

# Comparative Study of Temporalis Fascia Graft versus Cartilage Shield Tympanoplasty in Chronic Otitis Media - Mucosal Type

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## ABSTRACT

**Introduction:** Tympanoplasty is the procedure of choice for surgical correction of tympanic membrane perforation triggered by either chronic otitis media or trauma. Various types of autologous grafts have been used to close tympanic membrane perforations among which temporalis fascia and tragal cartilage are preferred, due to their anatomic proximity, ease of harvesting and suppleness. **Aims:** To compare clinical and audiological outcomes of type 1 tympanoplasty where temporalis fascia and tragal cartilage were used as the graft material. **Methods:** A prospective study was conducted on 50 patients of ages ranging from 10 to 50 years with Chronic Otitis Media - Mucosal. All the patients underwent type 1 tympanoplasty and were categorized into Group-A (Temporalis fascia graft) and Group-B (Cartilage graft), each group comprising of 25 patients. Graft uptake rate, hearing gain and air bone gap closure were compared between the groups in 4 and 8 weeks after surgery. **Results:** Out of total 50 patients, 20 were male and 30 were female. The average age of the patients was 28.20 years. The total hearing gain in the whole series was 14.94 dB while the total air bone gap closure was 14.78 dB respectively. The difference between pre and post-operative hearing was statistically significant for both air bone gap and air conduction, ( $P < 0.05$ ) in the whole series. There was 15.56 dB improvement in mean hearing threshold and 15.64 dB mean air bone gap closure in the fascia group, compared to 14.32 dB improvement in mean hearing and 13.92 dB mean air bone gap closure in the cartilage group. Graft uptake rate in the temporalis fascia group was 84% and the cartilage group was 92 % with significant difference in the graft uptake rate between the groups. **Conclusion:** The graft uptake rate and hearing results of tragal cartilage are comparable to those of temporalis fascia. Cartilage tympanoplasty has a higher graft uptake rate with low failure rate and also shows a high degree of reliability in high risk cases. Both cartilage and fascia tympanoplasty provided similar improvements in the hearing outcome post-operatively. Thus, cartilage tympanoplasty is recommended as an alternative option.

**Keywords:** Cartilage, Temporalis Fascia, Tympanoplasty

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## INTRODUCTION

The term tympanoplasty was first used in 1952 by Wullstein<sup>1</sup> to describe the surgical techniques for reconstruction of the middle ear hearing mechanism that had been impaired or destroyed by chronic otitis media (COM). Since the introduction of tympanoplasty by Wullstein<sup>1</sup> in 1952 and Zoellner<sup>2</sup> in 1955, different types of graft materials have been used to reconstruct the tympanic membrane (TM). Initially graft material were epidermal in origin, and later various mesodermal tissue, like vein graft, temporal fascia, cartilage, tensor fascia lata, perichondrium, and periosteum were used.<sup>3-5</sup> Temporalis

fascia is the most widely used graft because it can be harvested from a local operative site. Temporalis fascia has additional advantages over the other grafts owing to its light, mouldable structure which mimics the tympanic membrane. Temporalis fascia remains the most commonly used material for TM reconstruction, with a success rate of 93% to 97% in primary tympanoplasties.<sup>6</sup> However, the situation gets more complex, and failure rates are considered higher in cases of Eustachian tube dysfunction, retraction pocket, adhesive otitis media, and subtotal or total perforation. Therefore, graft materials that are more rigid than fascia (i.e. cartilage) and more resistant to infection, resorption and retraction have been proposed as

more appropriate for TM reconstruction.<sup>7-9</sup> In this study, we aimed to compare clinical and audiological outcomes of type I tympanoplasty where temporalis fascia and tragal cartilage were used as the graft material.

## METHODS

This was a prospective study conducted in the Department of Otolaryngology, Nepalgunj Medical College and Teaching Hospital, Banke from January 2022 to July 2022. A total of 50 patients with COM - Mucosal (inactive) type with moderate/large/subtotal perforations were included in the study. We divided these cases into two groups (25 cases in each group); Group A with Temporalis fascia graft and Group B with tragal cartilage graft. All patients underwent type-I tympanoplasty. Now, the aim of the study was to assess and compare the surgical outcome in terms of graft uptake rate and hearing improvement at the end of 4 and 8 weeks after surgery.

### Inclusion criteria:

1. Patients with COM (Mucosal /safe type).
2. Patients of age between 10 to 50 years.
3. A dry, central and subtotal perforation.
4. Intact ossicular chain found per-operatively.
5. Patients who underwent Type I Tympanoplasty.

### Exclusion criteria:

1. Patients with Sensori-neural type of hearing loss.
2. Patients with actively discharging ear.
3. COM - Squamous disease.
4. Patients below 10 years and above 50 years of age.
5. Eroded ossicular chain or ossicular fixation found per-operatively.
6. History of previous ear surgery.
7. Patients with contraindications to surgery or anaesthesia.

A written informed consent was taken from all the patients included in the study. A detailed history taking, thorough clinical examination (general ENT examination, otoscopic and microscopic examination of ear, tuning fork tests) was done. And for the hearing assessment, pure tone audiometry (PTA) was done 1 day prior to surgery and their pre-operative Air conduction (AC), Bone conduction (BC) and air–bone gap (ABG) were documented. Patients underwent routine blood investigations.

### Surgical Procedure

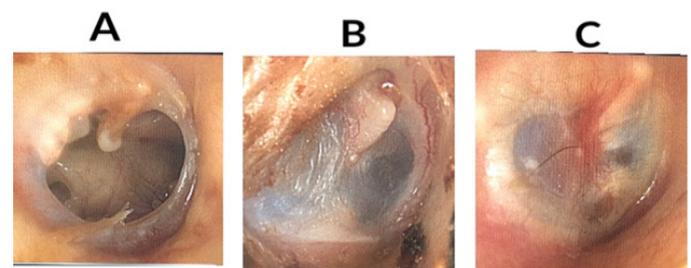
Patients were operated under local anesthesia using 2% lignocaine and 1:100000 adrenaline. Younger patients were operated under general anesthesia. All patients were operated using a post-aural incision. In Group A, the temporalis fascia graft was harvested through the same incision. The temporalis fascia graft was spread out and the redundant tissue shaved. It was pressed by graft press forcep and subsequently dried.

In Group B, tragal cartilage of size approximately 15\*10 mm was harvested through a medial incision, leaving behind a 2 mm rim of cartilage for cosmetic purposes. From the harvested cartilage, the perichondrium was removed from both sides and was refashioned to accommodate the size of the perforation. Thinning of the cartilage was done with a No. 15 blade. A 'V' shaped notch was removed from the cartilage to accommodate the handle of the malleus. Then the edges and undersurface of the perforation were freshened and tympanosclerotic patches and mass if present were removed. The handle of malleus was de-epithelialised. The tympanomeatal flap was elevated from 6 O'clock to 12 o'clock position to enter the middle ear. Ossicular intactness and mobility were confirmed. After putting antibiotic steroid soaked gel foam in the middle ear near the Eustachian orifice, the fascia graft was placed medial to the handle of malleus and carefully tucked below the perforation in Group A. In Group B, harvested cartilage was kept as a shield at the level of handle of malleus, medial to annulus. The temporalis fascia graft was kept lateral to the cartilage and medial to tympanic membrane remnant. Then the tympanomeatal flap was repositioned. The final graft position was checked and readjusted if required. The External auditory meatus was filled with antibiotic steroid soaked gel foam and ribbon gauge to stabilize the graft. The incision was closed and pressure dressing done.

### Post-Operative Care

After surgery, the patients were kept in postoperative ward under antibiotic coverage and analgesics. They were discharged after 2 days following dressing with oral antibiotics, analgesics, anti-histamines and decongestants for 3 weeks. Patients were advised not to cough, strain or sneeze. They were followed up on the 7<sup>th</sup> post-operative day for removal of aural pack and suture. Antibiotic ear drops were started after that to facilitate dissolution of gel foam and to promote healing. Afterwards, patients were advised to visit the outpatient department in the 4<sup>th</sup> week and 8<sup>th</sup> week after surgery.

The graft uptake was assessed on 4<sup>th</sup> week and pure tone audiometry was done on 8<sup>th</sup> week to assess the auditory function. Air conduction and the bone conduction threshold were calculated at frequencies of 500Hz, 1kHz and 2kHz. The rate of graft uptake, average post-operative hearing gain and average ABG closure were compared between both the groups. The results were tabulated and analyzed statistically using SPSS version 21.



*Pre- and post-operative surgical stages of Group A. (A). Pre-operative view of right tympanic membrane perforation. (B). At 4<sup>th</sup> weeks of surgery. (C). At 8<sup>th</sup> week of surgery*



**Pre- and post-operative surgical stages of Group B. (A). Pre-operative view of left tympanic membrane perforation. (B). At 4<sup>th</sup> weeks of surgery. (C). At 8<sup>th</sup> week of surgery.**

**RESULTS**

Our study included 50 patients; 30 females and 20 males out of which, 16 females and 9 males belonged to Group A (Temporalis fascia group), 14 females and 11 males belonged to Group B (Cartilage group). The average age of our patients is 28.20 years with a range from 12- 50 years. The mean ages for both groups were 28.20 years respectively. In total there were 25 right ears and 25 left ears operated, in which 13 right ears and 12 left ears belongs to Group A and 12 right ears and 13 left ears belongs to Group B. (Table I)

Sex	Group A [n=25]	Group B [n=25]	Total Number
Male	9	11	20
Female	16	14	30
Operated Ear			
Right	13	12	25
Left	12	13	25
Age (years)	28.20	28.20	28.20

**Table I: Sex, Operated ear and Age distribution of the study sample (n = 50)**

	Pre-operative Mean (dB)	Post-operative Mean (dB)	Difference Mean (dB)	P-value	% improvement rate
AC	48.44	33.50	14.94	0.000	30.84 %
ABG	30.16	15.38	14.78	0.003	49.005 %

**Table II: Comparison between pre and post-operative hearing threshold (AC and ABG) of total sample**

The mean pre-operative and post-operative AC threshold for the whole series was 48.44 dB and 33.50 dB respectively, whereas the mean pre-operative and post-operative ABG for the whole series was 30.16 dB and 15.38 dB respectively. The total hearing gain in the whole series was 14.94 dB (30.84 %) while the total ABG closure was 14.78 dB (49.005 %) respectively. The difference between pre-operative and post-operative hearing in the whole series is statistically significant for both AC and ABG. (P<0.05). (Table II).

S.N	Group	N	Pre-op AC (dB)	Post-op AC (dB)	Hearing gain (dB)	P value
1	A	25	46.04	30.48	15.56 (33.8%)	0.010
2	B	25	50.84	36.52	14.32 (28.2%)	0.000

**Table III: Showing comparison between pre-operative and post-operative AC in both the groups**

In group A, the mean pre-operative and post-operative AC threshold was found to be 46.04 dB and 30.48 dB and the mean hearing gain was 15.56 dB respectively, which is statistically significant (P<0.05). In group B, the mean pre-operative and post-operative AC threshold was found to be 50.84 dB and 36.52 dB and the mean hearing gain was 14.32 dB respectively, which is statistically significant (P<0.05). (Table III). Therefore, there was a significant improvement in the average air conduction threshold using temporalis fascia graft and cartilage graft.

S.N	Group	N	Pre-op ABG (dB)	Post-op ABG (dB)	ABG closure (dB)	P value
1	A	25	29.84	14.20	15.64 (52.41%)	0.557
2	B	25	30.48	16.56	13.92 (45.66%)	0.001

**Table IV: Showing comparison between pre-operative and post-operative ABG in both the groups**

In group A, the mean pre-operative and post-operative ABG was found to be 29.84 dB and 14.20 dB and the mean ABG closure was 15.64 dB respectively, which is statistically not significant (P>0.05). In group B, the mean pre-operative and post-operative ABG was found to be 30.48 dB and 16.56 dB and the mean ABG closure was 13.92 dB respectively, which is statistically significant (P<0.05). (Table IV).

S.N	Parameters	Group		Total series (Mean)	P value
		A	B		
1	Hearing gain	15.56 dB	14.32 dB	14.94 dB	0.060
2	ABG closure	15.64 dB	13.92 dB	14.78 dB	0.036
3	Graft uptake	21 (84 %)	23 (92 %)	88 %	0.029

**Table V: Showing comparison of outcomes between both groups**

On comparing the functional outcomes of the two groups as shown in Table V, the mean hearing gain was 15.56 dB in Group A and 14.32 dB in Group B. The difference between the two groups is not statistically significant (P>0.05). The mean ABG closure was 15.64 dB in Group A and 13.92 dB in Group B, which is statistically significant (P<0.05).

Type of graft	No.	Success	Failure	Success rate	P value
Temporalis fascia	25	21	4	84 %	0.029
Cartilage	25	23	2	92 %	
Total	50	44	6	88 %	

**Table VI: Comparison in success rate between fascia and cartilage grafts**

Overall, the surgical success rate for the whole series was 88 %. On comparing the anatomical outcomes in both groups as shown in Table VI, the graft uptake rate was 84% (n = 21) in Group A and 92% (n = 23) in Group B respectively and this difference is statistically significant (P<0.05). (Table V and VI).

## DISCUSSION

A clear consensus does not exist between otorhinolaryngologists over the choice of graft material in tympanoplasty. The selection of a graft material varies based on the experience and preference of the surgeon. Several surgeons prefer Temporalis fascia graft for its versatility, easy technique and thickness similar to that of the tympanic membrane. Several studies have shown the effectiveness of temporalis fascia in closure of small to moderate perforations but the chance of graft failure was reported to be higher in larger and subtotal perforations<sup>10</sup> as well as in cases of impaired tubal function. They generally favor the ability of the cartilage to withstand the varying negative pressure in the middle ear<sup>11, 12</sup> and a comparatively longer time taken for resorption. Tympanoplasty is generally successful surgery whether cartilage or fascia is used. The total success rate in our series was 88 %, which is comparable to other studies. Our study included two well-matched groups of patients, as there is no difference in mean age, sex or preoperative hearing between the two groups (Tables I and III). In our study, graft uptake rate for cartilage was 92 % as compared to Temporalis Fascia which was 84 % (P<0.05). This study has shown that cartilage graft has slightly better morphological and anatomical outcomes. We postulate that rigidity, stiffness and low metabolic rate of the cartilage play a role in resistance against retraction and provide stability and a reduced failure rate. The failure cases of our study were those who developed a defect in the graft. There were no cases of total graft rejection. The patients attending our hospital were mostly of low socioeconomic status, many had poor personal hygiene and poor nutritional status. This may probably contribute to factors affecting graft failure. We find statistical differences between the two groups regarding surgical success (Table VI).

This finding is in agreement with Tek et al<sup>13</sup> in which they compared cartilage reinforcement graft under fascia versus fascia alone in different sizes of tympanic membrane perforations. They found cartilage reinforcement graft significantly better than fascia in graft take rates. Regarding hearing, there was no significant difference between the two graft materials, which were similar to our study.

Queraishi and Jones et al<sup>14</sup> whose postoperative graft uptake

rate in the cartilage group was 94% and the fascia group was 84%. It is also consistent with the study by Sapci et al<sup>15</sup> which showed graft survival of 92% in the cartilage group, and 85% in the fascia group. Tayyar Kalcioğlu et al<sup>16</sup> did a retrospective evaluation of 307 patients with a tympanic membrane perforation or retraction due to chronic otitis media, graft survival rates were 95% in the cartilage group and 86.1% in the fascia group. All these studies are in favour of our study.

Similarly, in a study conducted by Chhapola et al<sup>17</sup> in the temporalis fascia group, 84.5% of patients had good neotympanum and 9.85% had residual perforation. In the cartilage group, 98.36% of patients had good neotympanum and 1.63% had residual perforation. In a similar study by Yegin et al<sup>18</sup> the graft uptake by temporalis fascia method was 65% whereas by cartilage method it was 92.1% and they concluded that the anatomical success rate of cartilage tympanoplasty was better than temporalis fascia and the results were statistically significant which was similar to our study. Ulka et al<sup>19</sup> has reported a 91.3% success rate of graft uptake in cartilage versus fascia, 88.2%, hearing gain of 12.3% in cartilage and 12.7% in fascia in cases of type I tympanoplasty. In both procedures there is good improvement of hearing. This is manifested as 15.56 dB improvement in mean hearing threshold in the fascia group, compared to 14.32 dB improvement in the cartilage group, giving an average of 14.94 dB improvement in the mean hearing threshold for the total series. There is no priority of one graft material over the other regarding hearing gain as there is no significant difference in hearing improvement between the two groups (Table V).

In our study, in Group A, there was 52.41 % closure of AB gap at 8 weeks post operatively. The study by Harkare et al<sup>20</sup>, Rakesh Kumar et al<sup>21</sup>, Patil et al<sup>22</sup> and Shyamkant Prasad et al<sup>23</sup> showed 56%, 45%, 47% and 49% closure of AB gap respectively at 12 weeks post operatively.

In Group B, a 45.66 % closure of AB gap was observed in 8 weeks post-operative. The study by Harkare et al<sup>20</sup> showed 46% closure of AB gap, Rakesh Kumar et al<sup>21</sup> showed 40% closure of AB gap, Patil et al<sup>22</sup> showed 50% closure of AB gap and Shyamkant Prasad et al<sup>23</sup> showed 52% closure of AB gap at 12 weeks post operatively. Similarly, Güneri et al, Ozbek et al and Wielgosz et al have also claimed a better graft uptake rate and hearing outcome in cartilage tympanoplasty compared with temporalis fascia in type-I tympanoplasty.<sup>24</sup>

## LIMITATIONS

There are certain limitations of this study as it has short duration of study period, short follow up period and only addresses short-term graft uptake and audiological results which might have changed with time. There were evidences mentioned in literature suggesting the improvement of post-operative hearing status with cartilage tympanoplasty with time, thus a long duration of study and longer follow up period would be ideal to clear these doubts.

## CONCLUSION

Cartilage tympanoplasty has been practiced for reconstruction of perforated tympanic membrane in COM since a long time with variable results. Both temporalis fascia and tragal cartilage shield grafts are great choices for tympanic membrane repair. It is evident from our study as well as various previous studies that tragal cartilage graft have comparatively better graft uptake than temporalis muscle fascia. Similarly, the acoustic transfer, hearing gain and air–bone gap closure are also comparable in both groups.

Consequently, both cartilage shield graft and temporalis fascia graft can be utilized as graft materials independently with good success rate in tympanoplasty surgery, but the above result suggestive of cartilage shield grafting can be considered as an alternative to temporalis fascia graft in type I tympanoplasty with satisfactory outcomes.

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