

## Repair of Central and Marginal Perforations with Endoscopic Notched Thinned Tragal Chondroperichondrial Graft Myringoplasty in Adults

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### ABSTRACT

**Background:** Tympanic membrane perforation repair methods are available in a variety of types and can typically be categorised as underlay or overlay grafting methods. Each approach has a specific use, benefits, and challenges.

**Objective:** Evaluation of hearing level and closure of the tympanic membrane by the graft after endoscopic notched thinned tragal chondroperichondrial graft myringoplasty with no need to elevate the tympanomeatal flap for repair of central and marginal perforations.

**Patients and Methods:** A total of 30 participants with medium-sized central or marginal posterior perforations were included. done for them endoscopically assisted with notched thinned tragal chondroperichondrial myringoplasty was done for them. Measurements of hearing level and attachment rate of the graft after six months from the surgery, then again nine months later on.

**Results:** At six months, the take rate of the graft together with complete closure of the perforation was 96.7% (29/30), but after nine months, it was 93.3% (28/30). One patient experienced anterior annulus lateralization in addition to extrusion, and there was still evidence of perforation. 2 patients had acute otitis media at the same side of surgery resulting in a perforation. The mean preoperative gap between air and bone conduction ( $27.62 \pm 3.15$  dB) was more significant than the mean air-bone gap postoperatively ( $12.16 \pm 3.01$  dB;  $P < 0.05$ ) at six months. However, there was no statistically significant difference in the functional success rate ( $P 14.472$ ), air-bone gap (ABG) levels ( $P 14.877$ ), or ABG gain ( $P 14 0.748$ ) between the post-6 months or post-9 months.

**Conclusion:** Endoscopic notched thinned chondroperichondrial graft myringoplasty with no need to elevate the myringomeatal flap is ideal for repairing central perforations. With minimally invasive technology. The long-term success rate of the graft is as high as the short-term success rate, and the hearing results are promising.

**Keywords:** Endoscopy, Myringoplasty, Central perforation, Chondroperichondrial graft.

### INTRODUCTION

Overlay or underlay myringoplasty is required to treat perforations relating to the mucosal type of chronic otitis media with intact ossicles. Generally speaking, the underlay approach carries a higher likelihood of graft failure. This is because marginal perforations cannot be supported by the residual natural tympanic membrane (TM)<sup>(1,2)</sup>. The graft lateralization, with anterior blunting of the overlay technique, makes it technically more challenging and occasionally more time-consuming. To increase the success rate of grafts, other surgical procedures have been devised, such as loop underlay tympanoplasty and over-under tympanoplasty. Mediolateral graft myringoplasty together with the "window shade" technique are considered as some different approaches to increase the success rate in such cases<sup>(3-7)</sup>.

To enhance the taking rate of grafts, all of these procedures call for the elevation and repair of tympanomeatal flaps of various sizes. The operation took longer because of the elevation. Although there may be no need to elevate the tympanomeatal flap in butterfly cartilage tympanoplasty, it can be challenging to guarantee that the cartilage part of the graft groove closely matches the perforation borders<sup>(8-10)</sup>.

In this study, central perforations together with marginal posterior ones are repaired using notched thinned cartilage-perichondrium graft myringoplasty. Elevated

tympanomeatal flap is not required because the perichondrium graft is positioned to the lateral side of the bone annulus, and the posterior wall of the external auditory canal (EAC). We discussed our preliminary findings regarding hearing improvement and grafting success rate.

### PATIENTS AND METHODS

A total of 30 participants with medium-sized central or marginal posterior perforations were included. Endoscopically assisted with notched thinned tragal chondroperichondrial myringoplasty was done for them. Measurements of hearing level and attachment rate of the graft after six months from the surgery, then again nine months later on. The duration of such a prospective case study was January 1, 2020, to December 31, 2021. A medium-sized central or marginal perforation located posteriorly, an intact ossicles without atticofacial disease or cholesteatoma, and a requirement for TM closure were among the inclusion criteria. It is necessary to rule out ossicular chain erosion or discontinuity besides secondary cases. To rule out cholesteatoma of the middle ear, computed tomography for the temporal bone/magnetic resonance imaging was needed. P audiometry of pure tone type was performed prior to operation, as well as 6 and 9 months later, at 0.5, 1, 2, and 3 kHz standard frequencies. The average difference in conduction between air and bone at 0.5, 1,

2, and 3 kHz was known as the air-bone gap (ABG). TM perforations were assigned to each one small (50% of the eardrum) or large (> 50% of the eardrum).

**Surgical procedure (Figure 1):**

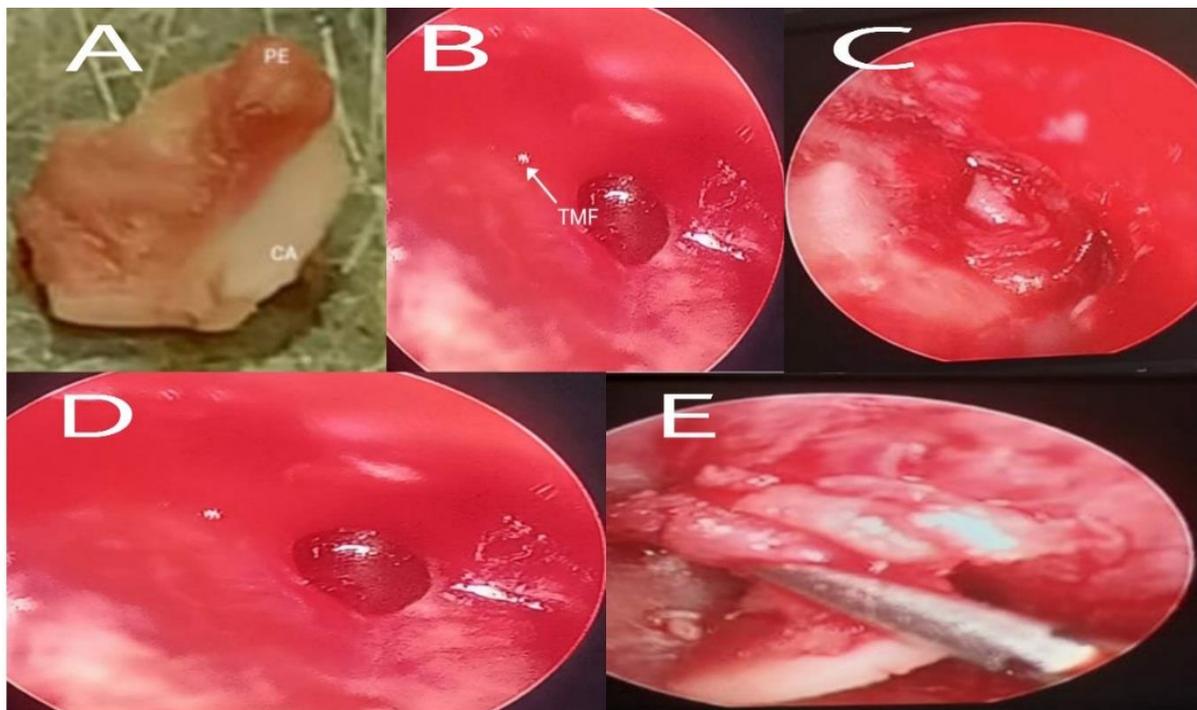
A rigid endoscope measured 0°, 4 mm with a focal length of 18 cm and a high one definition display was employed. Use of it was necessary to perform surgery using the right hand and hold the endoscope with the left hand. While the surgeon stood on the same side of the diseased ear, the monitor was put on the patient's other side. So each patient was asleep during general anesthesia. A 1.5 to 2 mm skin incision was made on the medial aspect of the tragus related to the same repair side to harvest the chondroperichondrial piece and ensure that the covering perichondrium was removed from either side of the cartilage.

The composite graft must be thinned and at least 2 mm broader than the perforation's diameter. One side of the composite graft's perichondrium was peeled over by at least 2 mm to reveal cartilage and create a free perichondrium. The perichondrium on the other side was left unattached to the cartilage. To guarantee that the graft was 2 mm greater than the perforation margins or more but not less than this measurement, the perichondrium-lacking cartilage was thinned and partially removed with a small scalpel thinning out of the cartilage to the degree that it became semiopaque. Another piece of cartilage was taken and designed as a perpendicular bar to be placed later on between the graft and the malleus handle to enhance the support.

Formation of a notch in the cartilage, from which the perichondrium was peeled off to accept and house the malleus' handle. Removing the epithelium from A pick with an angle was used to perforate the edges. To prevent the later development of cholesteatoma, cleaning of the epithelium covering the distal part of the malleus handle was done. Before inserting the graft, the middle ear was filled with gel foam. The next step was to put the perpendicular piece of cartilage and fix it to the malleus handle with endoscopy assistance. After that, the insertion of the graft came immediately. Use of some hyaluronic acid medial to the graft was done.

The cartilage graft's notch was facing that perpendicularly positioned piece of cartilage against the handle of the malleus and was positioned medial to the remaining TM, and the anterior annulus in an underlay fashion. Cartilage missing perichondrium was positioned medial to the posterior bony annulus. Without elevating a tympanomeatal flap, the free perichondrium was positioned lateral to the handle of the malleus, the posterior bony annulus, and the posterior EAC over a distance of at least 2 mm. Gel foam infused with antibiotic cream should be placed to support the thinned, notched cartilage medially and laterally. The EAC was packed with a small piece of merocele soaked in antibiotic ointment up to the tragus incision, which was sutured immediately after taking the graft.

**EAC** is for the external auditory canal; **MA** stands for malleus. **PE** stands for perichondrium, and **TMP** stands for tympanic membrane perforation.



**Figure (1): Diagram of surgical procedure.** One side of the graft peeling of perichondrium (A). A portion of the perichondrium-deficient cartilage was excised (B). Perforation before surgery (C). updated perforation edges (D). The posterior bone annulus and EAC were implanted anterior to the free perichondrium (E).

**Postoperative follow-up:**

After the gel foam remnants were removed from the EAC 3 to 4 weeks after surgery and the merocele packing was removed from the EAC 14 days after surgery, the graft could then be seen. All patients in the outpatient department were followed up after two weeks. Endoscopic otological evaluations were carried out 1, 3, 6, and 9 months after surgery.

Graft take-up was assessed with the aid of endoscopy after the sixth and ninth postoperative months in addition to audiometric evaluation for the ABGs. Recording of any intra- or post-operative complications was done.  $ABG \leq 20$  dB was the definition of functional success besides an intact graft lacking perforation, retraction, lateralization, significant blunting, and medialization.

**Ethical consent:**

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

**Statistical Analyses**

Utilizing the software SPSS version 20, statistical analyses were conducted (IBM Inc). Both means (SDs) and percentages (%) were used to express the data. We used the Wilcoxon signed-rank test to compare the pre- and postoperative ABGs.  $P \leq 05$  was regarded as statistically significant.

**RESULTS**

Thirty patients with unilateral, central perforations related to COM were included (17 right ear and 13 left ears), 21 females, plus nine males. There was no statistically significant difference between the groups after 6 and 9 months. Mean age was 46.3 years. There were 20 medium-sized and ten minor perforations. The average time between perforations was  $16.5 \pm 6.3$  years (Table 1).

**Table (1):** Demographic data of the studied patients

Gender	Number	Percent%
Males	9	30%
Females	21	70%
Age (Years) (mean $\pm$ SD; years)	46.32 $\pm$ 11.82	
Total	30	100%

All patients had healed tragal incisions by the tenth postoperative day. From the beginning of surgery following anesthetic induction through EAC packing, the mean operating time was 38.8  $\pm$  11.6 minutes. All patients underwent follow-up for a mean of 14.9 months, which was always more than 12 months (range: 12.2-18.4 months). At six months and nine months, the success rate of the graft was 96.7% (29/31) and 93.3% (28/31), respectively. Only one patient showed cartilage graft expulsion and migration towards the anterior annulus as well as a minor residual perforation. Another patient experienced moderate otorrhea but it went away after receiving systemic antibiotics and local ofloxacin otic solution. At 12 months, the recurrence affected two patients (Table 2, Figure 2).

**Table (2):** Comparison of Success Rates and Hearing Improvement in the Postoperative 6 and 9 Months

	ABG (mean, dB)	Gain (mean, dB)	ABG closures (dB), 0_10	ABG closures (dB), 11_20	ABG closures (dB), 21_30	Graft success, No.(%)
Postoperative six months	12.15 $\pm$ 3.0	16.14 $\pm$ 4.01	17 (44.8)	13 (41.9)	1 (2.2)	29(96.7)
Postoperative nine months	10.26 $\pm$ 2.41	17.36 $\pm$ 4.23	21 (71.0)	8 (25.8)	1 (3.2)	27 (93.3)
P value	0.871	0.658	0.293	0.293	0.472	0.605



**Figure (2):** Graft after 6 week postoperative.

## DISCUSSION

However, Low graft success rates and high complication rates have been seen. Some academics have recently improved the myringoplasty repair of central and marginal perforation. A 99.3% closure rate using loop underlay tympanoplasty was reported by **Barake *et al.***<sup>(1)</sup>. **Panchal *et al.***<sup>(2)</sup> achieved an over-underlay myringoplasty success rate of 95%. By employing other graft procedures, such as the double layer technique, other surgeons have achieved 95% success rates of graft take, 97.9%<sup>(12)</sup> and<sup>(11)</sup> 90%<sup>(13)</sup>. After the overlay technique for tympanoplasty, graft take rates in other investigations were 96.7%<sup>(14)</sup> and 97.1%<sup>(15)</sup>.

However, in investigations of the three latter procedures, the elevation of posterior meatal skin was necessary for the graft to take. After six months in this trial, the success rate of the graft was 96.7%. (29/30), and at nine months, it was 93.2% (28/30). ABG decline of 10 to 20 dB were attained by 96.7% of patients. At six months, the mean postoperative ABG ( $10.2 \pm 3.99$  dB) was significantly lower than the mean preoperative ABG ( $29.60 \pm 3.15$  dB) ( $P=0.05$ ). Regarding values of the air-bone gap, a gain of the air-bone gap, or hearing improvement, there was no statistically significant difference between the groups after 6 and 9 months. As a result, our findings are comparable to those of earlier research. The skin of the posterior meatal wall was not subjected to any manipulation by us. Free tail of the perichondrium was put on the lateral side of the malleus handle, the bony annulus, and the posterior EAC and the support of the graft medially was achieved by the perpendicular bar of cartilage against the handle of malleus, which in turn was connected to it by a small drop of fibrin glue. Even while some researchers have created endoscopic cartilage tympanoplasty techniques using only small tympanomeatal flaps, flap elevation is still necessary<sup>(16-18)</sup>. The procedure took less time when

there was no tympanomeatal flap elevation (on average,  $42.9 \pm 11.7$  minutes in the current study).

The cartilage was underlaid medially to the remaining TM and annulus, totally closing the perforation. The posterior EAC was implanted laterally into the free perichondrium that was still connected to the cartilage graft. A designed piece of merocele in the EAC was preceded by gel foam, which in turn supported and strengthened the graft. To keep the cartilage, the posterior bony annulus, and the remaining TM in close contact, the cartilage graft may be tautened by the EAC perichondrium to prevent collapse. The EAC is covered with the greatest perichondrial flap that can be used. This big flap nourishes the cartilage by coming into contact with the EAC and the underside of the TM. This increases the viability of the cartilage<sup>(19, 20)</sup>. Several researchers achieved reasonable success rates when they used butterfly myringoplasty with no need for an elevated tympanomeatal flap. The cartilage graft is secured to the bone annulus using a notch 1 to 2 mm deep.

On the other hand, we raised the tension applied to the cartilage graft's free perichondrium, which was designed as a tail and stuck to the external canal by gel foam. It takes time to carefully create the graft notch and make it too thin to accommodate the thickness of the tympanic membrane, together with reducing the bearing weight on ossicles (which must precisely suit the perforation edges). Follow-up revealed no issues (decreased hearing level, change of taste, facial nerve weakness, tinnitus, vertigo, EAC stenosis, graft, or blunting). However, in one case, there was evidence of cartilage transplant extrusion and lateralization in the part of the anterior annulus. It is possible that we used an enormous graft.

Our main worries were the clinical prognosis and the possibility of cholesteatoma development in the EAC surface perichondrium. We discovered that the perichondrium ultimately merged with the skin of the external auditory canal to the point where the "borders" were challenging to distinguish by endoscopy. At 24 months after surgery, computed CT showed a well-pneumatized mastoid cavity and middle ear. Although we did not find any cholesteatoma pearls, a longer-term inspection is still required.

## CONCLUSION

Central and marginal perforations can be successfully repaired using endoscopic notched thinned tragal cartilage graft myringoplasty without elevation of the tympanomeatal flap. The procedure is minimally invasive and has a high percentage of short- and long-term graft success. The results in terms of hearing are also satisfactory.

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