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Comparison of Graft Uptake and Post Operative Hearing between Cartilage Rim Augmented Fascia and Temporalis Fascia Tympanoplasty

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Abstract:-
Objective: To compare the graft uptake and postoperative hearing between cartilage rim augmented fascia and temporalis fascia type I tympanoplasty.

Materials and methods: This prospective, longitudinal, comparative, randomized and interventional study was conducted at Department of ENT, Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu for a period of 16 months amongst fifty two patients of age 15 years and above with the diagnosis of chronic otitis media mucosal with high risk perforation and cases of revision type I tympanoplasty with pure conductive or mixed hearing loss divided equally into cartilage rim augmented fascia tympanoplasty group and temporalis fascia tympanoplasty group. Graft uptake and hearing results were assessed after three months of surgery and compared. A postoperative residual air-bone gap of 20 dB or less was considered a successful hearing outcome.

Results: Graft uptake rate in cartilage rim augmented fascia group was 91.67% (22/24) and in temporalis fascia group was 96% (24/25) with no statistically significant difference in the graft uptake rate (p=0.609) between the two groups. The mean pre and postoperative air-bone gaps in the cartilage rim augmented fascia group were 29.68±9.66 dB and 12.56±5.10 dB and in the temporalis fascia group were 28.02±8.21 dB and 12.5±5.37 dB respectively. There was no statistically significant difference in successful hearing results between the two groups (p=1.00).

Conclusion: The graft uptake rate and hearing results of cartilage rim augmented fascia tympanoplasty are comparable to those of temporalis fascia tympanoplasty. Hence, cartilage rim augmented fascia type I tympanoplasty can be an alternative for the repair of high-risk perforations.

Keywords:- *Cartilage rim augmentation, chronic otitis media, high-risk perforation, temporalis fascia, tympanoplasty.*

I. INTRODUCTION

Chronic otitis media (COM) is one of the common ear diseases in South Asia.[1] In 1993, a national survey of deafness and ear disease in Nepal by Little et al. showed a prevalence of eardrum pathology of 7.4% in the country, 41.2% of which included cases with eardrum perforation.[2] Factors such as lack of breastfeeding, overcrowding, poor hygiene, poor nutrition, passive smoking, high rates of nasopharyngeal colonization with potentially pathogenic bacteria and inadequate health care contribute to the high prevalence of the disease in developing countries.[3]

COM is characterized by a permanent change in the tympanic membrane including atelectasis, perforation, dimer formation, tympanosclerosis, retraction pocket formation or cholesteatoma.[4] The most recent and common classification classifies COM broadly as mucosal and squamous type. It is then further subdivided into active or inactive based on the state of the mucosa of the middle ear and mastoid, whether inflamed or not.[5]

A perforation is usually a consequence of previous acute otitis media, COM, trauma & ventilation tube insertion.[5] Some literature mentions that some of the perforations of the tympanic membrane heal unless there is a coexisting eustachian tube dysfunction which is one of the main reasons for permanent perforation.[6] Management options for perforation due to COM mucosal type can be medical with oral and topical antibiotics for the control of infection during the active stage of the disease and surgical for the repair of tympanic membrane defect.[7] Permanent perforation can be treated by myringoplasty/ tympanoplasty type I.

Myringoplasty is the surgical procedure that is done for the repair and closure of pars tensa of the tympanic membrane and is the most common procedure done in COM mucosal type.[8] Myringoplasty deals with tympanic membrane reconstruction only whereas tympanoplasty includes middle ear and ossicular chain exploration, removal of the disease in the middle ear and tympanic membrane reconstruction. Tympanoplasty aims at reestablishing sound protection, obtaining a cavity filled with air and restoring the mechanism that transmits sound, improves hearing and stopping otorrhoea.[9,10] Five types

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of tympanoplasty were first described by Wullstein[11] in 1956 with the addition of the sixth type by Pratt in 1974[12]. Type I tympanoplasty entails tympanic membrane reconstruction without ossicular reconstruction, restoration of the normal middle ear with intact ossicles and thus suggests placing the graft against the handle of malleus (similar to myringoplasty).

Many techniques and graft materials have been described in the evolution of tympanoplasty. Temporalis fascia is the most common graft material used for the repair of the tympanic membrane. Cartilage, perichondrium, are also used as graft materials but are usually indicated for high-risk cases of chronic tubal dysfunction, adhesive processes or total defects of the tympanic membrane at the cost of less hearing benefit in comparison to temporalis fascia.[13] Even though the hearing outcome of temporalis fascia graft is considered superior to that of the cartilage, use of temporalis fascia in such cases may ensue subsequent graft failure due to atrophy, shrinkage or any unpredictable changes in the fascia.[14,15]

Varying techniques and modifications used in cartilage for myringoplasty have been described such as cartilage palisade, cartilage island graft, butterfly graft, ring graft, shield technique and reinforcement technique such as cartilage rim augmentation. The major advantage of cartilage is stiffness and bradytrophic metabolism which makes it suitable for difficult and high-risk conditions such as subtotal defects, adhesive otitis media and reoperation.[16]

In December 2017, Kolethekkat et al., in their retrospective study, introduced a newer technique, cartilage rim augmentation fascia tympanoplasty (CRAFT), which is comparatively newer to the field of ear surgery. Keeping in mind the pros and cons of cartilage and temporalis fascia for tympanoplasty, the authors used a piece of conchal cartilage structured in a horseshoe shape of 0.5 mm thickness and 1-2 mm width to reinforce the temporalis fascia graft placed using an underlay technique.[17]

Though preferred due to its tensile strength, cartilage graft has limitations of not providing improved hearing gain over temporalis fascia graft. However, reducing the thickness of cartilage to 500 micrometers or less resulted in an acceptable acoustic transfer loss when compared with the tympanic membrane according to a study done by Kazikdas et al.[15]

Reinforcement technique that includes the use of cartilage grafts to reinforce temporalis fascia has been previously described.[18] Kouhi et al. have utilized reinforcement technique in COM mucosal cases concluding a better graft uptake results but a lower hearing improvement.[19] Kolethakkat et al., however, introduced a new method of reinforcement technique with superior graft uptake and better hearing gain than temporalis fascia tympanoplasty.[17] The technique can hence be used in cases of high-risk perforation such as large or total perforations or cases of reoperation.

COM mucosal type is common in developing countries like Nepal. Various studies regarding techniques to repair tympanic membrane perforation have been done previously but very few retrospective and comparative studies regarding cartilage rim augmented fascia and temporalis fascia tympanoplasty in high-risk cases have been done. Hence, a prospective study comparing the results of cartilage rim augmented fascia and temporalis fascia tympanoplasty becomes rather necessary.

II. MATERIALS AND METHODS

This is a prospective, longitudinal, comparative, randomized and interventional study conducted at department of ENT and Head & Neck Studies, Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj, Kathmandu, Nepal for a period of 16 months from May 2019 to August 2020. Approval was taken from the ethical review board of the institution. Patients of age 15 years and above with COM mucosal with high risk perforation (subtotal, total perforation, perforation with history of previous myringoplasty, anterior perforation) with pure conductive or mixed hearing loss were included in the study. COM with cholesteatoma, pure sensorineural type of hearing loss, wet ear and with ossicular chain immobility or discontinuity or patients who previously underwent myringoplasty with additional procedures like ossicular chain reconstruction were excluded from the study. Informed and written consent were taken from all the patients included in the study.

A probability sampling method using a simple random lottery was applied. The patients who fulfilled the inclusion criteria underwent clinical evaluation. The otoscopic examinations of both the ears were performed and findings were recorded. The pure tone audiometry test was performed within seven days before the operation. The air conduction threshold (ACT) included the frequencies of 0.5, 1, 2 and 4 kHz (kiloHertz) and the bone conduction threshold included the frequency of 0.5, 1, 2 and 4 kHz according to the WHO guidelines.[20] The air-bone gap (ABG) was calculated by taking the differences between the ACT and the bone conduction threshold at the same time. The same procedure was done postoperatively and the ABG was calculated by taking the differences between postoperative ACT with postoperative bone conduction threshold.

Patients selected for the operation were divided into two groups using a random lottery method, group A: Cartilage rim augmented fascia type I tympanoplasty (CRAFT), group B: Temporalis fascia type I tympanoplasty. The planned ear was examined under the microscope before the operation and the findings were noted. The operations were performed by the faculty members of the department. All surgeries were performed either under local anesthesia or under general anesthesia with endotracheal intubation. The approach could be either permeatal or postaural depending upon the surgeon's choice and presence or absence of anterior bony overhang. Freshening of the margin of tympanic membrane perforation was done. Tympanomeatal flap was elevated

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from 6 o'clock to 12 o'clock and the middle ear was assessed for hyperemia or pus. The ossicular status was assessed. Any discontinuation of ossicular chain or ossicular fixation was excluded from the study. For CRAFT, temporalis fascia graft was harvested and cartilage graft was harvested from either tragus or concha depending upon the approach. Tragal cartilage was harvested for permeatal approach and conchal cartilage for postaural approach. The full-thickness cartilage graft was carved into a horseshoe shape. Gelfoam was placed in the middle ear cavity. Then the semilunar shaped cartilage graft was placed in the middle ear cavity against the annulus from the level of the supratubal recess, along the anterior, inferior and posterior tympanic annulus, stopping just short of the oval window to avoid contact with the ossicular chain. In cases of difficulty fitting the cartilage along the annulus, the horseshoe-shaped cartilage was cut into two halves and then placed accordingly at the site described above.

The temporalis fascia graft was then placed by underlay technique lateral to the cartilage graft but medial to the handle of malleus, extending to the adjacent bony wall. The tympanomeatal flap was repositioned and the ear canal was packed with gel foam and BIPP (Bismuth Iodoform Paraffin Paste) pack. For temporalis fascia tympanoplasty, instead of harvesting both cartilage graft and temporalis fascia graft, only temporalis fascia graft was harvested and placed to close the defect of the tympanic membrane via the same conventional underlay technique.

The patients were followed up for graft uptake results and hearing assessment after three months of surgery. ACT, bone conduction threshold, air conduction gain and ABG were calculated by using a pure-tone average of four frequencies of 0.5, 1, 2 and 4 kHz. The air conduction gain was calculated as a difference between postoperative and preoperative ACT values. The postoperative ABG was calculated by deducting the postoperative bone conduction threshold from postoperative ACT. The percentage of patients with postoperative ABG of ≤ 20 dB was calculated and compared between the two groups. The successful graft status was defined as a complete take up of graft. The perforation of any size or a total graft rejection was considered a failure. A postoperative residual ABG of 20 dB or less was considered successful regarding the hearing outcome.[17]

Data were calculated in terms of range, mean and standard deviation (SD), frequency and percentage (%). Graft uptake and hearing in each group were assessed and then compared between the two groups. Data were managed in MS Excel and analysed using SPSS (Statistical Package for the Social Sciences) statistical software version 21. Descriptive (mean, standard deviation) and inferential statistics (Chi-square test, Fisher exact test, Paired and Independent t-test) were used. The *p*-value < 0.05 was considered to be statistically significant.

III. RESULTS

A total of 52 patients were enrolled in the study with the anticipation of lost to follow-up of some of the patients. Forty-nine of them completed the follow-up. Twenty-four out of 49 patients underwent CRAFT (Group A) and the rest 25 patients underwent Temporalis fascia type I tympanoplasty (Group B). All patients were assessed for graft uptake but only 44 of them were assessed for hearing outcome. Patients with graft failure and those developing sensorineural hearing loss postoperatively were excluded from hearing evaluation. The mean age of patients in Group A (CRAFT) was 28.46±9.67 years and of Group B (Temporalis fascia) was 27.88±11.24 years. In group A (CRAFT), out of 24 patients, 11(45.83%) were males and 13(54.16%) were females. In group B (Temporalis fascia), eight (32%) were males and 17(68%) were females. The demographic data are shown in Table 1.

Variable	Group A (CRAFT) (n=24)	Group B (temporalis fascia) (n=25)	Significance (p value)
Age in years	28.46±9.67	27.88±11.24	0.848*
Gender (male/ female)	11/13	8/17	0.387**

Table 1: Demographic data of patients

- *Independent t-test, ** chi-square test, CRAFT (Cartilage rim augmented fascia type I tympanoplasty)*

Out of 24 patients in Group A (CRAFT), 16(66.66%) patients had subtotal perforations, seven (4.16%) patients had to undergo revision tympanoplasty and only one (4.16%) patient had total perforation. Similarly, out of 25 patients in Group B (Temporalis fascia), 22 (88%) had subtotal perforations, two (8%) had total perforations and only one patient (4%) had to undergo revision tympanoplasty (Table 2).

Types of perforations	Group A(CRAFT) (n=24)	Group B (Temporalis fascia) (n=25)
Subtotal Perforations	16 (66.66%)	22 (88%)
Total Perforations	1 (4.16%)	2 (8%)
Revision surgery	7 (29.16%)	1 (4%)
Total	24 (100%)	25 (100%)

Table 2: Distribution of high-risk perforations in two groups (n=49)

In Group A (CRAFT), there was a successful graft uptake in 22 (91.67%) out of 24 cases and two (8.33%) cases of failure. However, in Group B (Temporalis fascia), out of a total of 25 cases, there were 24 (96%) cases of successful graft uptake and a single (4%) case of graft failure. The difference in graft uptake results between the

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two groups was not found to be statistically significant (p=0.609) (Table 3).

In group A only 20 cases were taken for hearing assessment. Two cases of graft failure, one case of postoperative sudden sensorineural hearing loss and one case of postoperative sensorineural hearing loss were excluded. The mean preoperative air conduction threshold (ACT) was 44.81±10.80 dB whereas the mean postoperative ACT was 24.37±6.92 dB. The mean preoperative air-bone gap (ABG) was 29.68±9.66dB and the mean postoperative ABG was 12.56 ±5.10 dB. The improvement in hearing postoperatively within the group was found to be statistically significant (p=0.000).

Only 24 cases were taken for hearing assessment in group B. A single case of graft failure was excluded. The mean preoperative air conduction threshold (ACT) was 42.34±8.56 dB whereas the mean postoperative ACT was 25.31±7.30 dB. The mean preoperative air-bone gap (ABG) was 28.02±8.21 dB and the mean postoperative ABG was 12.5±5.37 dB. The improvement in hearing postoperatively was statistically significant (p=0.000). The difference in mean preoperative and postoperative ACT and ABG between the two groups were not found to be statistically significant (Table 4).

There was 95% (19/20) successful hearing outcome in group A (CRAFT) with their postoperative ABG less than or equal to 20 dB. In group B (temporalis fascia), 22 (91.66%) out of 24 cases had postoperative ABG less than or equal to 20 dB which was considered a successful hearing outcome (Table 5). The difference in postoperative ABG between the groups in each category was not found to be statistically significant (p=1.00).

Graft uptake status	Group A(CRAFT) (n=24)	Group B (Temporalis fascia) (n=25)	*p*-value
Success	22 (91.67%)	24 (96%)	0.609
Failure	2 (8.33%)	1 (4%)	

Table 3: Postoperative graft status in both groups (n=49)

- **Fisher exact test**

Mean(dB)±SD	Group A (CRAFT) [n=20]	Group B (Temporalis fascia) [n=24]	p-value
Preoperative ACT (dB)	44.81±10.80	42.34±8.56	0.403
Postoperative ACT(dB)	24.37±6.92	25.31±7.30	0.666
Preoperative ABG (dB)	29.68±9.66	28.02±8.21	0.533
Postoperative ABG (dB)	12.56±5.10	12.5±5.37	0.962

Table 4: Comparison of preoperative and postoperative hearing (ACT and ABG) between two groups (n=44)

- **Independent t-test, ACT: Air conduction threshold, ABG: Air bone gap**

	Group A (CRAFT) (%) n=20	Group B (Temporalis fascia) (%) n=24	p-value
Postoperative ABG ≤ 20 dB (successful)	19 (95%)	21 (91.66%)	1.00
Postoperative ABG >20 dB (unsuccessful)	1 (5%)	1 (8.33%)	

Table 5: Comparison of hearing outcome between two groups (n=44)

- **Fisher exact test**

There were a total of three cases of complication namely surgical site infection and two cases of sensorineural hearing loss at three months post surgery. All the cases were from Group A (CRAFT).

IV. DISCUSSION

This prospective, randomized study was conducted on patients of COM with high risk perforations without active discharge. The specific objective of this study was to compare the graft uptake and hearing outcome between cartilage rim augmented fascia type I tympanoplasty (CRAFT) and temporalis fascia type I tympanoplasty. There was a total of 41 cases of subtotal and total perforations who underwent primary tympanoplasty and eight cases of revision surgery in the study. All of these conditions are categorized as high-risk perforation. The mean duration of follow-up for CRAFT and temporalis fascia type I tympanoplasty was 4.04 and 3.8 months respectively. Singh et al. had followed up their patients after three months of surgery.[21] Mundra et al. and Uslu et al. followed up the patients at a mean duration of six months after surgery.[22,23] Kolethekkat et al. mentioned the mean duration of follow-up of 11 months in their study.[17] The lesser duration of follow up is one of the limitations of the study. The increase in duration post-surgery negatively affects the graft uptake status as evidenced by various studies.[24,25]

The successful graft uptake was present in 91.6% (22/24) in CRAFT and 96% (24/25) of cases in temporalis fascia type I tympanoplasty. Even though the anatomical success was more in the temporalis fascia group than the CRAFT group, the difference in the uptake rate was not statistically significant (p=0.609). In contrast to this study, Kolethekkat et al. in their study showed better graft uptake of cartilage rim augmented fascia tympanoplasty of 94.7% compared to that of temporalis fascia tympanoplasty of 69.7% in the mean duration of follow up of 11 months which was statistically significant.[17] Similarly, Tek et al., in their study of a total of 77 patients, had a successful graft uptake rate of 100% in the cartilage reinforcement group but 66% in the temporalis fascia group.[18] Singh et al. also reported a comparatively better graft uptake rate of

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95% in the cartilage reinforcement group compared to 85% in the temporalis fascia group which was statistically significant (p<0.01).[21] Both the studies of Tek et al. and Singh et al., included pars tensa perforation of any size in their study. The increased success rate of cartilage reinforcement in the studies could have been also because of the inclusion of smaller size perforations of tympanic membrane which are generally not considered high-risk cases. The anatomical success rate of cartilage reinforcement tympanoplasty of the present study was comparable to above-mentioned studies. However, the anatomical success rate of temporalis fascia tympanoplasty of the study was comparatively higher than the above-mentioned studies. While comparing the successful graft uptake rate between the two groups, a lesser success rate of CRAFT was seen in comparison to the temporalis fascia type I tympanoplasty group, though the difference in graft uptake status was not statistically significant. The reason behind this could be a learning curve amongst surgeons in the department of this institution involved in the surgery of the cases using the novel CRAFT technique which is quite a new technique. A comparatively smaller sample size might also have affected the result of the study. Kouhi et al. in their study of a total of 320 patients done by a single-handed surgeon had a successful graft uptake rate of 91.6% and 93.4% in temporalis fascia and cartilage reinforcement tympanoplasty respectively.[19] There was a significant improvement in hearing postoperatively in both groups. The average ABG came down from 29.68±9.66 dB preoperatively to 12.56±5.10 dB postoperatively in group A (CRAFT) and from 28.02±8.21 dB preoperatively to 12.5±5.37 dB postoperatively in group B (Temporalis fascia type I tympanoplasty) which was highly significant (Paired t-test, p=0.00). The findings of difference in ABG pre and postoperatively are supported by the study from Tek et al.[18] and Kolethekkat et al[17]. In the former study, the mean pre and postoperative ABG in cartilage reinforcement tympanoplasty were 23.87±7.73 dB and 12.09±5.9 dB respectively; the pre and postoperative ABG in temporalis fascia tympanoplasty were 23.03±8.95 dB and 13.11±7.13 dB respectively. Similar to the current study, they excluded any cases of ossicular immobility or defect. In the study done by Kolethekkat et al., the pre and postoperative ABG in cartilage rim augmented fascia tympanoplasty were 27.52±10.06 dB and 14.41±7 dB respectively; the pre and postoperative ABG in temporalis fascia tympanoplasty were 23.37±8.07 dB and 17.59±9.36 dB respectively.[17] However, the lower values of the present study compared to the above-mentioned study could be because of the inclusion of cases with only intact ossicular chain mobility and integrity in the present study. Compromised ossicular mobility and or integrity negatively affects the hearing outcome. Kolethekkat et al. included 20 patients out of 115 with defective ossicular chain.[17] Findings from the present study are however contradictory to the findings observed in the study done by Kouhi et al.[19] where cartilage reinforcement was done in the posterior aspect with pre and postoperative ABG in cartilage reinforcement tympanoplasty of 21.2±8.6 dB and 17.3±8.1 dB respectively; the pre and postoperative ABG in temporalis fascia tympanoplasty of 28.1±10.1 dB and 11.8±8.9 dB respectively. The average ABG of cartilage reinforcement was thus more than the value of the average ABG of temporalis fascia tympanoplasty.[17] The use of cartilage graft in the posterosuperior aspect of the tympanic membrane might have interfered with the ossicular mobility in such cases and thus worsened the hearing outcome in the cartilage reinforced group.

The rate of successful hearing outcome defined by postoperative ABG of ≤20 dB was 95.23% (20/21) in Group A (CRAFT) and 91.66% (22/24) in Group B (Temporalis fascia type I tympanoplasty) which was not statistically significant (p=1.00). The mean postoperative ABG of Group A and Group B were 12.08±5.43 dB and 12.86±5.48 dB. The difference between the postoperative ABG of both groups was not statistically significant. Kolethekkat et al. showed a better hearing outcome of the postoperative air-bone gap of ≤20 dB in 92.6% (25/27) in the cartilage rim augmented fascia group in comparison to 69.7% (23/33) in the temporalis fascia group with cases of normal ossicular chain mobility which was statistically significant. The mean postoperative ABG were 14.41±7 dB and 17.59±9.36 dB in the cartilage rim augmented fascia and temporalis fascia group respectively which included cases of both with or without normal ossicular mobility.[17] The result of audiological success in this study was similar to the study by Kolethekkat et al.[17] with better hearing outcome in cartilage rim augmented fascia tympanoplasty in comparison to temporalis fascia tympanoplasty however, it was not statistically significant. Cases with only normal ossicular chains were included in this study. This implies that the full thickness horseshoe-shaped cartilage placed medial to temporalis fascia graft in cartilage rim augmented fascia tympanoplasty does not interfere with the mobility of the ossicles and does not have a negative effect over transmission sound in comparison to temporalis fascia. Kolethekkat et al. and other various authors, to have an optimum transfer of sound through the cartilage graft, have advocated thinning out the piece to 0.5mm.[13,17] However, it seems that using cartilage as a reinforcement graft in this technique of CRAFT even with its full thickness does not interfere with the vibration of the temporalis fascia graft and thus the sound conduction from the external auditory canal to the middle ear is optimum. This study was also supported by Tek et al., that reported the postoperative ABG of ≤20 dB in 87.5% (28/32) of cases in cartilage reinforced cases and 85.1% (23/27) in temporalis fascia tympanoplasty cases.[18] Kouhi et al. showed a decreased percentage of ABG of ≤20 dB (55.5%) in the cartilage reinforced technique in comparison to the temporalis fascia tympanoplasty (87.5%) which was in contrast to the audiological finding of this study.[19] However, they used cartilage reinforcement in only the posterosuperior aspect of the temporalis fascia which might have interfered with the vibration of the ossicles.

There were three cases of complications in this study. All the cases had undergone cartilage rim augmentation type I tympanoplasty. The first case was that of postoperative infection that occurred within the first week after surgery because of upper respiratory tract infection which inadvertently lead to graft failure of the case. The

second case sustained a unilateral sudden-onset sensorineural hearing loss on his 3rd month of follow up in his operated ear. There was however a successful graft uptake. The third case suffered from sensorineural hearing loss in the operated ear when followed up at three months after surgery which was not sudden in onset but the graft uptake was successful. The incidence of immediate sensorineural hearing loss following tympanoplasty ranges from 4.5 to 5% in various literature. The main reasons behind being cochlear trauma, use of drills and suctions and the experience of the surgeons.[26] The surgeries in this study was done by experienced surgeons. The particular surgeries did not involve the use of drills. Therefore, there seems to be no plausible effect of tympanoplasty over the incidence of sudden sensorineural hearing loss in the case as it occurred three months after surgery and not in the immediate postoperative period. Lee et al. reported a case of sudden sensorineural hearing loss following tympanoplasty and simple mastoidectomy which occurred only two days after surgery.[27] However, in this study, the development of sensorineural hearing loss without sudden onset could have been because of unnoticed trauma to the oval window during surgery or because of the ongoing pathology of COM mucosal. The results of this study are comparable to the results of previous similar studies.[17,18] There were certain limitations of the study. The smaller sample size was one of the limitations. Multiple surgeons involved was also a limiting factor in the study. Few surgeons were less familiar with cartilage rim augmented fascia tympanoplasty than the temporalis fascia tympanoplasty. The learning curve performing cartilage rim augmentation fascia tympanoplasty might have affected the overall result of the study. The other limiting factor was the lesser duration of the follow-up in the study. Various other studies have their duration of follow-up from three months to 10 years. As it is well known that with an increase in duration after surgery the outcomes of tympanoplasty alter, shorter duration of follow up in this study is a limiting factor.

V. CONCLUSION

The graft uptake rate and hearing results of cartilage rim augmented fascia tympanoplasty are comparable to those of temporalis fascia tympanoplasty. Hence, cartilage rim augmented fascia type I tympanoplasty can be an alternative for the repair of high-risk perforations.

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