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Original Research Article

A comparative evaluation of graft uptake and audiological results of temporalis fascia graft vs reinforced sliced tragal cartilage in type 1 tympanoplasty

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ABSTRACT

Background: Numerous grafting materials have been applied for repair of tympanic membrane (TM) in chronic otitis media patients. This study aimed to compare the anatomical and audiological results of temporalis fascia alone versus reinforced sliced cartilage in type 1 tympanoplasty.
Methods: A prospective study was conducted on 50 patients of age group 15-55 years. Patients were randomly divided into two groups, each group having 25 patients. In group I patients under went type I tympanoplasty with temporalis muscle fascia alone and group II patients with sliced tragal cartilage reinforced to temporalis fascia. Post operatively all patients were followed on 30th, 60th and 90th day. In the last follow up, assessment of graft uptake was done and pure-tone audiometry was performed to evaluate air-bone gap closure. The data so obtained were collected and analysed using appropriate statistical tests.
Results: Overall graft uptake rate in group I (TF alone) was 84%, whereas in group II (TF+ reinforced sliced cartilage) was 92% (p=0.5). The mean post op ABG improved to 16.17±6.26 dB and 16.56±5.25 dB respectively in group I and II. There was significant hearing improvement in each group but no statistical significant difference was observed in post-op ABG between the two groups.
Conclusions: Reinforced sliced tragal cartilage technique is a good alternative to temporalis fascia alone in terms of graft uptake and prevention of disease recurrence, especially for large and subtotal perforations but additive effect of cartilage slicing in hearing gain still remains little controversial.

Keywords: Tympanoplasty, Temporalis fascia, Reinforced sliced cartilage

INTRODUCTION

Perforation of the tympanic membrane (TM) prevails as one of the common pathologies in otology practice. The most common cause of TM perforation is chronic suppurative otitis media (CSOM) followed by other causes of sudden perforation like direct trauma from diving and flying, blast injury, direct slap, self-cleaning of the ear using sharp articles and iatrogenic injury to TM.[1] Probable complications that can occur if perforations are not treated early includes mastoiditis, facial nerve paralysis, intracranial infections etc.[2,3]

Reconstruction of the TM or tympanoplasty is indicated to restore the hearing loss and to help prevent recurrence of infection by closing off the middle ear space.[4] Grafting materials used for closure of the TM includes fascia, areolar tissue, periosteum, perichondrium, cartilage, vein, skin, and fat tissue.[5,6] Temporalis fascia being the most favored grafting materials due to its anatomical proximity, low basal metabolic rate and translucency.[7] However, in the presence of advanced middle-ear pathology, retraction pockets and atelectatic ears, temporalis fascia tends to undergo post-operative atrophy

regardless of the placement technique.[6,7] Thus associated with increased failure rate in high-risk cases.[8,9]

Cartilage being a brady trophic tissue allows steady and functionally reliable reconstruction of the ear drum. Due to its low metabolic rate, minimal inflammatory reaction and resistance against pressure variations, it has widely gained popularity in re-perforation and retraction cases, especially in the presence of continuous Eustachian tube dysfunction.[10,11]

However, its rigidity is thought to hinder the acoustic transfer post-surgery, thus the concept of slicing the cartilage to improve acoustic gain came into existence.[12] Zahnert et al showed for ideal acoustic transfer performance, the cartilage should be cut as thinly as possible.[13,14] It has been seen that the cartilage disk thickness of 500 um (0.5 mm) has an E-modulus similar to that of TM.[15]

But hand slicing of cartilage into thin slices with a homogeneous thickness is extremely difficult. Therefore, this struggle has driven the surgeons to employ devices that could accurately slice the cartilage. The cartilage slicer possesses features like durable unibody design, capability to slice cartilage without damage, ease of use, adjustable cartilage thickness options, and low cost and practicality.[16]

In this study we have comparatively evaluated graft uptake and audiological result between temporalis fascia graft alone versus reinforced sliced tragal cartilage to temporalis fascia in tympanoplasty type 1.

METHODS

In this prospective study, a total of 50 patients of age group 15-55 years and random gender presenting with COM to department of ENT and head and neck surgery, government medical college and Rajindra hospital, Patiala from year 2018-2020 were included. Patients were randomly divided into two groups, each group having 25 patients. In group I patients under went type I tympanoplasty with temporalis muscle fascia alone and group II patients with sliced tragal cartilage reinforced to temporalis fascia.

The approval and permission from the local ethics committee and authority was obtained prior to starting the study. Patients were assessed with detailed clinical history and examination after informed consent. Routine laboratory investigations were done. All patients were subjected to pre-operative audiometric evaluation (PTA). Pre anaesthetic checkup was routinely done.

Inclusion criteria were patients of both sexes of age between 15 to 55 years presenting with TM perforation due to chronic otitis media, recurrent middle ear infection, in which ossicular systems are mobile and intact, dry ear for last one month.

Exclusion criteria were CSOM with attico-antral type, disease causing disruption and damage to ossicular chain like tympanosclerosis, middle ear atelectasis, middle ear tumors, congenital cholesteatoma and patient not willing for surgery.

The selected cases underwent tympanoplasty type 1 under either general anaesthesia or local anaesthesia with monitored anaesthetic care. Post aural approach was used in all cases.

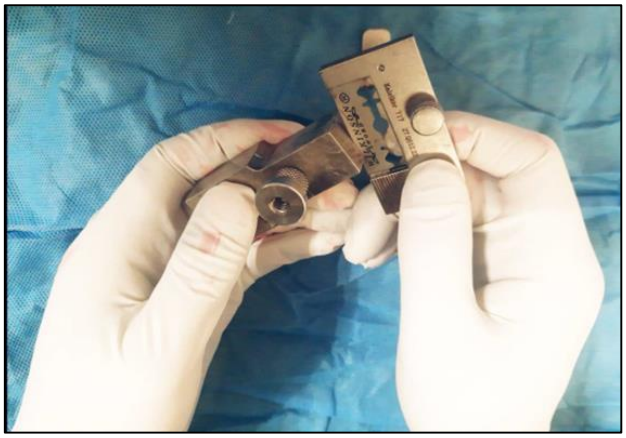

Figure 1: Slicing tragal cartilage using cartilage slicer.

Under standard aseptic conditions the patient were appropriately draped. The post-auricular area was infiltrated with 1% xylocaine with 1:100000 adrenaline. In group I patients, temporalis fascia graft was harvested through the post-auricular incision. In patients of group II, temporalis fascia graft was harvested through post auricular incision and for tragal cartilage, incision was made slightly posterior to the free edge of the tragus to expose the cartilage. The cartilage graft so obtained was thinned to 0.5 mm with the help of a precise cartilage slicer. Under operating microscope edges of the perforation in the pars tensa was freshened with the help of a sickle knife, tympanomeatal flap elevated up to the annulus after giving 6'O clock through 12'O clock incision. In patients of group I, temporalis muscle fascial graft was placed by underlay technique. In group II patients the sliced tragal cartilage graft of 0.5 mm thickness was placed by underlay technique in a meticulous manner after filling the middle ear with gel foam. Temporalis fascia was then placed lateral to the sliced tragal cartilage by underlay technique. Tympanomeatal flap was re-positioned. Gel foam placed over the graft. Meatal pack was placed and post auricular incision was sutured and mastoid bandage done.

All patients were put on injectable antibiotics, analgesics, and anti-histaminics in the post-operative period for the first three days. The patients were then shifted to oral antibiotics on fourth post-operative day for 1 week. All patients were instructed to take adequate precautions to prevent entry of water into the ear canal. Skin stitches were removed after seven days.

Post operatively all patients were followed in the OPD on 30th, 60th and 90th day. During the follow-up visit, healing of the surgical wound, presence or absence of any ear discharge and appearance of any new symptom were assessed. At the end of follow-up period on 90th post-operative day the external auditory canal was cleaned and status of the TM was examined to look for healing/non-healing of the perforation. Pure-tone audiometry was done at 3 months and to evaluate air-bone gap closure. The data so obtained were collected and analysed using appropriate statistical tests.

RESULTS

From May 2018 to January 2020, 50 ears underwent tympanoplasty type 1; 25 patients using a temporalis fascia alone in group I and 25 patients using sliced tragal cartilage reinforced with temporalis fascia graft in group II, with a minimum follow up of 3 months. Chi square and unpaired Student's t test was used for statistical analysis.

In group I, out of 25 patients, 16 (64%) patients were male and 9 (36%) were female with a M:F ratio of 0.5. In group II, out of 25 patients, 11 (44%) patients were male and 14 (56%) were female with M:F ratio of 1.2. In group I, maximum patients were in age group of 36-45 years (32%) with a mean age 35.4±10.4 years. In group II maximum patients belongs to age group of 26-35 years (32%) and 36-45yrs (32%) with a mean age of 33.04±10.48 years. In both groups, the most common symptom was ear discharge with hearing loss with 21 (84%) patients in group I and 24 (96%) patients in group II. In temporalis fascia group, 11 (44%) patients had large perforation followed by 8 (32%) patients with medium perforation, 3 (12%) patients with small perforation and 3 (12 %) patients with subtotal perforations.

Overall graft uptake rate in group I was 84%, whereas in group II patients had an uptake rate of 92% (p=0.5). In group I, successful graft uptake of 100% was seen in small and medium size perforation and 92% each in large size perforation and subtotal perforation. However, in group II, successful graft uptake of 100% was seen in small, medium size and subtotal perforation except in large perforation which had a graft uptake rate of 92%.

The mean improvement in post- operative PTA was 29.24 ± 8.69 dB in group I and 28.81±6.17 dB in group II. The mean post op ABG improvement in group I and group II was 16.17±6.26 dB and 16.56±5.25 dB respectively. There was significant hearing improvement in each group but no statistical significant difference was observed in post-op ABG between the two groups.

DISCUSSION

Two important goals which should be fulfilled post tympanoplasty are: closure of the perforation and acquiring a new TM with acoustic qualities similar to that of normal TM.[13] Temporalis fascia has been the most favored grafting material.[6] However, due to its disorderly arrangement of loose elastic fibers, shrinkage of temporalis muscle fascia becomes unpredictable especially in the presence of advanced middle-ear pathology or in high risk perforations.[6,7,18] Cartilage being a bradytrophic tissue allows more stable and functionally reliable reconstruction of the ear drum ,particularly in cases of chronic Eustachian tube dysfunction and total or recurrent perforation of the TM.[10,18]

However, full thickness cartilage had poorer sound conductivity in response to low-frequency sounds, which could be enhanced by reducing the cartilage thickness.[13] Thus For ideal acoustic transfer performance, the cartilage should be cut as much thin as possible.[19]

Still there is lack of evidence in literature to ascertain the role of sliced cartilage in hearing outcomes and graft uptake success rate in tympanoplasties. Thus, this study aimed to evaluate the graft uptake rate and hearing improvement in type 1 tympanoplasty using temporalis muscle alone and reinforced sliced tragal cartilage to temporalis fascia in a total of 50 patients. In our study, the overall success of graft uptake in group I (temporalis fascia) was 84% whereas in group II (temporalis fascia+sliced cartilage) graft uptake was 92%. No statistically significant (p=0.535) was observed in graft uptake between these two groups.

These results can be compared with other similar studies; where Telang et al reported a 93.3% successful graft uptake in temporalis fascia group as compared to the sliced cartilage (0.5 mm) group which had 96.7% successful graft uptake with no statistically significant between the two groups.[20]

Similarly, Khan et al reported that sliced cartilage (0.5 mm) group had a graft uptake rate of 98.20% at postoperative 2nd year and 97.7% at postoperative fourth year. Whereas in the temporalis fascia group, graft uptake rate was 87.42% and 82.63% respectively at 2nd and fourth postoperative year with no significant statistical difference.[21]

In our study in group I, successful graft uptake of 100% was present in small and medium size perforation and maximum failure of graft uptake was seen in large size perforation and subtotal perforation, each with failure rate of (8%). Whereas, in group II, successful graft uptake of 100% was present in small, medium size and subtotal perforation and maximum failure of graft uptake was seen in large perforation with a failure rate of 8%. No significant difference was observed in graft uptake according to size of perforation between the two groups.

Our findings were similar to study conducted by Uslu et al (Table 1) where they reported a success rate of 78.3% with cartilage reinforcement technique for TM healing. In their study 17 patients had perforation >75% of total TM

diameter preoperatively and 15 of them healed with no perforation; 1 of them had a perforation <25% of total TM diameter and 1 of them had a perforation between 50% and 75% of total TM diameter. Their study showed that the cartilage reinforcement technique had a more success rate in subtotal or total perforations.[21]

In another study conducted by Singh et al in group I (temporalis fascia), there was a 100% graft uptake in small perforation followed by 85.71% in medium perforation, 80% in subtotal perforation and least graft uptake in big central perforations with 66.66%. However, in group II (reinforced sliced conchal cartilage) there was a 100% graft uptake rate in all sizes except for medium-sized perforations (83.33%).[22]

Table 1: Graft uptake in various studies.

Study name	Temporalis fascia group (%)	Cartilage group (%)
Khan et al[7]	87.42	98.20
Singh et al[22]	85	95
Telang et al[20]	93.3	96.7
Vadiya et al[24]	89.61	98.46
Chhapola et al[25]	95.77	98.36
Ozbek et al[26]	70.2	100
Our study	84	92

Considering the audiological outcome, in our study, successful post-operative hearing improvement was considered if the postoperative ABG was within 20dB. In Group I, mean pre-op ABG was 22.92±6.09 dB and mean post op ABG was 16.17±6.26 dB with a hearing gain of 6.69±3.74 dB. Whereas In TF+ Sliced cartilage group, mean pre op ABG was 24.28±6.27 dB and post op ABG was 16.56±5.25 dB with a hearing gain of 7.72±3.58 dB. There was a significant hearing improvement in each group but no significant difference (p>0.5) was observed in post-operative ABG between the two groups.

Our results were similar to a study reported by Kim et al where in temporalis fascia group, mean pre-operative and post-operative ABG was 28.74±6.92 dB and 19.03±9.23 dB respectively with a hearing gain of 9.71±8.94 dB as compared to cartilage group with a mean pre-operative and post-operative ABG of 28.62±10.16 dB and 18.84±12.14 dB respectively with a hearing improvement of 9.78±15.25 dB. No statistically significant difference was observed between the two groups.[23]

Likwise, in a study conducted by Khan et al at 4 years of follow up, the average ABG was 7.103.10 dB in sliced cartilage group and 8.05±3.22 dB in temporalis fascia group respectively, with no significant p value between these groups. This result showed that tympanoplasty using sliced tragal cartilage achieves an acoustic benefit comparable with that of temporalis fascia tympanoplasty. The better audiological outcome in this study as compared to our study may be credited to longer follow up period of 4 years.[21]

In a study by Vadiya et al the average pre-operative and post-operative ABG at speech frequencies was 33.99 dB and 16.23 dB respectively in the temporalis fascia group whereas in modified cartilage group the average pre-operative and post-operative ABG was 34.48 dB and 17.05 dB respectively. The hearing improvement between the two groups was almost equivalent except at 8000Hz where hearing improvement was found to be better with the use of temporalis fascia alone.[24]

In contrary in a study by Zahnert et al it was shown that the acoustic transfer loss of cartilage can be reduced by decreasing its thickness. A thickness of 500 microm was regarded as a good compromise between sufficient mechanical stability and low acoustic transfer loss.[13]

Hence in our study we demonstrated that the the overall graft uptake rate of reinforced sliced tragal cartilage was comparable to temporalis fascia but for hearing gain improvement more studies are encouraged to establish the role of cartilage slicing in providing extra acoustic benefit in tympanoplasty surgeries.

The limitation of this study can be attributed to small sample size i.e., 50 patients and shorter follow up period of 3 months (12 weeks). A larger sample size with a longer follow-up is needed to see long term efficacy of reinforced sliced cartilage over temporalis fascia alone.

CONCLUSION

Thus, in our study we found, that the reinforced sliced tragal cartilage is a good alternative to temporalis fascia alone in terms of graft uptake and prevention of disease recurrence, especially for large and subtotal perforations but the additive effect of cartilage slicing in hearing gain still remains little controversial.

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