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

Tzu-Yen Huang, Kuen-Yao Ho, Ling-Feng Wang, Chen-Yu Chien, Hsun-Mo Wang

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).
We analyzed the demographic data, preoperative and postoperative pure tone audiometry and tympanogram results, surgical approach (endoscopic or microscopic), and operative duration. Postoperative 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 retroauricular 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, 29)

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

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

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

Graft condition

Perforated case [n [%]] | 1 (2)                     | 1 (2)                      | 1.0000 |

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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=1.000). 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., 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. 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., 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. 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.

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

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of KMUHIRB-E-20150075.

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

**Peer-review:** Externally peer-reviewed.


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**Conflict of Interest:** No conflict of interest was declared by the authors.

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**REFERENCES**