Endoscopic versus Microscopic Myringoplasty in Anterior Central Tympanic Membrane Perforations

Original Article

Hosam Adel Hussein, Ahmad Mahmoud Hamdan, Ahmed Hamdy Elshafai

Department of Otorhinolaryngology, Faculty of Medicine, Menoufia University, Egypt.

ABSTRACT

Objective: To compare the surgical and functional outcomes of endoscopic and microscopic myringoplasty (MM) in reconstructing anterior central tympanic membrane (TM) perforations.

Patients and Methods: A prospective comparative study was conducted on fifty patients with anterior TM perforation who were randomly and equally distributed among two groups for EM and MM. Both groups were compared regarding the operative details and postoperative outcomes.

Results: The graft success rates after 6 months for EM and MM were 88% and 72% respectively ($p=0.157$). The operative duration was significantly shorter in the EM group ($p<0.001$). Intra-operative blood loss was significantly less in EM ($p<0.001$). ABG was significantly improved in both groups ($P<0.001$) with no significant difference between the two groups ($P=0.081$). Post-operative pain was significantly less in EM ($p<0.001$). There was no significant difference between the two groups regarding the complications ($P=0.049$) with no complications with EM. In both groups, there was no difference between patients with anterior canal wall protrusion (ACWP) and patients without ACWP regarding operative duration ($p=0.123$ and 0.372 respectively). There was a significant relationship between ACWP and the graft taking rate after 6 months in both groups ($p=0.015$ and $p<0.001$ respectively).

Conclusion: Despite having comparable success rates in reconstructing anterior central TM perforations with both EM and MM, EM offering a shorter duration of surgery, less blood loss, less postoperative pain, and fewer complications, may serve as an acceptable and reasonable alternative to MM.

Key Words: Anterior tympanic membrane perforation, endoscopic ear surgery, microscopic ear surgery, myringoplasty.

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Corresponding Author: Ahmad Mahmoud Hamdan, Department of Otorhinolaryngology, Faculty of Medicine, Menoufia University, Shebin El-Kom, Menoufia, Egypt. **Tel.:** 00201008993175, **E-mail**: Ahmed.Hamdan@med.menofia.edu.eg

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INTRODUCTION

Myringoplasty is a reconstructive procedure that is limited to repairing the tympanic membrane (TM) perforation without eradication of middle ear disease[1] with its main objectives being the closure of the TM perforation and improvement of hearing[2] Performing myringoplasty to repair anterior central TM perforations is technically challenging due to the limited anterior visualization of tympanic membrane remnant being hindered by the anterior canal wall. Also, these cases show decreased graft viability because of the weak vascular supply, and poor graft stabilization.[3,4]

The conventional post auricular microscopic approach provides a stereoscopic view and two-handed surgery, but it is compromised by the straight field and narrow-angle view. Also, anterior canaloplasty may be required in patients with anterior canal wall protrusion to fully visualize the anterior border of the anterior TM perforation which needs an experienced surgeon.[5,6]

Endoscopy was first used in chronic suppurative otitis media (CSOM) surgery in the 1990s and has become increasingly popular in recent years.[7,8] Transcanal endoscopy provides a chance to examine the TM perforation, the middle ear mucosa, the eustachian tube opening, and the ossicular chain.[9] Furthermore, the minimally invasive endoscopy offers panoramic vision, magnification without resolution loss, exposure via simple back-and-forth endoscope movement, painless postoperative period, and satisfactory cosmetic results.[10] Therefore endoscopic myringoplasty (EM) overcomes the limitations of microscopic myringoplasty (MM), with decreased intraoperative and postoperative morbidity, complications, and increased patient satisfaction.[11]

To our knowledge, few studies directly comparing the EM and MM techniques in the treatment of anterior central TM perforations are available in the English literature. Thus, this study aimed to compare the EM and MM in reconstructing anterior central TM perforations in CSOM as regards surgical and audiological outcomes.

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PATIENTS AND METHODS:

This prospective randomized study was conducted in the Otorhinolaryngology Department of Menoufia University Hospital and private hospitals in Egypt from January 2017 to February 2020. Informed consent was obtained from all patients and the institutional review board approved the study.

The current study included patients with tubotympanic chronic suppurative otitis media (CSOM) with dry anterior central perforation (perforations not crossing beyond a line extended along the manubrium mallei were accepted as anterior central TM perforation). Patients should have a conductive hearing loss of less than 40 dB. The perforation should be dry for at least three months before the intervention.

Patients with active ear discharge or with a history of an episode of ear discharge in the previous three months, and patients less than 18 years were excluded from the study. Patients with postoperative residual or recurrent perforations of the TM and patients with ossicular chain abnormalities were excluded. Besides, patients with mixed hearing loss and patients with CSOM with a squamous disease or middle ear granulation tissue were excluded from the study. Eustachian tube function tests were performed for all patients during routine audiological assessment. Patients with poor eustachian tube function were excluded from the study.

Fifty patients were included in the study and randomly divided into two equal groups of 25 patients each. All patients were given serial numbers on a first come first serve basis. The technique for dividing groups was simple randomization with odd serial numbers allotted for endoscopic technique and even serial numbers allotted for microscopic technique.

All patients had their complete history taken. Complete ENT examination was performed, including otoendoscopy to assess the external canal (narrow, wide, ACWP), the TM perforation (site, size, shape, edge), and the middle-ear mucosal status. Audiological assessment using pure tone audiometry and the necessary pre-operative laboratory investigations were performed for all patients.

Surgical technique

All procedures were done under general anesthesia. In the endoscopic group, a permeatal endoscope-assisted approach was performed. Karl Storz Rigid endoscope 0, 30, 45, and 70-degree, 4 mm diameter and 100 mm length with camera and monitor were used. The endoscope was held in one hand (left hand for a right-handed surgeon), and the instruments and suction cannula were held alternatively in the other hand. In the microscopic group, myringoplasty was done by using a Zeiss microscope via post aural William Wilde's incision. In both groups, trimming of the margins of the perforation was done (Figure 1). A tympanomeatal flap and the annulus were raised from 1 to 10 o'clock. The drum remnant was removed from the handle of the malleus (Figure 2). The mobility of the ossicular chain was checked. A tragal perichondrium-cartilage graft was harvested and prepared by thinning of the cartilage, removing the perichondrium at the medial surface, and removing a V-shaped wedge of the cartilage sparing the perichondrium to accommodate the handle of the malleus (Figure 3). The graft was placed in an over-underlay technique, lateral to the handle of the malleus and medial to the tympanic membrane and annulus after filling the middle ear with gel foam. The tympanomeatal flap was pulled down and the annulus meticulously inserted in the sulcus (Figure 4) then packing the external auditory canal with gel foam and antibiotic ointment.

Postoperative assessment:

Patients were discharged 1 day after surgery and postoperative pain was analyzed by Wong-Baker FACES pain rating scale at the time of discharge then the patients were called for follow up after 7 days (to remove the suture), one, 3, and 6 months postoperatively and the possible complications such as blunting, lateralization of the tympanic membrane, iatrogenic cholesteatoma and ossicular injury were noted. Pure Tone Audiometry was done again at the three months follow-up visit.

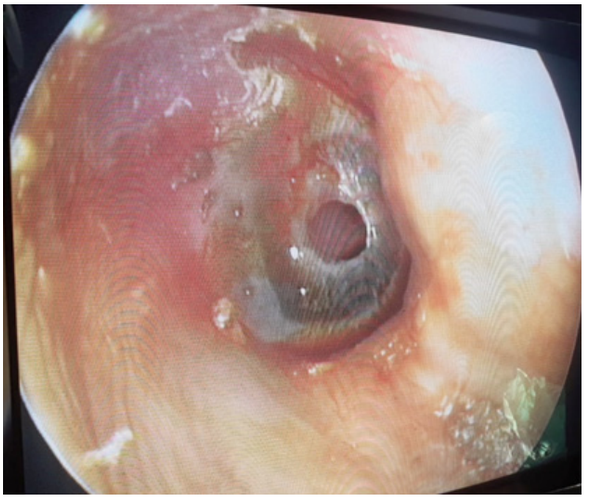

Fig. 1: Endoscopic view showing anterior central perforation after trimming of the edges.

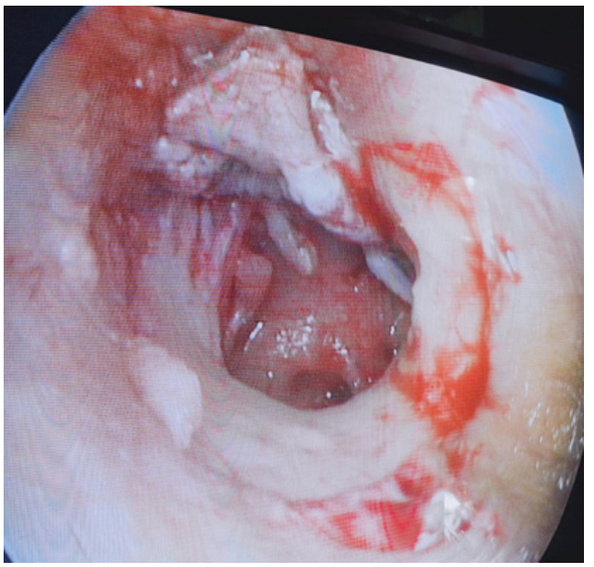

Fig. 2: Endoscopic view showing the ossicles after removal of the drum remnant from the handle of the malleus.

Fig. 3: Harvested composite chondro-perichondrium graft with the removal of a V-shaped wedge of the cartilage.

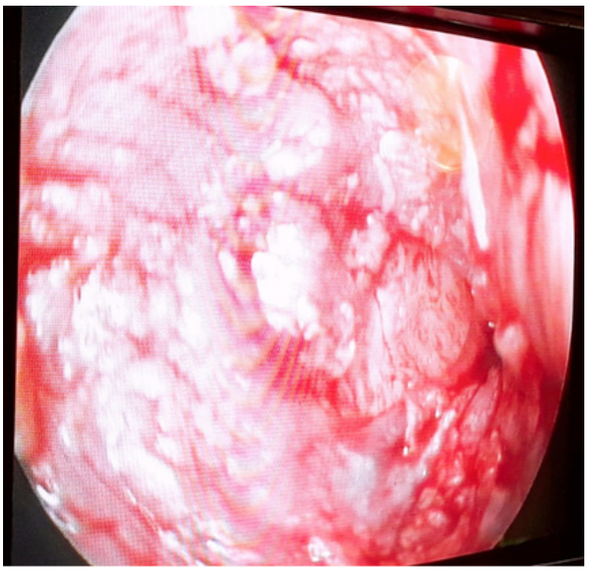

Fig. 4: Endoscopic view showing cartilage -perichondrium graft after placement in an underlay pattern and reposition of the tympanomeatal flap.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov was used to verify the normality of the distribution of variables. Comparisons between groups for categorical variables were assessed using the Chi-square test with Fisher's Exact correction. Student t-test was used to compare two groups for normally distributed quantitative variables while Mann Whitney test was used to compare between two groups for not normally distributed quantitative variables. Wilcoxon signed ranks test was assessed for comparison between two periods for not normally distributed quantitative variables. The significance of the obtained results was judged at the 5% level.

RESULTS:

A total of 50 patients with anterior central TM perforation were enrolled in the study and distributed equally between EM and MM groups. Of the patients in the EM group, 10 patients (40%) were females and 15 patients (60%) were males, and of the patients in the MM group, 13 patients (52%(were females and 12 patients (48%) were males, with a non-significant difference between the two groups (p = 0.157). The mean (±SD) age of the patients in the EM group was 30.7 ± 8.4 years (range: 18-47), and in the MM group was 31.8 ± 8.3 years (range: 20-48) with a non-significant difference between the two groups ($p = 0.65$). Preoperative ABG showed a non-significant difference between the two groups ($p = 0.841$) (Table 1).

Regarding the operative details, the mean (±SD) operative duration in EM was (68.8 ± 6.8 min) which was significantly shorter than the operative duration in the MM group which was (98 ± 11.3 min) (*p<0.001*). Regarding the intra-operative blood loss, the EM group showed significantly less average blood loss (9.2+2.7 mL) compared with the average blood loss in MM group (21.1+3.9 mL) (*p<0.001*). There were 7 (28%) patients with ACWP in the EM group, and it was the same in the MM group (Table 2).

In the current study, there was a highly significant improvement of ABG postoperatively in both groups (*p< 0.00001* in both groups) (Table 3). Regarding the postoperative outcomes, the postoperative pain score as assessed using the Wong-Baker FACES pain rating scale was significantly less in EM group (2.4+ 1.2) compared with the EM group (6.8+1.5). The graft healing rates in EM and MM group after 6 months follow-up, were 88% (22 out of 25) and 72% (18 out of 25) respectively with a non-significant difference between EM and MM groups as regard graft success rates (*p=0.157*). (*p<0.001*). The postoperative air-bone gap (ABG) difference showed a non-significant difference between the EM and the MM which were (8.6+7) and (11.6+7.1) respectively with a non-significant difference (*p=0.081*). There was no significant difference between the EM group and MM group regarding intra-operative or postoperative complications with no recorded complications in the EM group. (Table 4).

Regarding the impaction of the Anterior canal wall protrusion (ACWP) presence on the operative details and postoperative outcomes, there was a non-significant relationship between the ACWP and the average duration time in both groups (*p = 0.123* and *p = 0.372* respectively). However, there was a statistically significant relationship between ACWP and the graft taking rate after 6 months in both groups (*p=0.015* and *p<0.001* respectively) (Table 5).

Table 1: Comparison between the two studied groups regarding demographic and clinical data:

	Type of operation		Test of Sig.	*p*
	Endoscopic (n = 25)	Microscopic (n = 25)		
Sex				
Male	15 (60%)	10 (40%)	χ^2= 2.000	0.157
Female	10 (40%)	15 (60%)		
Age (years)				
Mean ± SD	30.7 ± 8.4	31.8 ± 8.3	t= -0.46	0.65
Preoperative air-bone gap				
Mean ± SD.	25.7 ± 5	25.3 ± 4.5		
Median (Min. – Max.)	25 (20 – 35)	25 (20 – 35)	U= 302.50	0.841
Median (Min. – Max.)	30 (18 – 47)	39 (20 – 48)		

χ^2: Chi-square test t: Student t-test U: Mann Whitney test
p: p-value for comparing between the studied groups

Table 2: Comparison between the two studied groups regarding operative details:

	Type of operation		Test of Sig.	*p*
	Endoscopic (n = 25)	Microscopic (n = 25)		
Operation time				
Mean ± SD.	68.8 ± 6.8	98 ± 11.3	t= 11.037	<0.001*
Median (Min. – Max.)	69 (58 – 81)	95 (78 – 127		
Intraoperative blood loss				
Mean ± SD.	9.2 ± 2.7	21.1 ± 3.9	t= 12.532*	<0.001*
Median (Min. – Max.)	9 (5 – 15)	20 (15 – 30)		
An anterior canal wall protrusion				
Absent	18 (72%)	18 (72%)	χ^2=0.000	1.000
Present	7 (28%)	7 (28%)		

χ^2: Chi-square test t: Student t-test U: Mann Whitney test
p: *p-value* for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

Table 3: Comparison between the preoperative and postoperative ABG in both study groups:

	Preoperative (n = 25)	Postoperative (n = 25)	Test of Sig.	*p*
Endoscopic group				
Mean ± SD.	25.7 ± 5	8.6 ± 7	z =-4.29	*p<0.00001*
Median (Min. – Max.)	25 (20 – 35)	5 (0 – 26)		
Microscopic group				
Mean ± SD.	25.3 ± 4.5	11.6 ± 7.1	z= -3.977.	.00006*
Median (Min. – Max.)	25 (20 – 35)	10 (5 – 25)		

χ^2: Chi-square test t: Student t-test z: Wilcoxon Signed Rank test
p: p-value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

Table 4: Comparison between the two studied groups regarding postoperative outcomes:

	Type of operation		Test of Sig.	*p*
	Endoscopic (n = 25)	Microscopic (n = 25)		
Pain scale				
Mean ± SD.	2.4 ± 1.2	6.8 ± 1.5	U= 7.000*	<0.001*
Median (Min. – Max.)	2 (0 – 4)	6 (4 – 10)		
Postoperative air-bone gap				
Mean ± SD.	8.6 ± 7	11.6 ± 7.1	U= 228.0	0.081
Median (Min. – Max.)	5 (0 – 26)	10 (5 – 25)		
Graft taking				
1 month follow up				
Not taken graft	5 (20%)	10 (40%)	χ^2= 2.381	0.123
Taken graft	20 (80%)	15 (60%)		
3 months follow up				
Not Taken graft	3 (12%)	7 (28%)	χ^2= 2.000	0.157
Taken graft	22 (88%)	18 (72%)		
6 months follow up				
Not taken graft	3 (12%)	7 (28%)	χ^2= 2.000	0.157
Taken graft	22 (88%)	18 (72%)		
Complications				
No	25 (100%)	20 (80%)	χ^2= 5.556	FEp= 0.049
Yes	0 (0%)	5 (20%)		

χ^2: Chi-square test U: Mann Whitney test
p: p-value for comparing between the studied groups
*: Statistically significant at $p \leq 0.05$

Table 5: Relation between anterior canal wall protrusions with operation time and taken graft after 3M in each group of operation

		anterior canal wall protrusion		Test of Sig.	*p*
		Absent (n = 18)	Present (n = 7)		
Endoscopic (n = 25)	Operation time				
	Mean ± SD.	67.4 ± 6.38	72.1 ± 7.2	t= 1.600	0.123
	Median (Min. – Max.)	68 (58 – 81)	69 (65 – 80)		
	Graft taking at 6 months				
	Not taken graft	0 (0%)	3 (42.9%)	χ^2= 8.766*	0.015*
	Taken graft	18 (100%)	4 (57.1%)		
Microscopic (n = 25)	Operation time				
	Mean ± SD.	96.7 ± 10.5	101.3 ± 13.7	t= 0.911	0.372
	Median (Min. – Max.)	93.5 (78 – 120)	99 (86 – 127)		
	Graft taking at 6 months				
	Not taken graft	0 (0%)	7 (100%)	χ^2= 25.0	<0.001*
	Taken graft	18 (100%)	0 (0%)		

χ^2: Chi square test t: Student t-test
p: p value for association between different categories
*: Statistically significant at $p \leq 0.05$ s

DISCUSSION

For more than 60 years, microscopic myringoplasty has been the standard surgery for repairing a perforated TM. Despite having a high rate of graft success of more than 90% but has disadvantages. The era of endoscopy in otology begun in the final quarter of the twentieth century when endoscopes were first used for an ear examination and surgery.[7,9,12]

Endoscopes in ear surgery gave significant visualization advantages of concealed areas, the margin of perforation after refreshing edges, Eustachian tube orifice, the round window through curvy external auditory canal without canaloplasty or frequent adjustment of microscope head in MM, and with lower complications.[13-15] On the other hand, the disadvantages of the endoscope were working with only one hand, the difficult elevation of the tympanomeatal flap, and the absence of stereoscopic view.[16] Several meta-analyses[17-19] have compared endoscopic and microscopic tympanoplasty. and found comparable tympanic membrane closure rates and hearing results for endoscopic and microscopic tympanoplasty, however, patients receiving endoscopic tympanoplasty had a lower canaloplasty rate and more desirable cosmetic results compared with those receiving microscopic tympanoplasty.

The most common area of graft failure with myringoplasty by underlay technique is the anterosuperior area for lack of graft support and less vascularity. Additionally, in many cases, canaloplasty needs to be performed to remove the prominent anterior canal wall to visualize the entire perforation.[20] Several grafting techniques have been used for repairing the anterior perforation of the tympanic membrane.[21] This study aimed to standardize the grafting material being composite cartilage and perichondrium graft and technique by tympanomeatal flap elevation with a comparison between the endoscopic and microscopic approaches.

In the current study, the graft healing rate in EM and MM group after 6 months follow-up, was 88% (22 out of 25) and 72% (18 out of 25) respectively with a non-significant difference between both groups (*p=0.157*). These findings are comparable to the findings of previous studies. Gülşen and Arıcı[22] compared the surgical outcomes of endoscopic transcanal tympanoplasty (ETT) and conventional microscopic tympanoplasty (CMT) in repairing anterior tympanic membrane perforations. They found that the graft success rates for ETT and CMT were 93.7% and 91.4% with no significant difference between the two techniques. El-Henawi *et al*.[14] evaluated the outcomes of endoscopic transcanal push-through (modification of underlay technique) and MM for anterior TM perforations using chondroperichondrial composite graft and found that the graft uptake rate was 92.9%, and 85 % respectively with a nonsignificant difference between the two groups.

In the present study, the mean (±SD) operative duration in EM was (68.8 ± 6.8 min) which was significantly shorter than the operative duration in the MM group which was (98 ± 11.3 min) (*p<0.001*). Many studies have shown that the endoscopic technique gave a shorter operative duration with a shorter time of exposure to anesthetic agents as compared

to the microscopic approach[14],[22-24]. Choi *et al*.[25] reported average times of 68.2 and 88.9 minutes for endoscopic and microscopic techniques respectively, and this was compatible with our results. Regarding the intra-operative blood loss, the EM group in this study showed significantly less average blood loss (9.2+2.7 mL) compared with the average blood loss in MM group (21.1+3.9 mL) ($p<0.001$). Similarly, El-Henawi *et al*.[15], and Gülşen and Arıcı[23] reported that mean average intra-operative blood loss in the endoscopic group was highly significantly less than the microscopic group.

In the present study, there was a highly statistically significant improvement postoperative mean ABGs in the EM group and MM group ($p<0.001$ for both) but with a non-significant difference between the two groups ($p=0.081$). This finding matches the findings of previous results who reported comparable results between endoscopic and microscopic tympanoplasty regarding hearing outcomes.[18-20] Dündar *et al*.[24] conducted a study to evaluate 60 pediatric patients undergoing type 1 tympanoplasty using a chondro-perichondral graft, a non-significant difference between EM and MM groups regarding the ABGs gain post-operatively. Regarding anterior tympanic membrane perforation, El-Henawi *et al*.[15] reported a non-significant difference between EM and MM groups regarding the ABGs gain ($p= 0.167$). The retro auricular approach in MM is the main factor that may explain the higher level of pain postoperatively. Postoperative pain reduces the quality of life and may result in increased analgesics use and may lead to prolonged hospitalization[23], and this explanation clue the results that we founded in our study with a highly significant less postoperative pain in EM group than in the MM group ($p<0.001$). Complications were recorded in five patients in our study which were dysgeusia, mild asymmetry at the auricle, wound infection, and two cases with postoperative hematoma. All complications were in MM group and all complications were managed probably. No complications were noticed in EM group.

Among both EM and MM groups of the current study, the operation time was longer in cases with ACWP than patients without ACWP but without reaching significance. Gülşen and Arıcı[23] reported a non statistically significant difference between patients with and without ACWP in the endoscopic group, whereas the mean operative time of patients with ACWP in the microscopic group was significantly longer than patients without ACWP. This can be attributed to the canaloplasty adopted in their study in some cases of the microscopic group with ACWP. In the current study, within each of the two study groups, the patients without ACWP showed significantly more graft taking after 6 months when compared to patients with ACWP. The limitations of this study included a relatively small sample size. All the cases meeting the inclusion criteria at the otorhinolaryngology outpatient clinic during the study period were included in the study without an initial sample size assessment. Another limitation is the lack of blinding from the authors to the results of both groups. This can be attributed to the presence of post-aural wound differenting microscopic group from endoscopic group.

CONCLUSION

Despite having comparable success rates in reconstructing anterior central TM perforations after 6 months in both EM and MM, EM offering a shorter duration of surgery, less blood loss, less postoperative pain, and fewer complications, may serve as an acceptable and reasonable alternative to MM in reconstructing the anterior central TM perforations. Patients without ACWP gave a significantly higher graft taking rate at 6 months follow up in both EM and MM groups..

CONFLICT OF INTEREST

There are no conflicts of interest.

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