

Fat graft myringoplasty in small central perforations

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ABSTRACT

Background: Perforations of the tympanic membrane (TM) are treated with various surgical techniques and materials. Although autologous temporalis fascia is the most common material used for the closure of TM perforations, however for a dry, small central perforation the fat graft myringoplasty (FM) is a good alternative as it is a simple and cost-effective technique. **Objectives:** The aim of this study was to determine the efficacy of FM for repair of small central perforations. Suggestions for optimizing the outcome of FM are presented. **Material and Methods:** Twenty patients (10 males and 10 females) who had uncomplicated dry small central perforation, which was confined to one quadrant of the pars tensa underwent FM. The outcome was evaluated after 1-week, 1-month, and 3 months. **Results:** After 3 months of follow-up, a closure rate of 80% was achieved. Mean preoperative air-bone (AB) gap was 22.90 ± 6.54 dB and mean postoperative AB gap was 21.80 ± 6.28 dB. Mean improvement in AB gap postoperatively was 1.1 ± 2.63 dB. **Conclusion:** Fat graft myringoplasty, with its ease of technique and good graft uptake rate justifies its use in the closure of small dry central TM perforations.

KEYWORDS: Audiometry, Fat graft, Myringoplasty

INTRODUCTION

Tympanic membrane (TM) perforations are, as a result, of infection, trauma, or the sequelae of tympanostomy tube insertion. Although 88% of traumatic perforations of any size heal without intervention, the remainders become chronic and require treatment.^[1] Without closure, morbidity may include hearing loss, chronic otorrhea and cholesteatoma formation.^[2] Myringoplasty, which is one of the most common otologic surgical procedures, involves the use of a graft to repair a TM perforation. A variety of autografts, allografts, xenografts, and alloplasts (temporalis fascia, tragal perichondrium, bovine pericardium, etc.) have been used for that purpose.^[3,4] At present, the most frequently used graft is autologous temporalis fascia, which has been used in myringoplasty since the 1960s. Ringenber first reported fat graft myringoplasty (FM).^[5] Several other authors have also reported their experiences with FM, and most of those investigators noted that the success rate of closure of the perforation ranged between 76% and 100%.^[6] FM is an easy, quick and cost-effective method of TM perforation closure with minimal morbidity. It can be done as an outpatient department

or office procedure. The fat is readily available from ear lobule, abdomen and buttocks. This prospective study evaluated the efficacy of FM in small central perforations of the TM.

MATERIALS AND METHODS

Study population and preoperative evaluation

The present study was conducted in the Department of Otorhinolaryngology, Pt. B.D. Sharma Postgraduate Institute of Medical Sciences, Rohtak, on 20 patients of either sex, between 2012 and 2014, in the age group of 15-50 years with a small central perforation (approximately 3 mm in diameter) confined to a single quadrant of the TM, having dry ear over a period of at least 4 weeks without use of topical or systemic antibiotics. All the cases were done under local anesthesia.

All patients were informed about the place from where the fat will be harvested (ear lobule). Informed consent was

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obtained after discussion of the alternatives. The approval of the institutional review board was obtained. Twenty patients were included in this study (10 males and 10 females). Fifteen patients had unilateral, and five patients had bilateral perforations. All patients underwent ENT history taking, a thorough clinical examination, audiometric and Eustachian tube function testing and laboratory preoperative testing. The evaluation of hearing was done preoperatively and the amount of air-bone (AB) gap at 0.5, 1, 2, 4 kHz was the parameter for evaluating hearing status.

Surgical technique

The osteocartilaginous junction of the external ear canal was infiltrated with 2 ml of 2% lidocaine with 1:100,000 epinephrine divided at 4 different sites 3, 6, 9 and 12 O'clock positions. The skin of the posterior surface of the ear lobule was infiltrated with 0.5 ml of the same solution. The 5-8 mm incision was given on the margin of the lobule, and a skinless fat graft that was 2-3 times larger than the perforation was harvested. The incision site was sutured with 4-0 silk sutures on cutting needle. The edges of the perforation were excised with a sickle knife or with a Rosen needle and were removed with microforceps [Figure 1]. Small pieces of absorbable gelatin sponge (Abgel, Sri Gopal Krishna Labs Pvt. Ltd., Mumbai, India). were inserted through the perforation into the middle ear. The fat graft was placed in the perforation through trans-tympanic technique in an hourglass shape for better stabilization, and the canal was packed with antibiotic drops soaked pieces of gelatin sponge [Figure 2]. Sutures were removed after 1-week. Postoperatively, hearing status was evaluated at 0.5, 1, 2 and 4 kHz and any change in the AB gap was noted.

Statistical analysis

The obtained data were compiled. Results were statistically analyzed by using the Chi-square test to assess the surgical outcome and the paired *t*-test to assess the audiological outcome. The significance level was set at $P < 0.05$.

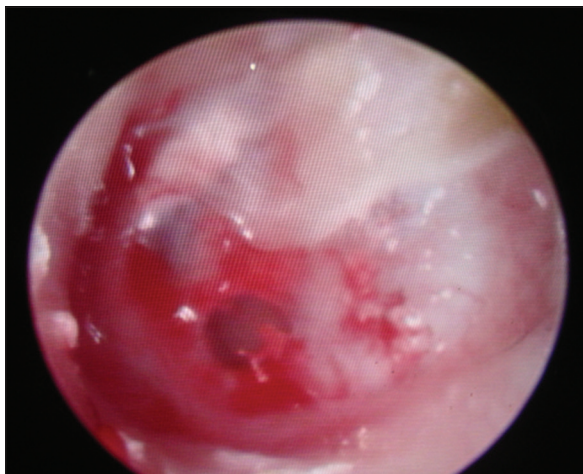


Figure 1: Freshening of perforation margins

RESULTS

The patients were divided into three age groups (A: 15-24, B: 25-34 and C: >35 years). The mean age of patients observed in the study was 24.7 ± 7.62 years (range: 17-45 years). Of 20, 11 (55%) were in the age group of 15-24 years, 5 (25%) were in the age group of 25-34 years and 4 (20%) were in the age group of 35 years and above. The gender ratio male versus female was 1:1 (10 of each sex). Five patients (25%) had bilateral TM perforations. The overall successful graft uptake rate was found to be 80% at the end of 3rd month [Graph 1]. Among 10 males it was 90% and in 10 females it was 70%. Out of 5 patients who had bilateral disease, all 5 (100%) showed graft uptake, whereas in unilateral disease 11 out of 15 patients (73.33%) showed graft uptake. No difference was observed in the healing of bilateral and unilateral chronic suppurative otitis media cases and in both sexes, on applying Chi-square test was found to be statistically not significant ($P = 0.259$). The difference among the graft uptake rate in various age groups was also statistically not significant ($P = 1.0$) on applying Chi-square test.

Pure tone audiometry was used to assess average AB gap pre- and post-operatively. Mean preoperative AB gap was 22.90 ± 6.546 dB (range: 10-35 dB). Mean postoperative AB gap was $21.80 \text{ dB} \pm 6.288$ dB (range: 10-37 dB) [Graph 2]. Mean improvement in AB gap was $1.1 \text{ dB} \pm 2.634$ dB. When the difference was analyzed statistically using paired *t*-test it was found to be not significant ($P = 0.077$). The difference between the audiometric improvement in both sexes came out to be not significant ($P = 0.809$). Age group wise postoperative improvement in AB gap in 15-24 years was 5/9 (55.5%), in 25-34 years was 2/4 (50%) and in >35 years group it was 1/3 (33.3%). On applying ANOVA test to the difference between audiometric improvement in different age groups post FM in successful patients was not statistically significant ($P = 0.939$).



Figure 2: Placement of fat graft into the perforation (trans-tympanic)

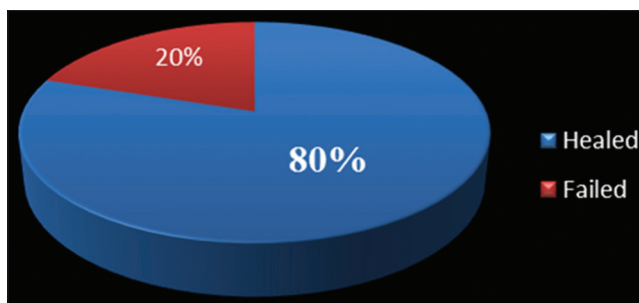
DISCUSSION

Ringenberg first described FM, with a success rate of 87% for small perforations.^[5] Since then, studies have shown success rates ranging from 76% to 92% in cases of small perforations.^[7,8] Deddens *et al.* had reported that size of TM perforation was a crucial factor. Perforations, in their series, were 5-30% of the drum surface, which was a good prognostic factor for an FM as compared to larger perforations for fat graft alone as was also observed by us.^[9]

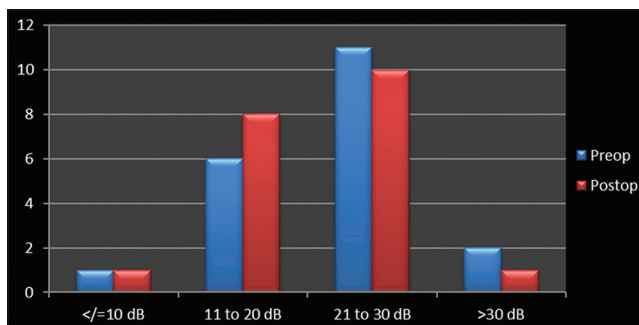
The fat graft can be harvested from the abdomen, buttock and ear lobule. The ear lobule fat harvesting is much simpler as it is done from the same sterile area of the surgical field prepared for the fat tympanoplasty and its scar is almost invisible. The fat of ear lobule is denser with big revascularization activity and acts as a good template for mucosal and epithelial growth.^[6] There is significant bulging postoperatively on the TM till the end of the 3rd month and after that it progressively disappears and gets converted into a smooth sclerotic area on the TM at the 5th month [Figure 3].^[10] This phenomenon was also observed by us in patients where graft uptake was there. There are two histological theories of fat grafts.^[11] “The host cell replacement theory” of Neuhof^[12] and “The cell survival theory” of Peer.^[13] The host cell replacement theory states that all the original cells die and are totally replaced by new wandering adipocytes or by fibroblasts. The cell survival theory states that not all the original adipose cells die. Those fat cells which receive adequate blood supply survive whereas remaining degenerate, thus explaining loss of volume. The transplanted fat cells are not replaced by scar tissue, instead a connective tissue capsule outside the fat graft begins 3 weeks after transplantation, which becomes progressively thinner over the course of a year. Fat tissue provides the basic requirement for the grafting of the TM with its own favorable characteristics.^[10,14]

In our study, the mean age was 24.7 ± 7.623 years. Similar age group was reported by Kamakshi. In this age group, there is less chance of upper respiratory tract infections and presbycusis.^[15] Shih *et al.* reported a success rate of 54% for children of 10 years and younger compared to 94% for children over 11 years of age.^[16] Friedberg and Gillis concluded that age is a significant factor in determining the success of FM, but favored the younger patient. There were no graft failures under 11 years of age in their series.^[17] Chandrasekhar *et al.* did not detect any magical age at which the success rate of TM repair improves and found no statistical difference in the three age groups studied 0-8, 9-12 and 13-19 years.^[18] These conflicting results clearly demonstrate that age alone cannot predict the success or failure of FM.^[8]

The size of the perforation is the main criterion used by many investigators to select candidates for FM. According to Kaddour, the size of the perforation should not exceed 30% of the size of the eardrum (closure rate, 80%).^[19] Terry *et al.*, who performed FM to correct perforations of various sizes, cited a closure rate of 79.4%



Graph 1: The number of graft taken up as compared to the graft failure



Graph 2: Comparison of pre- and post-operative air bone gap on pure tone audiometry



Figure 3: One month postoperative picture showing successful take up of the fat graft

if the perforation accounted for <50% of TM and 57.1% if the perforation was larger than that size.^[7] In our study we had chosen ears with a dry small central perforation, which was confined to only one quadrant of the TM. We achieved a successful closure rate of 80%. The result of our study and selection criteria used in our study for size matches with the above studies.

In the literature, success rate of 80-95.2% have been reported by various authors from different parts of the world as depicted in Table 1.

The failure rate in our study was 20% due to infection, detached fat graft and dehiscence due to undersized grafts. Fiorino and

Table 1: Comparison between the graft uptake rate of various studies conducted on fat graft myringoplasty

Author	Ears operated	Graft take up rate
Mitchell <i>et al.</i> ^[20]	56	91
Mitchell <i>et al.</i> ^[8]	370	92
Ozgursoy <i>et al.</i> ^[10]	30	82.4
Chalishazar ^[21]	20	90
Landsberg <i>et al.</i> ^[22]	38	81.6
Bertoli <i>et al.</i> ^[6]	73	80.8
Sinha <i>et al.</i> ^[14]	24	95.8
Kim <i>et al.</i> ^[23]	46	87
Hegazy ^[24]	68	88.2
Udaipurwala <i>et al.</i> ^[25]	22	95.2
Our study (2014)	20	80

Barbieri described various causes of failure. Immediate failures due to technical difficulties such as anterior perforations, inadequate graft support, poor vascular supply or infection and delayed failures due to atrophic TM, infections or Eustachian tube dysfunction with change in the TM structure.^[26] Hegazy *et al.* described technical operative points during fat grafting that is, graft size in relation with the perforation, degree of lateral bulge in the fat plug and moistening of the lateral side of the graft are important factors for success in the fat grafting procedure.^[24]

Fiorino and Barbieri recorded a slight insignificant improvement in hearing in their 31 patients postoperatively, which is consistent with our study as we also observed a slight upward shift that is, mean AB gap of 1.1 dB postoperatively.^[26] A difference of 1.1 dB was found to be statistically insignificant ($P = 0.077$). It might be due to dry, small sized central perforations in the TM, without any association with middle-ear pathology. As the preoperative AB gap was not significantly impaired, in some patients it was within normal limits and hence the postoperative AB gap did not show much of the change.

The advantages of FM for the repair of a perforated TM are many. Surgery can be performed as an office procedure after the patient has received a local anesthetic. It is a relatively safe procedure because the likelihood of otologic trauma from the manipulation of the tympanic cavity is reduced. Bilateral surgery is also possible, and the postoperative care required is minimal. Learning to perform FM is not difficult, and FM offers the possibility of recovery for noncompliant patients. However, performing FM is not without challenges. Finding an implant that is large enough to repair a large perforation in patients with a small lobule may be difficult. The possibility of postsurgical lobule deformity exists, as do the theoretical deposition of skin debris in the graft and the consequent development of an iatrogenic cholesteatoma, although never reported, to the best of our knowledge. A sense of fullness in the ear and temporary tinnitus, which are probably caused by the long-term persistence of the graft block. Some patients complain of an auricular discharge, which may be melting fat, for a few weeks after surgery.^[6]

In conclusion it is simple, safe, quick, economical procedure done under local anesthesia with as success rate as temporalis fascia and minimal or no morbidity and complications.

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