# Pediatric Myringoplasty Using Periosteum; An Institutional Overview

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## Abstract:

### Introduction:
Myringoplasty is a common otologic procedure to restore the integrity of the tympanic membrane in cases of traumatic or pathologic perforations. Many grafting materials were used with different techniques.

### Objectives:
In this work, we evaluate our surgical and audiological outcomes of periosteal graft overlying the mastoid cortex through a retroauricular incision in a pediatric cohort.

### Methods:
A retrospective study was carried out involving all children up to 16 years old who underwent periosteal graft myringoplasty for treatment of chronic suppurative otitis media with dry central perforation in our hospital during the period from April 2019 to April 2021. All patients were followed up for one year regarding anatomical success and functional outcomes by comparing preoperative and 6 months postoperative pure tone audiometry.

### Results:
We had 36 patients; 20 of them were females (55.6%) and 16 were males (44.4%). Their ages ranged from 7 to 16 years (mean 12.7 years). Four patients have done surgery for both ears (with interval 6 to 9 months). Out of 40 surgeries performed, 38 ears have shown anatomical success (95%). A highly significant improvement in hearing was obtained (the mean difference between pre and postoperative PTA was 14.6 ± 3.45 dB (p < 0.001).

### Conclusions:
We advocate the use of periosteal graft in pediatric population as a good alternative for other types of grafts with comparable and even better functional and anatomical outcomes.
**Introduction:**

The term "myringoplasty" was first described by Berthold by the end of nineteenth century; he succeeded to close tympanic membrane perforation using full thickness skin graft harvested from the forearm. Since that date, many trials were made using different biologic materials and autologous tissues until introducing the operating microscopy which made a revolution in otologic surgery (1,2). Myringoplasty is defined as the standard surgical treatment of tubotympanic chronic suppurative otitis media (CSOM) which includes simple grafting of the tympanic membrane (TM) without ossiculoplasty (3).

To restore the integrity of a perforated drum, numerous grafting materials have been used including temporalis fascia, cartilage, vein, fat, perichondrium and periosteum (4-7). The type of grafting material is a critical factor in the success of surgical procedure (4). Of these grafts, temporalis fascia ranks first among other grafting tissues with success rates range from 93 to 97% (6). In the last few years, there has been a rising trend in using cartilage grafts as the good substitute for temporalis fascia. Being more stiff, it can resist infection, however this stiffness might have a negative impact on hearing gain (5, 6). In comparison to temporalis fascia and cartilage grafts, periosteum graft has advantages over both in that it is thicker than fascia and thinner than cartilage, which allows it to be used in cases of otorrhoea, Eustachian tube dysfunction, or revision surgery with better hearing results than thick cartilage (8).

In pediatric population, myringoplasty has special considerations due to recurrent episodes of middle ear and upper respiratory tract infections (9). To our knowledge, this topic was rarely mentioned in previous research. In this study, we aimed to evaluate our experience in the use of periosteal graft in the repair of tympanic membrane perforations in pediatric patients with chronic suppurative otitis media (CSOM) discussing their demographics as well as their functional and anatomical outcomes.
Patients and methods:

A retrospective study was carried out involving children up to 16 years old who were diagnosed as having CSOM with dry central perforation (no witnessed aural discharge for 3 months or more) and periosteal myringoplasty was planned for them in our department during the period from April 2019 to 2021. The study copes with regional and institutional guidelines for human studies and was approved by our university ethical committee. A written informed consent was obtained from the patients' guardians. Detailed history was taken and full ENT examination was performed including endoscopic examination of the nose, nasopharynx and Eustachian tube as well as general examination and routine laboratory investigations were performed. Those with adenoid, adenotonsillar hypertrophy necessitating surgery were excluded from our cohort. Ear examination included inspection, palpation, otoscopic and microscopic examination after dry cleansing or suction of wax and any visible aural discharge. Hearing evaluation was done using tuning fork tests. A pure tone audiometry (PTA), for air conduction and for bone conduction (pure tone average - air-bone gap [PTA-ABG]) in the frequencies of 0.5 kHz, 1 kHz, 2 kHz, and 4 kHz, was performed for all patients within one week preoperatively and 6 months postoperatively. Patients with active, quiescent stage of CSOM, aural polyps or cholesteatoma were excluded from our cohort. In addition, patients with traumatic perforation whether accidental, iatrogenic or perforation following the insertion of tympanostomy tubes, ossicular discontinuity, tympanosclerosis, sensory neural hearing loss, and previous ear surgery were also excluded.

Surgical technique:

Surgery was performed by senior ENT surgeons under general anesthesia. Postauricular incision was performed and deepened until reaching the periosteal layer covering the mastoid cortex (Fig; 1). Then, the graft was harvested gently by the use of scalpel and periosteal elevator, crushed in a graft forceps and fashioned gently according to the size of perforation (Fig; 2). The posterior meatal wall was elevated until reaching the tympanic annulus and the middle ear was entered. Refreshing of the perforation edges was done with microscopic needle and round knife until a bleeding surface was obtained all around. Syringing of the Eustachian tube by saline through a wide pore cannula was done to confirm its patency. Ossicular chain mobility was assessed.
After preparing the graft, placement was done by underlay technique (underneath the malleus handle and medial to the remnants of the tympanic membrane) under microscopic vision. In cases of amputated or short malleus handle, the graft was put over the handle. Small pieces of gelfoam were placed layer by layer after replacement of the posterior meatal wall. Then, vaselinized gauze impregnated with antibiotic ointment was put in the EAC and the wound was closed. A tight sterile dressing was put over the wound for 48 hours. Both intraoperative and postoperative complications (during follow up visits) were reported if present.

Follow up:

Early postoperative; Patients were discharged on the next day of surgery. Systemic antibiotics were prescribed for 10 days, dressing was removed after 2 days and the vaselinized gauze was removed after 10 days.

All children were followed up for one year (anatomical success was assessed monthly for the first 6 months then every 2 months for the next 6 months) regarding the graft healing (anatomical success) {Fig 3&4} and pure tone audiometry was performed after 6 months to evaluate the hearing gain (functional success) (Fig 5).

Statistical analysis:

Categorial variables were expressed as numbers and percentages whereas continuous variables were expressed as mean ± standard deviation (SD). Student t-test was used to calculate the difference between pre and postoperative audiometric results. All analyses were done using statistical package for social sciences (SPSS) software version 19. $P$ value less than 0.05 was set as significant.
Results:

Our study included 36 patients; 16 were males (44.4%) and 20 were females (55.6%). Their ages ranged from 7 to 16 years (mean ± SD = 12.7 ± 4.5 years). The disease (CSOM) was unilateral in 21 patients (58.3%) and bilateral in 15 patients (41.7%). The main complaints of the patients were recurrent ear discharge in 91.7%, hearing loss in 86.1%, tinnitus in 13.9%, and recurrent otalgia in 16.7%. The right ear was operated in 18 patients (45%) and the left one in 22 cases (55%). Surgery was performed for both ears in 4 patients with an interval of 6 to 9 months. Anatomical success and the graft was taken in 38 out of 40 ears (95%). As regard hearing gain, we found a highly significant difference between the preoperative air-bone gap (ABG) [mean ± SD =34.42 ± 4.51] and postoperative ABG (mean ± SD = 19.83 ± 4.68), with a mean improvement in hearing of about 14.6 ± 3.45dB, \( p \text{ value} < 0.001 \). Table 1.
**Discussion:**

Since it was first described by Berthold, various grafting tissues have been used for myringoplasty in order to obtain an intact tympanic membrane after being disrupted by trauma or CSOM. Grafts vary regarding their ease of harvesting, preparation time, placement ease, viability, graft uptake and hearing improvement. Of these autologous tissues, temporalis fascia and cartilage are the commonest in the recent practice with comparable graft uptake and hearing outcomes that reach more than 90% (6, 8, 10). The periosteum has been used since a long time; however, its use is still limited. It has many advantages over temporalis fascia in TM repair due to its consistency, elasticity, easier manipulation, and matching with the fibrous layer of the ear drum that facilitates its uptake. In addition, Periosteum can resist well in the first few days after transplantation due to its very low metabolic requirements. Also, it has been proved to act as excellent templates for vascularization (11). Moreover, it can be used in cases of discharging ears and revision cases. Periosteum is characterized by easy availability (as it can be taken in the same incision), sufficient quantity, excellent contour, and good tensile strength (8).

To the best of our knowledge, the use of periosteum in pediatric CSOM was scarcely mentioned in previous research. Some authors have reported their experience with periosteal myringoplasty but without age predilection. In addition, most of their study groups were adults (7, 8, 12). Proper selection of a suitable graft is crucial especially in pediatrics due to recurrent episodes of respiratory tract infection which threaten surgical success (9). Our results have shown an excellent graft uptake (95%). These results of periosteal graft uptake are similar to ElTaher et al., Rao et al., Elmoursy and Elbahrawy, and ElBatawi et al., where the rate of periosteal graft uptake was 93%, 96%, 95% and 93% respectively (7,8,12,13) These results are also comparable to other types of grafts whether temporalis fascia or cartilage (6, 10, 12,13).

The Functional success of periosteal myringoplasty was evaluated by comparing preoperative ABG (34.42 ± 4.51) with postoperative ABG (19.83 ± 4.68) with the mean improvement in hearing of 14.6 ± 3.45dB. This agreed with ElTaher et al. and ElBatawi et al. They reported improvement of hearing in patients underwent periosteal myringoplasty by about 11dB at 6 month postoperative (7, 13). These functional outcomes are comparable and more superior to the results reported for other graft materials (6,12,13). As regard
complications of surgery and causes of failure in pediatric myringoplasty, several factors were reported in
literature including age (younger age groups showed higher failure rates), timing of surgery (operating on wet
ears increases failure rate), condition of the upper respiratory tract, contralateral ear, presence of
tympanosclerosis, size and site of perforation (9, 14, 15). In our series, two cases have shown graft failure. We
owed this failure to the occurrence of early postoperative infection and missed follow up visits.

In our opinion, periosteal graft is a very good option in pediatric myringoplasty as it can erase the black dots in
other types of grafting materials. Finally there were some limitations of our study including relatively small
sample size and lack of control group, In addition, longer follow up period would strengthen our results.

Conclusions

We advocate the use of periosteal graft in pediatric population as a good alternative for other types of grafts
with comparable and even better functional and anatomical outcomes.
References:


Figure legend

Figure 1: Postauricular incision.
Figure 2: Periosteal graft.

Fig 3: Preoperative left tympanic membrane dry central perforation.

Fig 4: 6 months postoperative left tympanic membrane same patient.

Figure 5: Pre and 6 months postoperative audiometry of one patient operated in the Rt ear from our series.

shows complete closure of the air bone gap.
Figure 1: Postauricular incision in one of our patients

65x48mm (300 x 300 DPI)
Figure 2: Periosteal graft

84x101mm (300 x 300 DPI)
Figure 3: Preoperative left tympanic membrane perforation in one of our patients

44x60mm (300 x 300 DPI)
Figure 4: Six months postoperative view of the tympanic membrane in the same patient

60x44mm (300 x 300 DPI)
Figure 5: Pre and 6 months postoperative audiogram showing closure of conductive gap in the right ear.

87x87mm (350 x 350 DPI)
Table 1: Demographic data, anatomical and functional outcomes of our study

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<tr>
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<tr>
<td>Age Years (mean ± SD)</td>
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<tr>
<td>Ear discharge</td>
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<td>Hearing loss</td>
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<td>Graft Uptake</td>
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<td>Preoperative ABG (In dBs)</td>
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<tr>
<td>Preoperative ABG (In dBs)</td>
<td>19.83 ± 4.68</td>
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<td>Mean Improvement in Hearing (In dBs)</td>
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