasty is in rising trend. They are ideal in conditions of bony canal overhang and narrow tympanomeatal angle. They offer the advantage of wider field of view and better depth perception.[1,4]

At the present moment, temporalis fascia is the most commonly used graft material for the reconstruction of the tympanic membrane. Its success as shown in various studies ranges from 70% to 95%.[1,4] However its use can be challenging in situations like atelectasis, revision surgeries, pediatric population and the anterior perforations as the graft tends to reabsorb and retract in due course. So, the cartilage scores the fascia in such situations. Hence, we had compared the temporalis fascia with cartilage to observe the graft uptake rate and audiological results.

The age group in our study ranges from 18-60 years with the mean age of 30.56±9.85 years in group A and 29.40±8.77 years in group B.

In the study performed by Mohanty et al. the mean age for the temporalis fascia group was 35.9±10.57 years whereas for the tragal cartilage group it was 34.63±12.27 years.[12] In another study performed by Chozhan et al. the mean age for the temporalis fascia group was 35.9±10.87

years whereas for the tragal cartilage it was 34.63±12.74 years.[13] In the study performed by Lou ZC, the mean age was 35±2.07 years in temporalis fascia graft whereas in the tragal cartilage grafts it was 34.6±1.30 years.[14] The distribution of age in our study is comparable with above studies. The higher incidence of perforation in the 21-35 years age group in our study could be due to the small sample size as well as the most of this age group being young, educated and concerned with their health.

In our study, there were 8 (32%) male patients and 17 (68%) female patients in group A and 11 (44%) male and 14 (56%) female patients in group B.

In the study done by Lou et al. there were 25 males and 42 females in the temporalis fascia group whereas there were 28 males and 39 females in the tragal cartilage group.[14] The other studies did not show any difference in a male and female patients ratio.[13,15,16]

The difference in the gender distribution in our study may be the dominance of female population in our community. The graft uptake rates in both groups were 92% (23) whereas the failure rates in both the groups were 8% (2). There were no statistically significant difference noted in graft success and failure rates between the two groups (p=1). The graft failures in our study were due to recurrent upper respiratory tract infections leading to recurrent episodes of middle ear infections in both the groups. The graft uptake rate in our study in both groups was comparable to different studies in the literature as shown in table 3.

Table 3. Graft uptake rates in different studies in the literature

Authors	Graft uptake rate		p value
	Temporalis fascia	Tragal cartilage	
Mohanty et al.[12]	79% (79/100)	91.9% (80/87)	0.51
Lou[14]	98.5% (63/67)	94% (66/67)	0.362
Chozhan et al.[13]	80% (24/30)	93% (28/30)	0.127
Keseroglu et al.[15]	90.7% (39/43)	89.8% (62/69)	1.000
Khan et al.[16]	87.42% (146/167)	97.5% (219/223)	0.01
Vadiya et al.[17]	89.64% (69/77)	98.46% (64/65)	0.0031
Yegin et al.[18]	65% (26/40)	91.3% (35/38)	0.009
Mohsen et al.[19]	90% (18/20)	95% (19/20)	< 0.05
Our study	92% (23/25)	92% (23/25)	1.000

The reason for the comparable graft uptake rate between the two groups could be due to the remodeling effect of the tragal cartilage where it gains elasticity similar to temporalis fascia over a long course of time. Additional benefits of the cartilage could be its better resistance to infection. It is also more suitable in conditions such as eustachian tube dysfunction, adhesive otitis media and subtotal perforation as it is tougher and provides better stability against retraction.[22]

Regarding the hearing assessment in our study, in temporalis fascia (Group A) the mean pre-operative ABG was 35.11±8.43 dB and the post-operative ABG was 23.78±8.75 dB (p=0.007). This showed statistically significant result. In a similar study performed by Mohanty et al. the mean pre-operative ABG in the temporalis fascia group was 28.33±4.48 dB whereas the mean post-operative ABG was 13.87±6.64 dB which was statistically significant (p= 0.01).[12] The study performed by Chozhan et al. showed that the mean pre-operative ABG in the temporalis fascia group was 48.33±4.66 dB whereas the mean post-operative ABG was 32.10±9.10 dB.[13] Likewise, study performed by Lou et al. the mean pre-operative ABG was 23.26±8.34 dB in the temporalis fascia group whereas the mean post-operative ABG at 6 months was 11.35±3.27 dB which was found to be statistically significant (p=0.001).[14] Another study performed by Khan et al. showed that the mean pre-operative ABG was 32.91±4.88 dB whereas the post-operative ABG was 6.97±2.11 dB on 6 months follow up.[16] Study performed by Vadiya et al. conclude that the pre-operative ABG was 34.48 dB whereas the post-operative ABG was 17.05 dB.[17] Yegin et al. showed that the mean pre-operative ABG was 33.68±11.44 dB whereas the post-operative ABG was 24.25±12.68 dB (p=.001).[18]

The postoperative hearing results in our study are comparable to different studies as shown above. The advantage of using temporalis fascia is that it has a close resemblance to the tympanic membrane. It can also provide a bigger graft when required especially for subtotal perforation. It has a low basal metabolic rate, good graft uptake results and good hearing outcome.

In our study, the mean pre-operative ABG in the tragal cartilage group was 37.82±10.82 dB and the mean post-operative ABG was 23.26±9.60 dB. This showed a statistically significant result following endoscopic myringoplasty in group B (p=0.01).

In the similar study done by Mohanty et al. in the tragal cartilage graft group, the mean pre-operative ABG was 28.33±4.48 dB whereas the mean post-operative ABG was 13.87±6.67 dB.[12] The difference was statistically significant (p=0.001). The study performed by Chozhan et al. showed that the mean pre-operative ABG in the tragal cartilage group was 47.47±4.94 dB whereas the mean post-operative ABG was 29.80±5.34 dB.[13] Likewise, the study performed by Lou et al. the mean pre-operative ABG in the tragal cartilage group was 24.15±7.84 dB whereas the post-operative ABG at 6 months was 10.12±2.43 dB which was found to be statistically significant (p=0.001).[14] In another study performed by Khan et al. showed that the mean pre-operative ABG was 30.68±4.77 dB whereas the post-operative ABG was 6.79±2.52 dB on 6 months follow up.[16] Study performed by Vadiya et al. conclude that the mean pre-operative ABG was 33.93 dB whereas the post-operative ABG was 16.23 dB.[17] Yegin et al. showed that the mean pre-operative ABG was 35.68±12.94 dB whereas the post-operative ABG was 26.11±12.87 dB (p=.001).[18]

The post-operative hearing results in our study are comparable to different studies as shown above. The advantage of using tragal cartilage could be its resistance to infection, its location near to the surgical site and the absence of need for head shaving which is more preferable for the female patient. Its possible disadvantages may include decreased middle ear volume and the possibility for the absence of hearing gain as the cartilage is rigid (which we did not find in our study and also different studies in the literature as mentioned above). The hearing gain could be due to resorption of chondrocytes in long term.[16]

In our study, the ABG closure using the temporalis fascia graft was 11.33±0.32 dB. Whereas the ABG closure using the tragal cartilage graft was 14.56±1.22 dB. The difference in hearing gain between the two groups were not statistically significant (p=0.765).

In the study done by Mohanty et al. the hearing gain using the temporalis fascia was 15.26±5.56 dB whereas in the tragal cartilage graft, it was 17.52±3.84 dB.[12] Study performed by Chozhan et al. showed the hearing gain in the temporalis fascia group was 16.23±8.72 dB and the hearing gain in the tragal cartilage group was 17.67±6.30 dB.[13] Similarly, the study done by Lou et al. the hearing gain in the temporalis fascia group was 14.28±8.41 dB, whereas in the tragal cartilage group, it was 12.12±5.92 dB.[14] In another study performed by Khan et al. showed that the audiological gain of 8.05 dB in temporalis fascia group whereas 7.10 dB gain in tragal cartilage group.[16] The hearing gain (ABG closure) was not statistically significant (p=0.05).

Yegin et al. showed that the hearing gain in the temporalis fascia group was 9.42±8.91 dB and the hearing gain in the tragal cartilage was 12.57±9.34 dB.[18] The hearing gain (ABG closure) was not statistically significant (p=0.968).

The hearing gain (ABG closure) in both the groups in different studies was comparable to our study. The reason of good hearing gain in cartilage, though it was of full thickness, may be due to the softening of the cartilage over time due to degeneration of chondrocytes. So, the hearing gain is comparable with temporalis fascia. It is also resistant to infection; hence, graft success rate is also comparable to that of temporalis fascia.

This study helps to establish the importance of tragal cartilage as par temporalis fascia in repair of tympanic membrane and hearing results. However there are certain limitations like; the small sample size, the shorter duration and a single institutional study. So we recommend that the larger population sample size with multi-institutional study will provide the significant results and long term results will show the fate of cartilage and fate of temporalis fascia in graft uptake status and hearing results.

CONCLUSION

Since the graft uptake rate and hearing results of the tragal cartilage graft is comparable with temporalis fascia graft, so the cartilage graft can be used in a condition wherever required without any hesitation.

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