



Original Article

A Comparative Study of Endoscopic and Microscopic Approach Type 1 Tympanoplasty for Simple Chronic Otitis Media

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OBJECTIVE: Tympanoplasty is a common surgery for chronic otitis media. We analyzed the results of endoscopic and microscopic approaches for type 1 tympanoplasty in patients with simple chronic otitis media.

MATERIALS and METHODS: We evaluated the records of 95 patients (100 ears) who underwent type 1 tympanoplasty from 2011 to 2014. Group 1 underwent tympanoplasty with a microscopic approach (50 ears), and Group 2 underwent tympanoplasty with an endoscopic approach (50 ears). The epidemiological profiles and postoperative results, including hearing gain, duration of surgery, perioperative nausea or vomiting, and graft success rate, were reviewed.

RESULTS: The epidemiological profiles and preoperative hearing status were similar in both groups. Postoperatively, both groups had equal improvements in hearing and air-bone gap as well as equal perforation rates. However, the endoscopic group suffered less perioperative nausea or vomiting and had a shorter operative time.

CONCLUSION: The endoscopic approach for tympanoplasty offers superior visualization and shorter operative time than conventional surgery, in addition to equal hearing outcomes and perforation rates. Furthermore, observations of fewer tissue injuries, better cosmetic outcomes, and lesser perioperative nausea and vomiting suggest that the endoscopic approach is a better choice for surgery.

KEYWORDS: Endoscopic tympanoplasty, microscopic tympanoplasty, operative duration, nausea, vomiting

INTRODUCTION

Incorrect and inadequate treatment of chronic otitis media (COM) may cause serious complications^[1]. Tympanoplasty is a common operation used to eradicate infection and reconstruct the eardrum.

Traditionally, surgeons perform microsurgery of the middle ear with the assistance of a microscope. However, a microscope offers a straight-line view, which limits the visual field in the deep recesses of the middle ear. If a narrow or protruding canal is encountered in the surgical field, the traditional technique requires a surgical procedure to expose and visualize the structures behind it. Therefore, middle ear surgery is increasingly being performed endoscopically^[2], and it has recently been suggested that endoscopy could replace the use of a microscope^[3]. Endoscopes offer a wide field of view with magnification. Surgeons can also rapidly obtain close-up and wide-angle views by inserting or withdrawing the endoscope, whereas a microscope requires adjustment. Further, surgeons can rotate an angled endoscope to obtain all-round vision, thereby enabling visualization of the anterior margin of the perforation; the anterior canal wall, attic, and hypotympanum in the middle ear can also be visualized.

In this study, we compared the results of hearing improvement, operation duration, and perforated cases after at least a 6-month follow-up period for patients who received endoscopic and microscopic type 1 tympanoplasty. We then evaluated whether the endoscopic approach offers advantages over conventional surgery.

MATERIALS and METHODS

We retrospectively analyzed 100 ears of 95 patients (33 males and 62 females) aged 13 to 82 years with COM who underwent tympanoplasty in our hospital from 2011 to 2014; all procedures were performed by a single senior surgeon (H.M. Wang). Central or peripheral perforations of the tympanic membrane were noted in all patients. Ears with cholesteatoma were not included in this study. The minimum follow-up period was 6 months. This study was approved by the institutional review board.

The patients were divided into two groups according to the surgical procedure they received. Group 1 underwent conventional microscopic tympanoplasty (50 ears of 48 patients), and Group 2 underwent endoscopic tympanoplasty (50 ears of 47 patients).

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We analyzed the demographic data, preoperative and postoperative pure tone audiometry and tympanogram results, surgical approach (endoscopic or microscopic), and operative duration. Postoperative

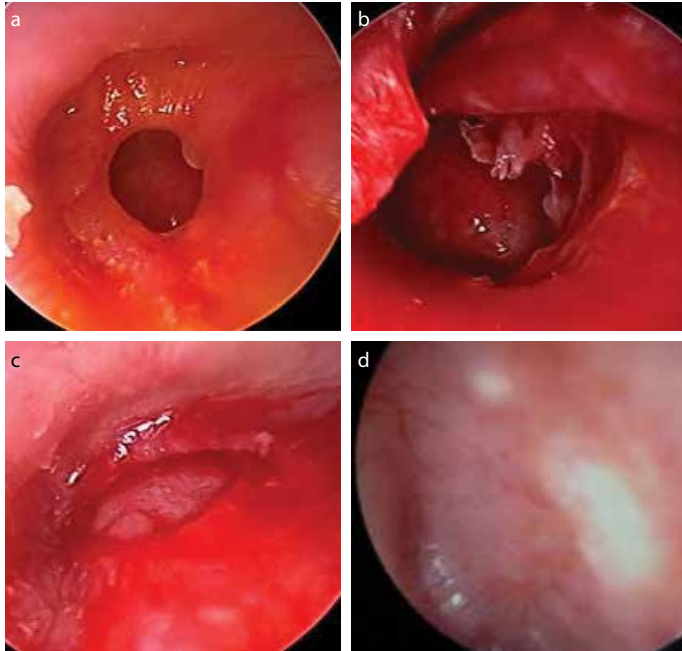


Figure 1. a-d. Endoscopic image: Pre-operative (a), Visualization of middle ear (b), Post tympanoplasty (c) and 6 months post-operative (d)

follow-up evaluations were performed after 1, 3, and 6 months; they included pure tone audiometry, tympanometry, and endoscopic or microscopic evaluation of the status of the graft. Hearing thresholds, including air conduction threshold and bone conduction threshold, were evaluated by the averages at 0.5, 1.0, and 2.0 kHz. The air-bone gap (ABG) was also calculated in each examination.

The tympanoplasty procedures were performed by the same ear surgeon under general anesthesia. In Group 1, a microscope (Opmi Vario/s88; Carl Zeiss, Oberkochen, Germany) was used and a retro-auricular approach was employed. The temporal muscle fascia was harvested at the beginning of the operation, and the “underlay” graft was placed medial to the malleus.

In Group 2, an endoscopic system (Karl Storz; Tuttlingen, Germany) and rigid endoscopes [2.7 mm (6.0 cm) and 4.0 mm (16.0 cm); Karl Storz; Tuttlingen, Germany] were used for this approach. After removing calcification of the tympanic membrane, an incision was made laterally in the posterior and inferior parts of the external auditory canal (about 5 to 10 mm from the tympanic membrane). A tympanomeatal flap was elevated, and the middle ear cavity was visualized. A piece of perichondrium graft was taken from the tragus and was stretched and pressed. After preparation, the underlay graft was placed as in Group 1. (Figure 1a-d)

The T test and chi-square test were calculated using Statistical Package for the Social Sciences (SPSS) software (IBM Corporation; NY,

Table 1. Demographic characteristics and outcomes of Groups 1 and 2

	Microscopic (Group 1) (50 ears)		Endoscopic (Group 2) (50 ears)		p
Number of patients	48 (16 men, 32 women)		47 (17 men, 30 women)		
Left [n (%)]/Right [n(%)]	27 (54)/23 (46)		31 (62)/19 (38)		0.4177
Age (mean±SD)	49.9±15.0		54.2±15.6		0.1687
Preoperative (pathological ear)					
Air conduction (mean±SD)	44.0±21.9		44.4±20.6		0.9253
Bone conduction	22.6±17.0		22.8±15.2		0.9507
Air-bone gap [n (SD)]	21.4±10.6		21.6±11.2		0.9270
Tympanogram [n (%)]	A/C	B	A/C	B	0.2945
	3 (6)	47 (94)	6 (12)	44 (88)	
Postoperative (>6 months) (pathological ear)					
Air conduction improvement (mean±SD)	9.5±8.6		9.5±8.6		1.0000
Bone conduction improvement	1.2±7.8		0.6±7.0		0.6865
Air-bone gap improvement (mean±SD)	8.3±10.0		8.9±10.0		0.7641
Tympanogram (mean±SD)	A/C	B	A/C	B	0.1475
	42 (84)	8 (16)	36 (72)	14 (28)	
Operation duration (minutes) (mean±SD)	75.5±20.4		50.4±13.4		<.0001
Perioperative nausea [n (%)]	Yes	No	Yes	No	0.0025
	34 (68)	16 (32)	18 (38)	30 (62)	
Perioperative vomiting [n (%)]	Yes	No	Yes	No	0.0006
	22 (44)	28 (56)	6 (13)	42 (87)	
Graft condition					
Perforated case [n (%)]	1 (2)		1 (2)		1.0000

USA). A *p* value of less than 0.05 was considered to be statistically significant.

RESULTS

The demographic characteristics and clinical findings of Groups 1 and 2 are shown in Table 1. In total, 50 ears of 48 patients (16 men and 32 women) were subjected to the microscopic approach, and 50 ears of 47 patients (17 men and 30 women) were subjected to the endoscopic approach. The mean age of the patients was 49.9 ± 15.0 years in Group 1 and 54.2 ± 15.6 years in Group 2. According to an independent samples *t*-test, there were no significant differences in the ages of the patients between Groups 1 and 2 ($p=0.1687$). In Group 1, 27 (54%) left ears and 23 (46%) right ears were analyzed, and in Group 2, 31 (62%) left ears and 19 (38%) right ears were analyzed. The sides of the pathological ears showed no significant differences by Chi-square test ($p=0.4177$).

Preoperatively, the air conduction levels of the pathological ears in Group 1 and Group 2 were 44.0 ± 21.9 dB and 44.4 ± 20.6 dB, respectively. There were no significant differences between the two groups ($p=0.9253$). The bone conduction levels of the pathological ears in Group 1 and Group 2 were 22.6 ± 17.0 dB and 22.8 ± 15.2 dB, respectively. There were no significant differences between the two groups ($p=0.9507$). The ABGs were 21.4 ± 10.6 and 21.6 ± 11.2 , respectively. There were no significant differences between the two groups ($p=0.9270$).

Postoperatively, the improvements in the air conduction level of the pathological ears in Group 1 and Group 2 were 9.5 ± 8.6 dB and 9.5 ± 8.6 dB. There were no significant differences between the two groups ($p=1.0000$). The improvements in the bone conduction level of the pathological ears in Group 1 and Group 2 were 1.2 ± 7.8 dB and 0.6 ± 7.0 dB. There were no significant differences between the two groups ($p=0.6865$). The improvements in ABG were 8.3 ± 10.0 dB and 8.9 ± 10.0 dB, respectively. There were no significant differences between the two groups ($p=0.7641$).

We analyzed the tympanograms and separated the ears into two groups: Type A/C and Type B. Preoperatively, there were 3 (6%) Type A/C ears and 47 (94%) Type B ears in Group 1, and 6 (12%) Type A/C and 44 (88%) Type B ears in Group 2. There were no significant differences between the two groups by chi-square test ($p=0.2945$). Postoperatively, there were 42 (84%) Type A/C ears and 8 (16%) Type B ears in Group 1, and 36 (72%) Type A/C and 14 (28%) Type B ears in Group 2. There were no significant differences between the two groups by Chi-square test ($p=0.1475$).

The average operation time in Group 1 was 75.5 ± 20.4 minutes, compared to 50.4 ± 13.4 minutes in Group 2. The operation time in Group 2 was significantly shorter than that in Group 1 based on an independent samples *t*-test ($p<0.0001$).

In Group 1, 34 (68%) and 22 (44%) patients experienced perioperative nausea and vomiting, respectively, compared to 18 (36%) and 6 (12%) patients in Group 2. The Chi-square test showed significantly lower rates of nausea and vomiting in Group 2; the *p* values were 0.0025 and 0.0006, respectively.

During the follow-up period (>6 months), there was one (2%) perforation in Group 1 and one (2%) in Group 2. Both patients received a second operation with the same primary technique; however, the data were not included in this study.

DISCUSSION

The main goals of treatment for COM are to relieve symptoms, rehabilitate hearing, and minimize complications and drainage. Conventionally, tympanoplasty is performed under an operative microscope. The main advantages of the microscopic approach are stereo vision and bimanual handling. However, despite providing direct exposure, microscopes require frequent adjustment and may still not be sufficient when encountering protruding structures, particularly the anterior wall. In a study conducted by Furukawa et al. [4], the circumference of the perforation could not be confirmed with a microscope before denuding in 12.0% of cases. Furthermore, the entire perforation was not visible in 20.0% of cases after refreshing the edges. In contrast, endoscopy can show the entire tympanic membrane in one field with clear visualization of the perforation edges, even when the ear canal is narrow or protruding.

Using a thin, rigid endoscope, a surgeon can perform minimally invasive procedures with protection of the anatomy, which allows for functional reconstruction during surgery [5]. When exploring the middle ear, the endoscope approach can provide more information regarding the orifice of the tube, the incudostapedial joint, and the round-window niche, which are usually difficult to observe under an operating microscope.

The advantages of the endoscopic approach also include a decrease in the operative time, which results in a decrease of the duration of anesthesia and related side effects, and a lower effect on the surgeon's concentration. In a study by Ghaffar et al. [6], the mean operative time was 62.85 minutes among 34 patients who underwent endoscopic tympanoplasty. In our study, the mean operative time among the 50 ears that received the endoscopic approach was 50.4 minutes, compared to 75.5 minutes for the microscopic approach; this shows a significant difference. In our institution, the preparation of the microscope and the time to harvest the graft and adjust the microscope were the major factors responsible for this difference. A higher level of experience can shorten the duration of surgery.

To the best of our knowledge, this is the first study to describe perioperative nausea and vomiting during endoscopic or microscopic tympanoplasty. According to our results, the endoscopic approach (Group 2) patients experienced statistically significantly lower perioperative nausea (38% vs. 68% in Group 1) and vomiting (13% vs. 42% in Group 1). Nausea and vomiting are unpleasant experiences after surgery, and may be the main sources of discomfort in postoperative recovery [7]. Nausea and vomiting can also expand recovery room time, increase nursing care requests and hospital stays, and can further increase total health care costs. The high levels of patient discomfort and dissatisfaction should also be considered [8].

With the increasing use of minimally invasive surgery, Karhuketo et al. [9] point out that using an endoscopic approach could fulfill the goal of causing the least amount of trauma to normal tissues. Lade et al. [10] compared 60 patients undergoing either microscopic or endoscopic

type 1 tympanoplasty. Of the 30 patients who underwent the microscopic approach, five required canalplasty and four underwent external auditory canal curettage to evaluate the ossicular system. Of the 30 patients who underwent the endoscopic approach, none required such interventions, and no difficulty was noted in assessing the ossicular chain.

The endoscopic approach is less invasive (no skin incisions or canalplasty are required), results in no hair loss, and enables better visualization. Compared with the microscopic approach, the endoscopic approach can reduce postoperative bleeding and pain and achieve superior cosmetic results. In addition, minimal damage of healthy structures is likely to minimize postoperative adverse reactions locally and generally ^[11].

Karhketto et al.^[9] reported 29 endoscopic myringoplasty patients with a one-year follow-up period. The perforation closure rate was 80%, and postoperative improvement of ABG was 7 dB. Furukawa^[4] reported 25 ears that underwent transcanal endoscopic myringoplasty; a perforation closure rate of 84.0% was obtained, with only one case of reperforation. The improvement in ABG was 10.3 dB. Ayache^[12] reported that using cartilage grafts in patients undergoing endoscopic tympanoplasty can achieve a success rate of 96%. In our study, we had one case of reperforation in 50 ears that underwent the endoscopic approach, and the improvement in ABG was 8.9 dB.

In this study, the preoperative hearing threshold and postoperative hearing improvement showed no differences between the two groups. We observed a relationship between the operative method and the tympanogram results. The tympanograms of the retroauricular microscopic approach showed more Type A or C than the endoscopic approach, although the difference was not significant (84% in Group 1 vs. 72% in Group 2, $p=0.1475$). We assume that the graft source is the reason for this difference. We harvested temporal muscle fascia in the microscopic group and tragus perichondrium in the endoscopic group; the elasticity of temporal muscle fascia may be superior to that of perichondrium. However, this result is limited due to the lack of long-term outcomes, and further studies are needed to investigate whether this difference further affects long-term hearing status or the possibility of perforations.

Despite the benefits, there are still several disadvantages to the endoscopic approach that need to be overcome. The endoscope lacks sufficient microscopic magnification and focus; also, this approach requires the surgeon to perform one-handed, holding the endoscope in one hand and other instruments or suction in the free hand. In the endoscopic approach, instruments may crowd the ear canal, and the endoscope may become frequently or heavily contaminated with blood ^[13].

Endoscopic surgery offers 2D images, and 2D images lack depth perception ^[14]; thus, lifting the graft to make contact with the edge of the perforation will be difficult. However, improvements in full high-definition camera systems can provide much more delicate endoscopic views with better contrast to minimize these problems.

In conclusion, the endoscopic approach for tympanoplasty offers superior visualization and shorter operative times than conventional

surgery, in addition to equal hearing outcomes and perforation rates. Other advantages of this surgical technique include a lower rate of tissue injury, better cosmetic outcomes, and lower rates of perioperative nausea and vomiting.

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Informed Consent: Written informed consent was obtained from patients who participated in this study.

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