

## Original Research Article

# Palisade cartilage fascia tympanoplasty: our experience

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### ABSTRACT

**Background:** Cartilage tympanoplasty is one of the procedures performed for treatment of tympanic membrane perforation, more so in those cases associated with eustachian tube dysfunction, or failed previous temporalis fascia type 1 tympanoplasty. Palisade cartilage tympanoplasty, initially described by Heerman utilizes strips of conchal cartilage to reconstruct the tympanic membrane.

**Methods:** A retrospective study which was presented with 64 patients who underwent palisade cartilage- fascia type I tympanoplasty and compared their hearing outcome after three years of post-operative period. Indication to perform a cartilage-fascia tympanoplasty was either an atelectatic middle ear or large perforation of the drum or residual or recurrent perforation following previous temporalis fascia myringoplasty.

**Results:** Average pre-operative hearing loss was  $37.38 \pm 15.04$  dB, while post-operative hearing loss was  $20.47 \pm 8.85$  dB, giving an average gain of 17.03 dB. Of 64 patients, 93.7% patients had fully healed neotympanum.

**Conclusions:** Palisade cartilage fascia tympanoplasty is an effective method to ensure graft uptake and at the same time achieve competitive hearing gain. The reliability of this technique lies in its use for recurrent and residual perforations of the tympanic membrane as well as in cases associated with eustachian tube dysfunction.

**Keywords:** Large central perforation, Neotympanum, Chronic otitis media, Eustachian tube dysfunction, Atelectasis, Myringoplasty, Cartilage fascia tympanoplasty

### INTRODUCTION

Tympanoplasty has evolved significantly since its introduction by Wullstein in 1952.<sup>1</sup> It has been classified several times in order to establish the relation of the graft with respect to the ossicular chain in the middle ear. Out of the types of tympanoplasty procedures described, type 1 tympanoplasty or myringoplasty is the most commonly done procedure for repair of the tympanic membrane. The graft is placed either by underlay, overlay or interlay technique to close the perforation, commonly caused by chronic otitis media. The grafts commonly used are vein, temporalis fascia, autologous or homologous cartilage and perichondrium. Of these, temporalis fascia graft and conchal and tragal cartilage grafts are commonly used for myringoplasty.<sup>2</sup>

Temporalis fascia graft although beneficial in many patients, is associated with post-operative complications like residual perforation or re-perforation or retraction of neotympanum, especially in those patients who have eustachian tube dysfunction.<sup>3</sup> This is postulated to be due to irregular shrinkage of the temporalis fascia graft.<sup>4</sup>

Alternatively conchal and tragal cartilage grafts were used. Due to its inherent rigidity it resists the negative pressure generated by eustachian tube dysfunction and prevents postoperative retraction of neotympanum.<sup>5</sup> Various authors have described different variations of performing cartilage tympanoplasty. There are 23 known methods of cartilage tympanoplasty. Tos has subdivided them into 6 groups (group A to group F).<sup>6</sup> Owing to the rigidity and thickness of the cartilage graft, it was considered that it would hamper middle ear volume and

sound transfer mechanism. However recent studies have shown that there is no significant difference in post-operative hearing with use of cartilage and temporalis fascia.<sup>7-9</sup>

The study was conducted to assess the morphological and functional outcome of palisade cartilage-temporalis fascia tympanoplasty done in our institution between 2014-2015.

## METHODS

This was a retrospective study performed in the Department of Otolaryngology at a tertiary institute in India. The audiological records of all the patients were obtained from Medical Records Department for the comparison with post-operative hearing thresholds. 89 cases were operated between January 2014 to December 2015 by palisade cartilage fascia tympanoplasty, of which 25 patients were excluded from the study due to non-adherence to the follow up protocol and inadequate records, remaining 64 patients were included in the study. This study includes only those cases which were operated for central perforation of the tympanic membrane without any ossicular pathology.

### Follow up protocol

Patients were followed up weekly for the first month, fortnightly for the next month and monthly for next two months to examine the healing of the graft. Pure tone audiometry assessment was done at third month post operatively and then repeated after 3 years of surgery.

Indications for cartilage tympanoplasty are recurrent or residual perforation of neotympanum, large or subtotal central perforation of the tympanic membrane and atelectatic middle ear.

### Procedure of palisade cartilage fascia tympanoplasty

Patients were given pre-medication using Inj. pethidine, Inj. promethazine and Inj. glycopyrrolate administered intramuscularly, 30 minutes before starting the procedure. Surgery was performed under local anesthesia using 2% lignocaine with 1 in 2 lakh adrenaline infiltrated in the postaural region and within 4 quadrants of the external auditory canal. Post aural Wilde's incision was given, temporalis fascia and conchal cartilage graft of suitable size was harvested by Heerman's technique.<sup>10</sup> Conchal cartilage graft was cut into strips of 2 mm × 9 mm.

12 o'clock and 6 o'clock canal wall incisions were given and posterior canal wall skin was elevated up to the annulus, the annulus was lifted and middle ear was entered. After confirming ossicular continuity and round window reflex, strips of cartilage were placed parallels in the middle ear extending from anterior margin of the remnant to posterior under the annulus. Temporalis fascia graft was placed by underlay technique medial to handle

of malleus, draping the lateral surface of palisades of cartilage. Canal skin was repositioned back and gel foam was placed in the external auditory canal. Surgical dressing and sutures were removed after one week.

Data was compiled and statistical analyses was done using SPSS version 14.0.

## RESULTS

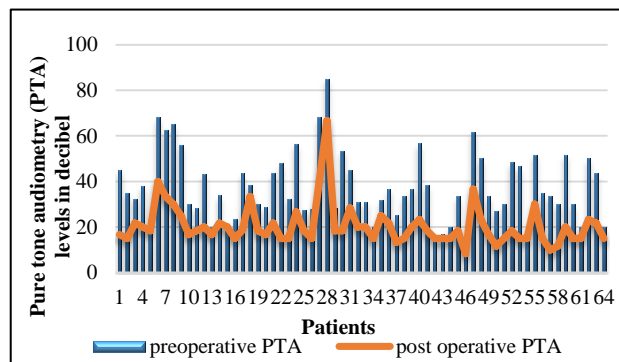
There were total of 89 patients operated in 2014-2015 by palisade cartilage fascia tympanoplasty. Of this only 64 patients followed the required post-operative protocol and were selected for the study. Out of 64 patients, 28 were males and 36 were females.



**Figure 1: Intraoperative showing strips of conchal cartilage graft arranged by palisade technique and tympanomeatal flap.**

The age group ranged from 17 to 60 years, with mean age of 34.86 with standard deviation of 10.70. Majority (54.7%) of the patients were between 25 to 45 years of age.

Out of 64 patients, 22 (34.37%) had bilateral chronic otitis media, 38 (59.4%) had unilateral disease while 4 (6.25%) had a re-perforation or residual perforation following prior type 1 tympanoplasty using temporalis fascia graft. There were no patients with atelectasis.



**Figure 2: Comparison between preoperative and post-operative air-bone gap in individual patients.**

Pre-operative average hearing loss (air-bone gap/ABG) tested by pure tone audiometry at 500, 1000 and 2000 Hz was  $37.38 \pm 15.04$  dB. Postoperative pure tone audiometry repeated after 3 years revealed average hearing loss (air-bone gap/ABG) at 500, 1000 and 2000 Hz of  $20.47 \pm 8.85$  dB (Figure 2). The average post-operative gain was 17.03 dB. The study was statistically analysed and had a p value of less than 0.01, thus was statistically significant. Two patients did not have desirable hearing/acoustic gain probably secondary to tympanosclerosis involving round window and promontory, however they had a healed neotympanum.

Of all the patients operated, 4 patients (6.3%) had a residual perforation. Two patients developed post-operative upper respiratory tract infection within a week following the surgery possibly causing the residual perforation whereas the cause of residual perforation was not known in the other two patients.

**Table 1: Summary.**

<b>Total number of patients</b>	89
<b>Patients fulfilling the inclusion criteria</b>	64
<b>Mean age (in years)</b>	$34.86 \pm 10.7$
<b>Male: female ratio</b>	1:1.3
<b>Preoperative ABG</b>	$37.38 \pm 15.04$ dB
<b>Post-operative ABG (after 3 years)</b>	$20.47 \pm 8.85$ dB
<b>Average post-op gain</b>	17.03 dB
<b>Postoperative recurrence or reperforation (complication)</b>	6.30%
<b>Graft uptake rate</b>	93.7%

ABG = Air bone gap.

## DISCUSSION

The term tympanoplasty was first introduced by Wullstein in 1953, to describe surgical techniques for reconstruction of middle ear hearing mechanism that had been impaired or destroyed by chronic ear disease. He also described 5 types of tympanoplasty procedures, depending on the involvement of various middle ear structures.<sup>1</sup> Subsequently throughout the history of the surgery for the repair of middle ear hearing mechanisms tympanoplasty has evolved significantly over the years with improved understanding of middle ear acoustics and introduction of various surgical techniques and instrumentation.

Chronic otitis media is one of the commonest causes of perforation in the tympanic membrane. The size of perforation is determined according to area of the ear drum involved. It is classified into small (<25% of drum), medium (25-50%) and large (>50% of the ear drum involved) size perforation.<sup>11</sup> It is believed that size of the perforation correlates quantitatively with the degree of hearing loss, however it is now proven, that the size of the perforation is not the only criteria determining the

degree of hearing loss.<sup>12-14</sup> In our study, 48.4% of patients had large or subtotal central perforation and their pure tone audiometry showed only a mild conductive hearing loss with an average air bone gap of 32.8 dB.

Myringoplasty or type 1 tympanoplasty involves the repair of the tympanic membrane and re-establish the middle ear hearing mechanism. This can be done using various grafts to close the perforation in the ear drum. Of which temporalis fascia graft has been commonly used by virtue of its thickness and ease of harvesting.<sup>15</sup> On the other hand, cartilage tympanoplasty has gained popularity in the recent times for closure of tympanic membrane perforation because of its superior postoperative results.<sup>5</sup>

Various techniques have been described to perform a cartilage tympanoplasty. Tos has classified 23 different variations of cartilage tympanoplasty procedures into 6 groups (A to F).<sup>6</sup> Palisade cartilage tympanoplasty falls in Group A. The palisade technique specifically involves placement of 0.5-3 mm thick pieces of cartilage placed side by side, under the TM remnant until the defect is covered.<sup>16</sup>

Our study has been conducted mainly to see the effectiveness of palisade cartilage tympanoplasty and compare the pre-operative ABG vs post-operative ABG (done 3 years post-surgery) and the condition of neotympanum after a period of 3 years following the procedure, thus demonstrating the benefits of the surgery. The decision of using palisade cartilage tympanoplasty was restricted to patients with large or subtotal central perforation of the tympanic membrane, revision cases and atelactic middle ear or a known eustachian tube dysfunction.<sup>16,17</sup>

In one of the largest series of 1000 cartilage tympanoplasty procedures conducted by Dornhoffer, 215 patients underwent myringoplasty and showed pre-operative ABG of  $21.7 \pm 13.5$  dB while the postoperative value was  $11.9 \pm 9.3$  dB, signifying a clear improvement in hearing.<sup>18</sup> Another study done by Sohil, hearing evaluation done after 6 months showed an improvement in air-bone gap from a preoperative value of 37 dB to post-operative value of 18.6 dB with an average gain of 18.4 dB following a shield cartilage tympanoplasty.<sup>19</sup>

A comparative study done by Khan et al (cartilage vs temporalis fascia consisting of 400 patients) showed that at the four-year follow up, the average air-bone gap was  $7.10 \pm 3.01$  dB in the cartilage group and  $8.05 \pm 3.22$  dB in the temporalis fascia group.<sup>20</sup> Similarly a study reported by Demirpehlivan et al who has compared results of temporalis fascia vs cartilage island graft vs palisade cartilage graft for myringoplasty showed a pure tone average of 24.54 dB for the perichondrium or cartilage island flap group, 24.51 dB for the fascia group and 23.23 dB for the cartilage palisade group.<sup>21</sup> Another study comparing palisade cartilage myringoplasty to temporalis fascia myringoplasty by Vashishtha et al in which the

mean pure tone air-bone gap pre- and post-operatively in the fascia group were  $30.43 \pm 5.75$  dB and  $17.5 \pm 6.94$  dB, respectively, whereas for the cartilage group, these values were  $29 \pm 6.21$  dB and  $7.33 \pm 3.88$  dB, respectively.<sup>22</sup> In our study, pre-operative pure tone hearing loss was  $37.25 \pm 15.06$  dB while the post-operative ABG was  $20.00 \pm 7.45$  dB, thus the average hearing gain being 17.37 dB.

Traditionally it was believed that cartilage as a graft material gives rise to a rigid and non-pliant neotympanum which hampers the conduction of sound. This view has been challenged by various studies and it has been demonstrated that there is no statistically significant differences in hearing results between cartilage and perichondrium grafts.<sup>8,23,24</sup> So does our study demonstrate that hearing gain in palisade cartilage fascia tympanoplasty is equivalent to other studies with temporalis fascia graft.<sup>21,22</sup>

Cartilage tympanoplasty has dual benefits with respect to closure of the perforation while at the same time resisting the deleterious effects of eustachian tube dysfunction and also maintaining the conductive mechanism of the middle ear.

In our series of 64 patients, 4 patients (6.3%) had a reperforation (anteriorly placed), while rest of 93.7% patients had completely healed neotympanum at end of 3 year period following surgery. Two of these four patients developed post-operative upper respiratory tract infection within a week following the surgery, which could be a possible cause for residual perforation. Cause of residual perforation was not known in other two patients.

There was no correlation of age or comorbidities with that of failure of surgery. Out of 64 patients, 4 patients comprised of revision cases (prior myringoplasty done with temporalis fascia graft). All of these patients had healed neotympanum.

Vashishtha et al reported a graft uptake of 90% with palisade cartilage tympanoplasty while 83.3% with a temporalis fascia graft.<sup>22</sup> Similarly Khan et al reported graft uptake rate of 97.8% and 82.6% with palisade cartilage tympanoplasty and temporalis fascia graft respectively, while Dornhoffer reported a rate of 95.8%.<sup>18,20</sup> Thus demonstrating the superiority of palisade cartilage graft over temporalis fascia graft in terms of healing.

Two of our patients did not have a desirable hearing outcome. Both these patients had intraoperative finding of tympanosclerosis involving the promontory and round window area. However they had a healed neotympanum post operatively. We had several cases which had myringosclerosis which was treated by submucosal excision of tympanosclerotic plaques. Tympanosclerosis is known to cause conductive hearing loss (if it involves middle ear sound transfer mechanism) and rarely even

sensorineural hearing loss. In a study conducted by Aslan in 37 patients, 81% patients had conductive hearing loss while 19% had mixed type of hearing loss.<sup>25</sup>

The patients who did not have anticipated hearing results post operatively were prescribed appropriate hearing aids.

### **Limitation**

Our study was limited due to non-availability of data on the tympanometry findings in the post-operative cases. The compliance of neotympanum could have been assessed using impedance audiometry. This was the limitation of our study and requires future research.

### **CONCLUSION**

We recommend palisade cartilage fascia tympanoplasty as an effective method to ensure graft uptake and at the same time achieve competitive hearing gain. The reliability of this technique lies in its use for recurrent and residual perforations of the tympanic membrane as well as in cases associated with eustachian tube dysfunction.

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