Original Research Article

**ABSTRACT**

Background: Chronic otitis media mucosal type is commonly encountered in otorhinolaryngology. Myringoplasty is a common surgery performed to repair the tympanic membrane (TM). Management of subtotal perforation of the TM has become better with the use of endoscopes. The use of cartilage as palisade for repair of the TM has become popular. The aim of the study was to assess graft uptake and hearing after endoscopic palisade myringoplasty.

Methods: A prospective study was conducted in the otorhinolaryngology department from April, 2022 to January, 2023. The study included 65 patients, aged 21 years and above diagnosed as chronic otitis media mucosal type, inactive with subtotal perforation and conductive hearing loss. History, clinical examination, otoscopy, tuning fork tests, examination under microscope (EUM) were conducted preoperatively. All patients underwent endoscopic palisade cartilage myringoplasty. Pre-operative and post-operative pure tone audiograms of the patients were done to record the air conduction threshold (ACT), bone conduction threshold (BCT) and air bone gap (ABG). SPSS 16 software was used for analysis of results. The statistical tests used for analysis was paired t-test, level of statistical significance was set at the P < 0.05.

Results: The mean age of the patients was 28.51±7.20 years with a female preponderance (57.9%). Graft uptake following surgery was 91.9%. There was significant reduction (p<0.001) in the air bone gap postoperatively that suggested improvement in hearing. The mean hearing gain was 13.91±6.79 dB.

Conclusions: The use of endoscopic palisade cartilage myringoplasty to correct subtotal perforation has good results in terms of graft uptake and hearing improvement.

**INTRODUCTION**

Chronic otitis media mucosal type is commonly encountered in the otorhinolaryngology department. Myringoplasty is one of the common surgeries performed in otology to repair the perforation of the tympanic membrane (TM). Over the years, various modifications have been introduced, with the use of different materials including fascia, perichondrium, adipose tissue, synthetic materials, and cartilage. Although, the overall success rates for these materials are high under normal circumstances, the prognosis is not as good in cases of underlying eustachian tube dysfunction, middle ear mucosal disease, active middle ear infection, tympanic fibrosis and large and subtotal tympanic membrane perforations.

Cartilage palisade technique was first described by Heermann in 1962. The use of cartilage as palisade for repair of TM has become more popular due to advantages of this material. Advantages of cartilage as graft are its low metabolic rate with nourishment by diffusion, its stability and resistance to negative pressure and infection in the middle ear. Myringoplasty can be done using permeatal, endaural or postauricular approach. Management of subtotal TM perforations through the transcanal approach can be challenging, but a major boost was given by the use of endoscopes, that allowed minimally invasive surgery without additional endaural or retroauricular incisions. The aim of the study was to assess the graft uptake and hearing after endoscopic palisade myringoplasty in chronic otitis media mucosal type at our hospital.

**METHODS**

A prospective study was conducted at Nepal Medical College Teaching Hospital, otorhinolaryngology department from April, 2022 to January, 2023. The study included patients aged 21 years and above diagnosed as chronic otitis media mucosal type inactive with subtotal perforation and conductive hearing loss. After taking clearance from the Institutional Review Committee (IRC) of Nepal Medical College Teaching Hospital, a written informed consent was taken from all patients before surgery explaining the procedure involved, possible outcomes and complications.

Patients with diseases of the external ear, chronic otitis
media squamous type, mixed and sensorineural hearing loss and congenital anomalies were excluded. History, clinical examination, tuning fork tests, otoscopic examination under microscope (EUM) were conducted preoperatively. Preoperative and post-operative pure tone audiograms of the patients were done to record the air conduction threshold (ACT), bone conduction threshold (BCT) and the air bone gap (ABG). Air bone gap closure in speech frequencies (500 Hz, 1 KHz, 2 KHz, and 4 KHz) according to the American Academy of Otolaryngology Head and Neck Surgery guidelines.\(^9\)

Patients were given oral ciprofloxacin 500 milligrams 12 hourly one day prior to surgery and continued till the seventh day postoperatively. Injection pethidine and promethazine were given intramuscularly to sedate the patient. Local anaesthesia consisting of 5-10 ml of 2% xylocaine with 1: 200,000 of adrenaline, was infiltrated for four quadrants canal wall block and around the tragus. Cartilage graft was harvested from the tragus. Perichondrium of one surface was peeled off leaving the other surface perichondrium intact. The harvested cartilage was sliced into palisades of cartilage using 15 number surgical blade. Rigid Hopkins II endoscope (Karl Storz) 0\(^\circ\) with 4 mm diameter, 18 cm in length was used for surgery. Freshening of the margins of TM and skeletonization of malleus handle was done by using a straight needle through the permeatal approach. Assessment of the perforation, ossicular chain status, middle ear mucosa, and the eustachian tube orifice was done, then dry gelfoam pieces were placed in the middle ear. First, a semilunar-shaped palisade was placed anteriorly near the eustachian tube, then a second piece was placed parallel and anterior to the handle of malleus in contact with the edge of the first. A third piece was then placed like the second one but under the handle of malleus. An appropriately sized and shaped fourth piece was placed posteriorly. Gelfoam pieces soaked in ciprofloxacin ear drops were placed over the graft. Ear canal was packed using ribbon gauze impregnated with antibiotic mupirocin ointment and mastoid bandage was applied. Patients were discharged after the surgery. Follow up was done after 1 week and external auditory pack and sutures were removed from the tragus. Ear drops were prescribed to the patients for 3 weeks and follow up was done after 4\(^{th}\) and 12\(^{th}\) week. Graft uptake was evaluated in 12 weeks by by comparing post-surgery with a p value of <0.001 (Table 2). Mean hearing gain post operatively was 13.91±6.79 dB.

The mean preoperative bone conduction threshold was 13.91±3.06 dB as compared to 13.93±3.65 dB postoperatively. Similarly, the mean preoperative air conduction threshold was 44.81±7.38 dB, with the postoperative value being 29.93±7.26 dB. The mean preoperative air-bone gap was 30.35±7.41 dB, while the air-bone gap postoperatively was 16.44±5.49 dB. Paired t-test comparing the means of the preoperative to postoperative air-bone gap showed a significant difference post-surgery with a p value of <0.001 (Table 2). Mean hearing gain post operatively was 13.91±6.79 dB.

Table 1: Post-operative graft status (n=62)

<table>
<thead>
<tr>
<th>Graft status</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>57 (91.93)</td>
</tr>
<tr>
<td>Failure</td>
<td>5 (8.07)</td>
</tr>
<tr>
<td>Total</td>
<td>62 (100)</td>
</tr>
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Table 2: Comparison of mean pre-operative and post-operative hearing in successful graft uptake (n=57)

<table>
<thead>
<tr>
<th>Hearing Status</th>
<th>Pre-operative</th>
<th>Post-operative</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone conduction threshold</td>
<td>13.91 ± 3.06</td>
<td>13.93 ± 3.65</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Air conduction threshold</td>
<td>44.81 ± 7.38</td>
<td>29.93 ± 7.26</td>
<td></td>
</tr>
<tr>
<td>Air bone gap</td>
<td>30.35 ± 7.41</td>
<td>16.44 ± 5.49</td>
<td></td>
</tr>
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</table>

Out of 57 successful cases, 18 (31.6%) had improved hearing by 1-10 dB, 36 (63.2%) had improvement by 10-20 dB and 3 (5.2%) had improvement in hearing by 21-30 dB (Table 3). Table 3: Air bone gap closure (n=57)

<table>
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<th>Air bone gap closure</th>
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<tr>
<td>1-10 dB</td>
<td>18 (31.6)</td>
</tr>
<tr>
<td>11-20 dB</td>
<td>36 (63.2)</td>
</tr>
<tr>
<td>21-30 dB</td>
<td>3 (5.2)</td>
</tr>
<tr>
<td>Total</td>
<td>57 (100)</td>
</tr>
</tbody>
</table>

RESULTS

A total of 65 participants were recruited for the study, out of which, three were lost to follow-up and graft uptake failed in five patients. The age of the participants ranged from 21 years to 55 years old, with the mean being 28.5±7.20 years. There was a female preponderance 57.9% among the participants with the male to female ratio being 1:1.37. The success rate among the participants who underwent palisade myringoplasty regarding graft uptake was 91.9% (Table 1).

Figure 1: a. Tragal incision b. Harvesting graft c. Palisading of tragal cartilage graft

Figure 2: a. Refreshened margin of tympanic membrane b. Placement of graft in the middle ear c. Graft status after 12 weeks

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DISCUSSION

The study comprised mostly younger patients with a mean age of 28.51±7.20 years, which is similar to other studies. The age range of the patients was also similar to ours with more patients in the younger age groups. Our study had a female preponderance whereas other studies showed males who were affected by the condition undergoing surgery.

Ear surgery was revolutionized initially by the introduction of the monocular microscope in 1921 and then even further in 1922 by Gunnar Holmgren who is responsible for the development of the binocular microscope. This helped illuminate and magnify the surgical field while freeing up both hands to operate on the ear. However, it had its limitations providing a line-of-sight image with a narrow field of view that was restricted by size and shape of the external auditory canal and the speculum. Apart from the technical difficulties it also required a postauricular access into the middle ear spaces, which was associated with its own morbidities.

Endoscopes were used by ENT surgeons since the 1980s primarily for sinus surgery but since the 1990s the focus shifted to include middle ear surgeries. Since then, over the last four decades this instrument has become a powerful addition in the armamentarium of the otolaryngologist, allowing access to hidden recesses for visualization without unnecessary disruption of overlying soft tissue or bone, hence, reducing morbidity.

Endoscopes have provided a non-line-of-sight view that is less limited by the anatomy of the external auditory canal, with image capture taking place at the tip of the endoscope allowing close proximity to the surgical field. The endoscope has allowed for the external auditory canal to be used as a minimal access surgical corridor minimizing the need for soft tissue retraction or bony drilling. Moreover, the endoscope is seen to be more ergonomically suited for operating in the ear as compared to the microscope. Studies have shown that prolonged use of microscopes in less-than-optimal positions during surgery have led to musculoskeletal disorders among otolaryngologists. It has been seen that 48 to 97% of otolaryngologists from around the world have work related musculoskeletal disorders. The main disadvantages of endoscopic ear surgery are mostly related to specific procedures and diseases, which include loss of depth perception and binocular vision, one-handed surgical technique that necessitates the need for a bloodless field, recurrent footing and smearing of the tip of the endoscope and thermal injuries.

Working with the endoscope has offered the surgeon distinct advantages but other factors which are important are graft uptake and improved hearing. Various materials have been used in myringoplasty since the concept was first recognized in 1640 by Banzer who used pig’s bladder. The first true tympanoplasty was performed by Berthold in 1878, using de-epithelised tympanic membrane. Modern tympanoplasty started with the use of microscope and various materials have been used for the graft, ranging from skin, fascia and vein. Cartilage as a graft material has been used in managing retraction pockets. Cartilage as a graft is seen to be more rigid which makes it more resistant to resorption and retraction. They offer more mechanical stability and are better in cases of chronic tubal dysfunction, adhesive processes or total/sub-total defects of the tympanic membrane. Cartilage is also well tolerated by the middle ear and long-term survival is possible. Cartilage is also supplied by diffusion and seems to offer high resistance to lack of vascularization and infections.

A number of techniques were used to prepare the cartilage, which included perichondrial cartilage island technique, the shield technique, the butterfly technique, the crown cork technique and the palisade technique. It was seen that large pieces of cartilage may twist later on, so small palisades of cartilages were used. The palisade cartilage technique was first described by Heermann in 1962, which was later proposed as the method of choice for recurrent defects in the tympanic membrane. It has also been shown that a palisade cartilage tympanoplasty provides restoration of the same level of auditory function as a tympanoplasty using temporalis fascia.

Measures of success of the surgery depends on various factors with the end points being graft uptake and improved hearing. Our study showed a graft uptake of 91.93%, which is comparable to other studies, where the uptake ranged from 88% to 95.24%. Graft uptake rates even in children were similar to adults. Whereas, a study showed 85% graft uptake in palisade cartilage group and 86.3% in the one-piece group.

Another measure of the success of the surgery was improved hearing. Our study showed significant reduction (p<0.001) in the air bone gap postoperatively that suggested improvement in hearing. Mean post operative hearing gain was 13.91±6.79 dB with the maximum number of patients having improvement in hearing ranging from 11 dB to 20 dB. Similarly, most studies showed hearing improvement ranging from 6.3 dB to 19.6 dB.

CONCLUSION

Endoscopic ear surgery is used frequently in cases of chronic otitis media, mucosal type, inactive with subtotal perforation with conductive hearing loss. The use of palisade cartilage myringoplasty to correct these perforations is seen to have good results both in graft uptake and improved hearing as seen by this study.

ACKNOWLEDGEMENT

None

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None
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