

# Assessment of the role of otoendoscopy in evaluating Eustachian tube and middle ear status during myringoplasty

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## Objective

To assess the role of otoendoscopy in evaluating Eustachian tube and middle ear status during myringoplasty.

## Background

Eustachian tube function has been the center of focus as a prognostic factor for middle ear surgery success because of its primary role in the middle ear aeration and in the pathogenesis of otitis media. Otoendoscopic evaluation of Eustachian tube allows visualization of the protympanic segment of the Eustachian tube and hidden recesses of the middle ear.

## Patients and methods

In this prospective study, patients with a persistent dry central tympanic membrane perforation were operated at Otorhinolaryngology Department of Menoufia University Hospital in the period from March 2017 to February 2019. All patients were divided into two groups: group A included 50 cases that underwent otoendoscopic-assisted microscopic myringoplasty, and group B had 50 cases that underwent microscopic myringoplasty.

## Results

This study included 100 patients, with a mean age of 30.2 years. Overall, 42% of the patients were male and 58% of the patients were female. Otoendoscopic examination of middle ear in group A showed 20% of cases with adhesions and secretions at tympanic orifice of the Eustachian tube opening plus 8% of cases with congested mucosa at middle ear apparatus. The success of graft uptake was 94% in group A and 84% in group B.

## Conclusion

The result of this study supports the use of otoendoscopy in traditional microscopic myringoplasty. Endoscopy could be utilized efficiently to improve the visibility of the Eustachian tube opening and middle ear apparatus and then dealing with any pathology affecting them.

## Keywords:

Eustachian tube, middle ear, myringoplasty

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## Introduction

Tympanic membrane (TM) perforations primarily result from either infections or trauma. Overall, 80% of these perforations heal spontaneously. Surgical repair, known as myringoplasty, is usually proposed for persistent perforations. Myringoplasty is a surgical technique used to restore the integrity of TM [1].

Traditionally, surgeons perform microsurgery of the middle ear with the assistance of a microscope. However, the microscope offers a straight-line view, which limits the visual field in the deep recesses of the middle ear. Therefore, middle ear surgery is increasingly performed endoscopically. Surgeons can also rapidly obtain close-up and wide-angled views by inserting or withdrawing the endoscope to enable visualization of the whole perforation, anterior canal wall, attic, and hypotympanum in the middle ear [2].

The advantages of the endoscopic approach also include a decrease in the operative time, which leads to decrease of the duration of anesthesia and related adverse effects [3]. Using a thin rigid angled endoscope, a surgeon can perform minimally invasive procedures with the protection of the anatomy, which allows functional reconstruction during surgery [4].

Eustachian tube function (ETF) has been the center of focus as a prognostic factor for middle ear surgery success because of its primary role in the middle ear aeration and in the pathogenesis of otitis media. So,

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there is general agreement that adequate ETF is necessary for successful middle ear surgeries [5].

Several tests have been proposed for evaluation of ETF such as Valsalva maneuver, Politzer test, tympanometry, Valsalva computed topography, and sonotubometry. However, otoendoscopy offers direct assessment tool for such function and to visualize middle ear compartments. The aim of this study is to evaluate the role of otoendoscopy in evaluating Eustachian tube and middle ear status during myringoplasty.

### Patients and methods

Our prospective study was carried on 100 patients with persistent dry central TM perforation after approval of the ethical committee of the hospital during the period from March 2017 to February 2019. Patients were divided randomly into two groups: group A, which was composed of 50 patients for otoendoscopic assisted microscopic myringoplasty to assess Eustachian tube and condition of the middle ear, and group B, which was composed of 50 patients for traditional microscopic myringoplasty.

Patients were recruited from Otorhinolaryngology Department of Menoufia University Hospital in line with the following inclusion and exclusion criteria:

- (1) Inclusion criteria: patients with inactive chronic tubotympanic otitis media, patients with pure conductive hearing loss, and patients less than 10 years old or more than 40 years old.
- (2) Exclusion criteria: patients with sensori-neural hearing loss, discharging ear, or previous ear surgeries and patients with comorbid systemic diseases like diabetes or any chronic specific infections.

#### (1) Preprocedure assessment

- (a) Full medical history included onset, course, duration, last attack, amount and color of otorrhea, hearing loss, tinnitus, and other complaints plus history of previous surgery or other system affection.
- (b) Clinical examinations including otological examination, site, size by visual assessment of perforation and any ear discharge or any abnormality of the external auditory canal were carried out. Nasal examination was done to detect any abnormality, for example, deviated nasal septum or rhinosinusitis.
- (c) Audiological assessment (pure tone audiometry and tympanometry) was done.

#### (2) Operative technique:

- (a) After taking a written consent from every patient, all patients were subjected to otoendoscopic assisted microscopic myringoplasty to assess Eustachian tube and middle ear condition under general anesthesia.
  - (b) The middle ear was examined with an operating microscope (Carl Zeiss, Jena, Germany) in different positions. The visible anatomical areas were evaluated and recorded by performing gentle maneuvers on the patient's head.
  - (c) The middle ear was evaluated using a 0° and 30° rigid endoscope (Karl Storz image 1 high-definition H3 3-chip camera head and diameter 4 mm, work length 18 cm, Karl Storz image lens; Karl Storz, Tuttlingen, Germany). The condition of middle ear mucosa and Eustachian tube opening were examined. Incus, the handle of malleus, and remnant of TM were also examined to deal with any detected pathology.
  - (d) After sterilization of the ear, trimming of the perforation edges was done. The margins of perforations were freshened. Temporalis fascia graft was taken which was placed in an underlying manner, medial to handle of malleus, via postaural approach after tympano-meatal flap elevation. Gelfoam soaked in ear drops containing antibiotics was used to stabilize the graft.
- #### (3) Postoperative assessment:
- (a) All patients had a postoperative systemic antibiotic treatment for 2 weeks.
  - (b) Clinical otological examination, pure tone audiometry, and tympanometry were done at 3 and 6 months postoperatively.
- #### (4) Outcomes:
- (a) Primary outcome: the comparison between microscopic and endoscopic findings in the middle ear cleft.
  - (b) Secondary outcome: assessment of the success rate of otoendoscopic assisted microscopic approach regarding the closure of TM perforation and improvement of postoperative air-bone gap (ABG) after 3 and 6 months.

### Statistical analysis

Statistical analysis was carried out using statistical package for the social sciences software (IBM SPSS for Windows, version 22.0; SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were presented as mean±SD. The  $\chi^2$ -test was used for comparison between qualitative variables. An independent-sample *t*-test was

used for comparison between normally distributed quantitative variables. Statistical significance was set at *P* value less than 0.05.

## Results

The mean age of patients was 30.2 years. Overall, 42% of patients were male and 58% of patients were female (Table 1).

In this study, otoendoscopic examination of Eustachian tube opening and middle ear status showed nonsignificant differences compared with microscopic findings in group A ( $P > 0.05$ ; Table 2).

Our study showed a highly significant decrease in postoperative ABG. The mean preoperative ABG was  $32.8 \pm 8.1$  and the mean postoperative ABG after 3 and 6 months was  $17.4 \pm 4.5$  and  $9.7 \pm 6.0$ , respectively, in group A. The mean preoperative ABG was  $32.8 \pm 8.1$  and the mean postoperative ABG after 3 and 6 months was  $17.8 \pm 3.9$  and  $10.2 \pm 7.1$ , respectively, in group B ( $P < 0.001$ ; Table 3).

The success rate in our study was 94% in group A compared with 84% in group B, with statistically insignificant difference (Table 4).

## Discussion

TM perforations may result from infection, trauma, or tympanostomy tube insertion. Although 88% of

traumatic perforations heal without intervention, the rest of them become chronic and require surgical intervention. These unhealed perforations typically require tympanoplasty for closure [6].

The ETF is one of the most important factors that determine the surgical outcome in patients with chronic tubotympanic otitis media [7]. A properly functioning Eustachian tube is an integral part of a normally functioning middle ear, and the existence of good tubotympanic mucociliary drainage constitutes a favorable prognostic factor in the outcome of reconstructive surgery of the middle ear [8].

In this study, the otoendoscopic Eustachian tube evaluation is significantly correlated with the outcome of surgery. Earlier studies of ETF have mainly employed the technique of politzeration, which is insensitive and difficult to quantitate. Sientop [9] and Palva [10] worked on quantitative methods for measuring preoperative tubal function in patients with perforation of the drum.

Using sonotubometry, the rate of detectable Eustachian tube opening with swallowing varies among studies. The rate of Eustachian tube opening with swallowing in diseased patients appears lower. Swarts *et al.* used white-noise signal sonotubometry simultaneously with tympanometric methods to confirm Eustachian tube opening and found that sonotubometry had a sensitivity and specificity of 74.2 and 65.6%, respectively, for identifying Eustachian tube openings in healthy individuals. Although widely applicable, the efficacy of sonotubometry when a middle ear effusion is present is debated, with one study suggesting sonotubometry has a predictive rate for otitis media with effusion in children of 85% [11].

**Table 1 Epidemiological study of the studied cases**

Variables	Total cases (N=100)
Age (mean±SD) (years)	30.2±9.8 (10–40)
Sex [n (%)]	
Male	21 (42)
Female	29 (58)

**Table 2 Microscopic and endoscopic findings of both groups**

Findings	Total (N=100) [n (%)]		$\chi^2$ -Test	P value*
	Endoscopic findings in group A (N=50)	Microscopic findings in group B (N=50)		
ME mucosa				
Healthy	46 (92)	50 (100)	6.439	0.169 (NS)
Congested	4 (8)	0		
Remnant of TM				
Normal	42 (84)	47 (94)	7.538	0.110 (NS)
White patches	8 (16)	3 (6)		
ET opening (tympanic orifice)				
Normal	40 (80)	47 (94)	7.612	0.461 (NS)
Discharging	10 (20)	3 (6)		
Ossicles				
Normal	50 (100)	50 (100)	–	–
Eroded	0	0		

\* $P < 0.001$ , highly significant (HS); \* $P > 0.05$ , NS; \* $P \leq 0.05$ , significant (S).

**Table 3 Postoperative air-bone gap in studied groups**

Groups	Postoperative air-bone gap after (mean±SD)		t-Test	P value
	3 months	6 months		
Group A	17.4±4.5	9.7±6.0	15.631	0.0002 (HS)
Group B	17.8±3.9	10.2±7.1	14.541	0.0002 (HS)

\* $P \leq 0.001$ , highly significant (HS); \* $P > 0.05$ , NS; \* $P \leq 0.05$ , significant (S).

**Table 4 Success rate regarding graft uptake in studied groups**

Groups	Total (N=100) [n (%)]
Group A	
Success	47 (94)
Failure	3 (6)
Group B	
Success	42 (84)
Failure	8 (16)

A prospective study by Tarabichi and Najmi [12] indicated that in most persons with healthy ears, temporal bone computed tomography scans performed during the Valsalva maneuver can visualize the distal third of the Eustachian tube lumen, suggesting that this imaging strategy could help to localize disorders in patients with symptoms of Eustachian tube obstruction. The study was performed on 38 patients, with the distal third of the lumen visualized in 71 (93%) ears and the entire lumen visualized in 27 (36%) ears.

Using transnasal videoendoscopy in 33 adults, Alper *et al.* [13] found evidence that during swallowing, elevation of the soft palate (which is associated with rotation of the medial lamina and widening of the Eustachian tube orifice) is decreased in persons with a healthy middle ear but with a history of middle ear disease, compared with persons with a healthy middle ear and no history of middle ear disease, perhaps indicating that such individuals have reduced ETF and a greater risk for otitis media.

Smith *et al.* [14] emphasized that the Eustachian tube is a complex structure. In their review of Eustachian tube imaging, they claimed that best method for Eustachian tube imaging can be achieved by computed tomography and MRI.

In group A of patients, endoscopic examination of Eustachian tube opening showed 20% of cases with discharging tympanic orifice of the Eustachian tube plus 80% of cases with normal appearance. Microscopic examination of Eustachian tube opening showed 6% of cases with discharging tympanic orifice of the Eustachian tube plus 94% of cases with normal

appearance. Endoscopic findings also showed four cases with congested mucosa around Eustachian tube opening that could not be detected by the microscopy. However, Farhani *et al.* [15] found out that 51% of chronic otitis media cases only could be examined for Eustachian tube opening using microscopy and 91.4% of chronic otitis media cases could be examined for Eustachian tube opening using otoendoscopy.

Generally, the success rate of otoendoscopic assisted microscopic myringoplasty improved the surgical outcome of chronic otitis media owing to the eradication of remaining pathologies in middle ear cleft, as studied by Farhani *et al.* [15].

Lakpathi *et al.* [16] found that 86.6% patients had a successful outcome in the endoscopy group and 90% patients had a successful outcome in microscope group after 6 months of follow-up. However, in this study, we found out that endoscopic assisted microscopic technique had 94% successful outcome in group A and 84% successful outcome in group B. This could be explained by dealing with the pathology detected.

In this study, postoperative ABG after 3 months and 6 months in group A was 17.4±4.5 and 9.7±6.0, respectively, which is highly significant, whereas Shoeb and Gite [17] found that postoperative ABG after 3 and 6 months was 18.13±2.59 and 14.47±1.96 in endoscopic group, but postoperative ABG after 3 and 6 months was 17.4±4.9 and 16.87±4.3 in microscopic group.

Using endoscopy in middle ear surgeries has some limitations, including the necessity using one hand instead of two, the creation of significant heat in the middle ear, and trauma to the middle ear because of undesirable hand movements. Further studies with a larger sample size are necessary to provide a statistically significant value to gauge the more effective method.

## Conclusion

Otoendoscopy is an important tool for assessment of middle ear status and ETFs during myringoplasty, proposing an increase in the success rate. The endoscopic-assisted microscopic myringoplasty had a 94% rate of surgical success for the closure of TM defects. The result of this study supports the use of otoendoscopy in traditional microscopic myringoplasty.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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