Comparison of Reinforcement Cartilage Graft and Temporalsis Fascia Graft in Type 1 Tympanoplasty

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Abstract:
Background: Chronic otitis media (COM) is the long-standing infection of a part or whole of middle ear cleft characterized by ear discharge and perforation. It is the commonest ear problem in adult and children. Most common presenting symptoms are ear discharge, mild to severe hearing loss, sometimes tinnitus even vertigo. Treatment of COM is mainly operative. Inactive mucosal variety of COM presents with the perforation in tympanic membrane with non-inflamed middle ear mucosa. The treatment of inactive mucosal variety of COM is Type 1 tympanoplasty. It can be done by conventional temporalsis fascia or cartilage graft. Both have some merits and demerits.

Objective: To compare the outcomes between reinforcement cartilage graft and temporalsis fascia graft in type 1 tympanoplasty.

Methods: 86 (43 patients in each group) patients with COM (inactive mucosal) who were admitted in the department of Otolaryngology – Head and Neck Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka from January 2018 to June 2019, and had fulfilled the inclusion and exclusion criteria were selected for the study. History, examinations, investigations were done. All patients underwent type 1 tympanoplasty. Prior to surgery relevant investigations...
Introduction:
Chronic otitis media is a chronic inflammatory disease of the middle ear and mastoid causing conductive hearing loss. The mainstay of therapy of COM is surgery. Tympanoplasty is the surgical choice with the main goals being eradication of disease, prevention of recurrent discharge, and preservation or improvement of hearing. Tympanoplasty was introduced by Wullstein in 1952 and Zollner in 1955. Since then numerous graft materials such as skin, fascia, vein, perichondrium and dura matter have been used to reconstruct the tympanic membrane (TM). Temporalis fascia and perichondrium remain the most employed materials for closure of TM perforation till date. In the last decade, it had shown a renewed interest an increasing use of cartilage graft as an alternative to more traditional grafting materials for TM reconstruction. Cartilage is like fascia in that it is mesenchymal tissue. Besides that, it has more rigid quality to resist resorption and retraction, even in the milieu of continuous eustachian tube dysfunction.

Cartilage was first used as graft material for reconstruction of middle ear by Utech in 1959. Salen and Jansen in 1963 first reported the use of cartilage perichondrial composite graft for reconstruction of the TM. Heermann was the main advocate of cartilage tympanoplasty who extensively used cartilage since 1962 for middle ear and mastoid reconstruction, and popularized palisade cartilage tympanoplasty. Cartilage is pliable, can resist deformation due to its high elasticity and nourished by diffusion that may improve its graft uptake.

Different graft materials have been used for repair of tympanic membrane perforation by different surgeons in their own choice with variable outcomes. To the best of our knowledge there is no protocol-based study conducted in our country regarding reinforcement cartilage tympanoplasty. This study had compared the graft uptake and hearing outcome of tympanoplasty by using reinforcement cartilage with temporalis fascia.

Methods:
This is an observational type of cross-sectional comparative study conducted in the Department Otolaryngology – Head & Neck surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka from January 2018 to June 2019. After obtaining clearance and approval from Institutional Review Board, 86 (43 patients in each group) patients with COM (inactive mucosal) fulfilled the inclusion and exclusion criteria, were selected for the study. Inclusion criteria were a) Only inactive mucosal variety of COM cases b) Age-11 to
50 years of age and Exclusion criteria were: a) Sensorineural type of hearing loss, b) Patients with squamous disease/active mucosal disease c) COM with ossicular fixation or disconnection d) Patients were not fit for general anesthesia. All patients with a clinical diagnosis of inactive variety of mucosal COM underwent a detailed clinical examination including otoscopic and microscopic examination, and all findings were recorded. Audiological evaluation was done by pure tone audiogram.

All cases were operated under general anesthesia through post auricular approach. Tragal cartilage was used as graft material in case group (Group-A) and temporalis fascia in the control group (Group-B). Temporalis fascia graft was harvested by a standard postauricular incision in both groups. Transcanal incision was given. Margin of perforation was freshened. Tympanomeatal flap was elevated. For harvesting a tragal cartilage a horizontal incision was given at 2-3 mm below and behind the tip of tragus to maintain the cosmesis of tragus. The tragal cartilage was harvested by keeping the perichondrium attached to medial wall and perichondrium free lateral wall. Then the perichondrium was separated from the harvested cartilage. Then it was sliced and reshaped with the scalpel. A wedge-shaped piece of cartilage was excised from superior border to accommodate the malleus handle. In cartilage group, the cartilage was placed underneath the remnant tympanic membrane or fibrous annulus and over handle of malleus to accommodate within the notch. The previously harvested temporalis fascia was placed over the cartilage and medial to margin of perforation. In temporalis fascia group, the harvested temporalis fascia was placed in underlay technique (under the remnant tympanic membrane or fibrous annulus, and or under or over the handle of malleus). The patients were kept under regular follow up. Graft uptakes were evaluated by otoendoscopic examination. PTA and Impedance were done at the end of 3 months. Postoperative air conduction and bone conduction threshold and Air-Bone Gap (ABG) were calculated at 500, 1000, 2000 Hz.

Successful surgical result was considered when patient had intact new tympanic membrane without any perforation and postoperative hearing gain than preoperatively. Those patients who failed the criteria was considered as failure.

Data collection technique:
Relevant data were collected in a predesigned data collection sheet for each of the patient with chronic otitis media.

Presentation of data: After compiling data were arranged and presented in simple ways.

Statistical Analysis: Data were processed and analyzed by using Microsoft Office Excel, 2007 software. Data were presented as mean± standard deviation (SD) or percentages. Finally, the result was evaluated by using proper statistical test of significance. To compare between intervention groups, a CHI-SQUARE (÷2) was used and data of each parameter before and after operation were compared using a paired t-test. A P value less than 0.05 was considered statistically significant.

Result:
Results was tabulated and analyzed as shown below

| Operated Ear involvement |
|--------------------------|
| Operated ear | Group A | Group B |
| (n=43) | (n=43) |
| No. (%) | No. (%) |
| Right | 15(34.88%) | 16(37.2%) |
| Left | 28(65.12%) | 27(62.79%) |
### Table II:
Comparison of graft uptake between intervention groups

| Intervention                  | Graft Uptake | Total | $\chi^2$ | p-value |
|-------------------------------|--------------|-------|----------|---------|
|                               | Success      | Failed|          |         |
| Group A (Reinforcement cartilage) | 41           | 2     | 1.3996   | >0.05   |
| Group B (Temporalis fascia)   | 38           | 5     |          |         |
| Total                         | 79           | 7     |          |         |

Chi-square ($\chi^2$) = 1.3996; $P$-value >0.05.

### Table III:
Comparison of graft uptake between intervention groups

| Intervention                  | Audiological result | Total | $\chi^2$ | p-value |
|-------------------------------|---------------------|-------|----------|---------|
|                               | Success             | Failed|          |         |
| Group A (Reinforcement cartilage) | 20               | 23    | .211     | >0.05   |
| Group B (Temporalis fascia)   | 28               | 15    |          |         |
| Total                         | 48               | 38    |          |         |

Chi-square ($\chi^2$) = .2118; $P$-value >0.05.

### Table IV:
Comparison of graft uptake between intervention groups

| Group A (Reinforcement cartilage) (n=43) | Group B (Temporalis fascia) (n=43) |
|-----------------------------------------|-----------------------------------|
| Audiological success                    | 20(46.51%)                        |
| Audiological fail                       | 15(34.88%)                        |
| Total                                   | 43                                |

### Table V:
Complications between two intervention groups

| Complications                        | In Reinforcement cartilage group (Group-A) | In Temporalis fascia group (Group-B) |
|---------------------------------------|--------------------------------------------|-------------------------------------|
| Wound infection                       | No                                         | No                                  |
| Sensory neural hearing loss           | No                                         | No                                  |
| Facial nerve palsy                    | No                                         | No                                  |
| Tinnitus                              | No                                         | No                                  |
| Myringitis                            | No                                         | No                                  |
Discussion:
Various graft materials including temporalis fascia, perichondrium, skin, vein, cartilage etc. have been using to repair the tympanic membrane perforation for long time. There are variable results having merits and demerits of each graft material used in tympanoplasty. In this study tragal cartilage and temporalis fascia were used as graft materials. Total numbers of subjects in this study were 86 where 43 were selected in each group. Among them in group-A, 25 male, 18 female patients underwent type-1 tympanoplasty which was reinforced with tragal cartilage, while in group-B, 19 male, 24 female underwent temporalis fascia tympanoplasty in group-B.

The mean ± standard deviation (SD) age was 28.2± 8.65 years (range,11 to 50 years) in the reinforcement cartilage group and 30.39 ± 9.6 years (range, 11 to 50 years) in the temporalis fascia group; the difference in mean age was not statistically significant (p=0.2669). This finding was quite similar to Kulkarini et al\textsuperscript{8}.

In reinforcement cartilage group (Group-A) right ear was operated in 15 (34.88%) cases and left ear was operated in 28(65.12%) cases and in temporalis fascia group (Group-B) right ear was operated in 16 (37.2%) cases and left ear was operated in 27 (62.79%) cases. (Table I). These findings coincided with the findings of Yung et al\textsuperscript{9}.

All patients were followed up for at least 03 months. Overall graft uptake rate was 91.8% (79/86). In reinforcement cartilage group graft uptake was achieved in 41(95.34 %) out of 43 patients and 88.34 % (38/43) in the temporalis fascia group. The difference was statistically not significant. (p=0.2367). This finding correlated with the results of Ozdamar et al\textsuperscript{10}. The graft uptake results in cartilage group was near to similar in some other studies- Onal et al 92.3%,\textsuperscript{11} Pradeep et al 96.7%,\textsuperscript{12} Yakup et al 92.1%\textsuperscript{13} and Gun et al 96.7%\textsuperscript{14}. But there are variable results 65-84% in temporal fascia graft uptake rate in same study group.

New graft was rejected in 02 cases (4.6 %) in reinforcement cartilage group and 05 cases (11.62 %) in temporalis fascia group. This finding was not statistically significant.

Pure tone audiometry was done after 03 months of operation. The mean preoperative and post-operative air conduction threshold in the reinforcement cartilage group (Group-A) was found to be 23.16 ± 5.75 dB and 13.98 ± 4.9 dB, respectively with 9.82 ± 4.5 dB closure of the air bone gap (ABG). Air bone gap was calculated in frequency level in both Group-A and Group-B in 500, 1000 and 2000 Hz. In temporalis fascia tympanoplasty patients (Group-B) mean preoperative and postoperative air conduction threshold were found to be 23.53 ± 3.7 dB and 12.36 ± 3.49 dB, respectively with 11.26 ± 7.32 dB closure of the ABG. The mean gain was 9.82 dB and 11.26 dB in the reinforcement cartilage group and temporalis fascia group respectively.

Air bone gap closure in PTA e" 10 dB were considered as audiological success\textsuperscript{12}. In our study, overall audiological success was 55.81% (48/86). In the reinforcement cartilage group 46.5% (20/43) and temporalis fascia group 65.11 per cent (28/43), (Table -V). In this study showed audio logical improvement in temporalis fascia group (Group-B) was better than reinforcement cartilage group (Group-A) but the difference was statistically not significant (p=0.082). This result was almost similar to Ozdamar et al\textsuperscript{10}, Onal et al\textsuperscript{11} and Yakup et al\textsuperscript{13} and Tan et al\textsuperscript{15}.

No major intraoperative and immediate postoperative complications like wound infection, sensory neural hearing loss and facial nerve palsy were found in any patient of either group in the procedures. No cosmetic deformity of tragus was observed in reinforcement cartilage group.
These encouraging anatomical and functional results may be due to the nature of the cartilage. As cartilage is nourished by simple diffusion from surrounding tissue, it can survive in a relatively avascular condition thus reinforcement cartilage may be a valid alternative to conventional temporalis fascia graft for the reconstruction of tympanic membrane.

**Conclusion:**
Cartilage tympanoplasty has been practised for reconstruction of perforated tympanic membrane in COM since long with variable results. Graft uptake rate in cartilage reinforcement is comparatively better than temporalis fascia graft. So, reinforcement cartilage graft can be adopted as an alternative to temporalis fascia graft in type- I tympanoplasty.

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