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Research Article
Tympanoplasty

Comparative Study of Clinical Outcome between Microscopic and Endoscopic Type I Tympanoplasty

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Introduction: Tympanoplasty is one of the most common surgical procedures in ENT. It can be performed with the help of a microscope or endoscope. We carried out a prospective randomized comparative study in our tertiary care centre to evaluate and compare the results of endoscopic and conventional microscopic tympanoplasty in terms of hearing outcome, surgical time and graft success rate. **Materials and Methods:** This prospective randomized comparative study was conducted in the Department of Otorhinolaryngology, SHKM Hospital, an associated hospital of GMC Nuh, Haryana, India, for 12 months from October 2019 to September 2020. Eighty patients with central perforation were randomly divided into two equal groups of 40 patients each. In the first group, an endoscope was used, and in the second group, the microscope was used to do type 1 tympanoplasty. The patients were kept on follow-up for six months. The graft success rates, hearing outcomes and duration of surgery in patients were compared in both groups. **Results:** Graft success rates were 90% and 92.5% for the endoscopic and microscopic groups, respectively ($p > 0.05$). Postoperative air-bone gap values significantly improved in both groups ($p < 0.05$). The average duration of surgery was significantly shorter in the endoscopic group (mean 42.9 min) relative to the microscopic group (mean 57.2 min) ($p < 0.05$). **Conclusion:** In managing chronic otitis media, endoscopic transcanal tympanoplasty can be a viable alternative to conventional microscopic tympanoplasty, with comparable graft success rates and hearing outcomes.

Keywords: CSOM. Endoscopic tympanoplasty. Microscopic tympanoplasty, Perforation, Operative duration, ABG

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Introduction

Chronic otitis media is any structural change in the middle ear system associated with a permanent defect in the tympanic membrane (TM) [1]. The goal of tympanoplasty is to eradicate the disease from the middle ear and restore the hearing mechanism. Wullstein divided tympanoplasty into five types in 1956. When the middle ear ossicles are intact, type I tympanoplasty involves the repair of the perforated tympanic membrane. It can be done via endaural, postural, or transcanal routes, and the graft can be placed employing overlay, interlay, or underlay techniques. Incorrect and inadequate treatment of chronic otitis media (COM) may cause severe complications [2]. Conventional microscopic tympanoplasty with a postauricular incision remains the most effective and commonly used treatment for chronic otitis media, particularly in cases of anterior or large tympanic membrane perforation with anterior bony overhang [3]. Endoscopes were first used in middle ear surgery in the 1990s and have since been accepted worldwide [4, 5]. Endoscopes are currently employed as a primary or auxiliary device in nearly all types of middle ear surgeries, including chronic otitis surgery, stapes surgery, and cochlear implantation [6,7]. Endoscopy is commonly used in tympanoplasty because it gives a clear surgical field and allows for exposure of the circumferential TM, and avoids a postauricular incision and subsequent scar formation. Unlike a microscope, the endoscope is easily transportable and ideal for in-ear surgery camps. Despite these benefits, the endoscopic approach has its drawbacks. The endoscope lacks adequate microscopic magnification and focus; also, this procedure necessitates the surgeon operating one-handed, holding the endoscope in one hand and other equipment or suction in the freehand. Instruments may crowd the ear canal during the endoscopic approach, and the endoscope may get frequently or substantially coated with blood [8]. Endoscopic surgery provides 2D pictures, and 2D images lack depth awareness [9], making it difficult to raise the graft to establish touch with the perforation's edge. However, advanced high-definition camera systems can provide considerably more delicate endoscopic views with improved contrast. There is a shortage of research on endoscopic tympanoplasty.

Furthermore, there have been few comparative studies between standard microscopic techniques and endoscopic procedures [10]. As a result, a comparative evaluation of the endoscopic and microscopic techniques of tympanoplasty is warranted. This study aims to evaluate and compare the results of endoscopic and conventional microscopic tympanoplasty in terms of hearing outcome, surgical time and graft success rate. The aim was to compare the clinical benefits of permeatal endoscopic tympanoplasty to conventional postaural microscopic surgery.

Material and Methods

This prospective randomized comparative study was conducted in the Department of Otorhinolaryngology, SHKM Hospital, an associated hospital of GMC Nuh, Haryana, India, for 12 months from October 2019 to September 2020. The hospital's institutional review board approved this study. All patients who participated in our study provided written informed consent. A total of 80 patients with central tympanic membrane perforation were recruited. Patients who fulfilled all of the inclusion and exclusion criteria and were ready to provide their voluntary consent for study participation were divided into two groups depending on the surgical intervention they underwent. Group 1 underwent endoscopic tympanoplasty (40 ears from 40 patients), while Group 2 underwent microscopic tympanoplasty (40 ears from 40 patients). Under local anesthesia, all patients underwent type 1 tympanoplasty, and the underlay technique with temporalis fascia as graft material was employed across all cases. A single surgeon operated on all of the cases. The pre-and postoperative audiograms, graft uptake, and surgery time were compared in both groups.

Inclusion criteria

01. Chronic suppurative otitis media (CSOM) with dry central perforation
02. Age >18years
03. Dry ear for at least last six months
04. Patients with conductive hearing loss < 40 dB

Exclusion criteria

01. Active ear discharge
02. Cholesteatoma and granulation tissue in the middle ear
03. CSOM with ossicular chain defects

01. Postoperative residual and recurring tympanic membrane perforations

Surgical equipment: The procedure was performed with a 0-degree 4 mm rigid endoscope. After the tympanomeatal flap was elevated, a 30 degree 4 mm rigid endoscope was employed for some time in the middle of the surgery to inspect the middle ear cavity. Moller-Wedel surgical microscope (GmbH Rosergarten Germany) was used for microscopic tympanoplasty. The display and video system were from Karl Storz. The surgical instruments were conventional micro-instruments used in otology.

Surgical Technique: All the patients were operated on under local anesthesia. Intramuscular injections of 1 ampoule for twin and one ampoule Phenergan were administered as a premedication. The external auditory canal was anaesthetized with 2% lignocaine with 1 in 100,000 adrenaline injections. Under local anesthesia, a temporalis fascia graft was harvested and allowed to dry.

Endoscopic surgery: Cerumen and external auditory canal (EAC) secretions were removed before surgery. The EAC's long hair was cropped. Using the 0 degrees 4 mm endoscope, the perforation margin was freshened with a sickle knife or an angled pick. A curvilinear incision was made about 5 mm lateral to the annulus, extending between 11 o'clock and 1 o'clock position, with a round knife. The skin was gradually elevated away from the external canal's bone. The annulus was upgraded, and the middle ear mucosa was incised. The tympanomeatal flap was then elevated from the handle of the malleus to gain access to the middle ear cavity. After skeletonizing the malleus handle, the temporalis fascia graft was placed using the underlay technique. The tympanomeatal flap protected the temporalis fascia graft. Gelfoam pieces were put over the tympanomeatal flap.

Microsurgery: Cerumen and EAC secretions were cleaned before surgery. The EAC's long hair was cropped. The affected ear was adequately positioned by turning the patient's head towards the opposite side. The external auditory canal was exposed via Wilde's incision. After anteriorly retracting the pinna with a Mollison's retractor, the perforation margin was freshened with a sickle knife. The tympanomeatal flap was raised from 5 mm lateral to the tympanic annulus, skeletonizing the malleus handle. The temporalis fascia graft Was spread uniformly below the handle of the malleus. The tympanomeatal flap was repositioned over the temporalis fascia. Gelfoam pieces were placed over the tympanomeatal flap. The postural wound was sutured with 3-0 silk and stitches removed after one week. The length of the surgery was also documented. On the second postoperative day, all patients were discharged with oral antibiotics and analgesics for seven days. The aural wick was removed after one week.

Follow-up: Postoperative follow-up evaluations included pure tone audiometry, tympanometry, and endoscopic or microscopic evaluation of the graft condition at 1, 3, and 6 months. The final audiometric assessment done at six months was taken for analysis in our study. Averages of 0.5, 1.0, and 2.0 kHz were used to assess hearing thresholds, including air conduction and bone conduction thresholds. In each examination, the air-bone gap (ABG) was also estimated.

Statistical analyses: The T-test and chi-square test were calculated using Statistical Package for the Social Sciences (SPSS) software (IBM Corporation; NY, USA). A p-value < 0.05 was considered to be statistically significant.

Results

The mean age was 25.3 years (range 19—61 years) in group I, with 19 (47.5%) males and 21 (52.5%) females, while the average age was 33.5 years in Group II, with 26 (65%) males and 14 (35%) females (range 19—72 years). Endoscopic type 1 tympanoplasty was performed on 29 (72.5%) right and 11 (27.5%) left ears in Group I. In the microscopic tympanoplasty group, 22 (55%) of the ears operated on were right, and 18 (45%) were left.

There was no previous history of ear surgery in either group. All patients were discharged on 2nd postoperative day. Table 1 shows the demographic characteristics and surgical results of subjects undergoing endoscopic and microscopic type 1 tympanoplasty.

After the first month following surgery, 32 patients out of 40 in the endoscopic group had intact tympanic membrane, and by the third month, 36 patients out of 40 had intact tympanic membrane. Thirty-six patients had intact tympanic membrane at the end of the 6-month

Follow-up period. All five graft failure patients had developed a postoperative infection and were erratic in their follow-up.

After one month, 33 patients out of 40 in the microscopic group had intact tympanic membrane, and by the third month, 37 patients out of 40 had intact tympanic membrane. Thirty-seven patients had intact tympanic membrane at the end of the 6-month follow-up. All four graft failure patients had developed a postoperative infection and were not following up regularly.

In conclusion, after six months of follow-up, the graft success rates for Group I (36 out of 40 ears) and Group II (37 out of 40 ears) were 90% and 92.5%, respectively. There was no significant difference in graft success rates between the groups ($p > 0.05$). For patients in Groups I and II, the mean operative time (SD) was 42.9 ± 10.1 minutes (range 30—56 minutes) and 57.2 ± 4.9 minutes (range 46—75 minutes), respectively. The duration of the procedure in group I was considerably shorter than in Group II ($p < 0.05$).

Table 1: Demographic characteristics and surgical outcomes of the patients.

	Endoscopic Group (n=40)	Microscopic Group (n=40)	p-value *
Age (mean age)	25.3 (19-61)	33.5 (19-72)	
Gender			
Male	19 (47.5%)	26 (65%)	
Female	21 (52.5%)	14 (35%)	
Side			
Right	29 (72.5%)	22 (55%)	
Left	11 (27.5%)	18 (45%)	
Graft uptake rate (%)	90%	92.5%	>0.05
Mean operative duration (mean ± SD)	42.9 ± 10.1	57.2 ± 4.9	<0.05

SD, standard deviation.

*A p-value less than 0.05 was considered to be statistically significant.

The preoperative air-bone gap in the endoscopic group was 30–35 dB in 28 patients and 35–40 dB in 12 patients (Fig. 1) with a mean pure tone Air-Bone gap of 32.17 dB pre-operatively. At the end of a 6-month follow-up, all 36 cases of graft uptake in this group had a mean pure tone Air-Bone gap of 19.21 dB.

The preoperative air-bone gap in the microscopic group was 30–35 dB in 23 patients and 35–40 dB in 17 patients (Fig. 1) with a mean pure tone Air-Bone gap of 34.21 dB pre-operatively. At the end of the 6-month follow-up, all 37 graft uptake patients had a mean pure tone Air-Bone gap of 18 dB.

In conclusion, in our research, the postoperative air-bone gap was below 20 dB in 90% of endoscopic group patients and 92.5% of microscopic group patients. The mean ABG gain in the endoscopic group was 12.96 dB (SD = 3.88) and 16.21 dB (SD = 4.71) in the microscopic group (Fig. 4). This finding was statistically significant (p-value < 0.05).

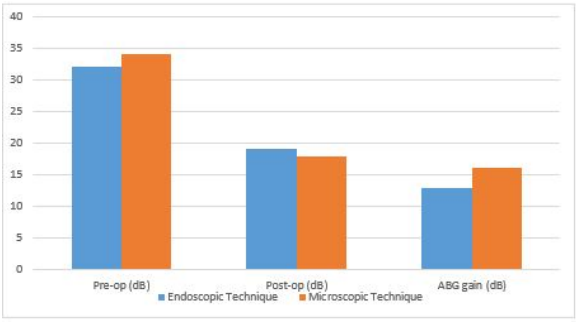

Figure 1: Pre- and postoperative air-bone gap values in both endoscopic and microscopic techniques.

Discussion

The main goals of chronic otitis media treatment are to repair the tympanic membrane, eradicate the chronic infection, and, if necessary, restore ossicular chain integrity and mobility by ossiculoplasty or artificial prosthesis [4, 5, 11, 12]. Various surgical procedures, artificial prosthesis, graft materials, and grafting techniques have been used [6, 7]. El-Guindy [13] was the first to publish a series on endoscopic myringoplasty in 1992. However, Thomassin et al. [14] were the first to report the use of endoscopic assisted surgery to look at hidden areas during cholesteatoma surgery. Stereo vision and bimanual handling are the significant benefits of the microscopic technique. Despite providing direct exposure, microscopes require constant adjustment and maybe ineffective when dealing with protruding structures, especially the anterior wall. The endoscopic technique offers a new perspective to understanding anatomy, pathology, and operative techniques.

A surgeon can do minimally invasive procedures while protecting the anatomy with a thin, rigid endoscope, enabling functional reconstruction during surgery [15].

Furukawa et al. [16] found that in 12% of cases, the circumference of the perforation could not be examined using a microscope before denuding. Furthermore, after refreshing the margins, the whole perforation was not visible in 20% of cases. Endoscopy, on the other hand, can reveal the entire tympanic membrane in one field with clear visualization of the perforation margins, even if the ear canal is small or protruding. When evaluating the success of perforation closure with endoscopic and microscopic type 1 tympanoplasty, some authors had superior outcomes with the microscope [10,17-19] and others with the endoscope [20,21], although these differences were statistically insignificant.

Pap et al. [22] conducted a meta-analysis of endoscopic versus microscopic type I tympanoplasties and discovered that endoscopic surgical outcomes were comparable to microscopic type I tympanoplasty. In our study, the success rates of the microscopic approach for perforation repair and ABG closure were just marginally higher.

According to Tseng et al., graft success rates for endoscopic and microscopic tympanoplasty were 85.1% and 86.4%, respectively, with no significant difference [23]. The graft success rates in the endoscopic and microscopic techniques were 83.3% --100% and 82.4% --100%, respectively, in the studies comparing the endoscopic and microscopic tympanoplasty [24-27]. The current study is consistent with the existing literature in that there was no significant difference in graft success rates between the endoscopic and microscopic groups.

In studies comparing endoscopic and microscopic Type 1 tympanoplasty, the pre-and postoperative ABG values were between 28.5--46.4 dB and 18.1--8.1 dB, respectively. The current studies found that postoperative ABG values improved significantly in either endoscopic or microscopic tympanoplasty [19, 25-28]. In our study, postoperative ABG values improved significantly in both groups compared to preoperative ABG values. Furthermore, we found no statistically significant difference between Groups I and II in postoperative ABG gain. Endoscopic tympanoplasty is a safe and reasonable alternative to the conventional microscopic retroauricular Approach in Type 1 tympanoplasty in terms of hearing outcomes.

The advantages of the endoscopic technique also include a reduction in operative time, which leads to a reduction in anesthesia duration and accompanying side effects, as well as a lesser burden on the surgeon's concentration. Ghaffar et al. [29] found that the average operation time for 34 patients undergoing endoscopic tympanoplasty was 62.85 minutes. The mean operating time in our study was 42.9 ± 10.1 minutes for the 40 ears that had the endoscopic technique, compared to 57.2 ± 4.9 minutes for the microscopic approach on a similar number of ears, which is a statistically significant difference (p-value < 0.05). The preparation of the microscope, as well as the time required to harvest the graft and adjust the microscope, were the key variables accountable for this discrepancy in our hospital.

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.

Conclusion

Endoscopic tympanoplasty is the way of the future. With outcomes comparable to microscopic techniques and other advantages, the endoscope may surpass the microscope in popularity. Endoscopes may be used in the future for all types of ear procedures such as tympanoplasty, stapedotomy, cholesteatoma surgery, and cochlear implant. We advocate using an endoscope for type I tympanoplasties, either as a primary tool or as an adjunct tool to the microscope, due to the enhanced imaging via a minimal access approach and comparable results to microscopic surgery.

What does the study add to existing knowledge? Our study substantiates the new emerging trend of endoscope utilization in performing ear surgeries and found results of endoscopic tympanoplasties on par with the current standard microscopic tympanoplasties.

Contribution by authors: Author 1: (Yadav M) conceived the project proposal,

Manuscript writing and performed surgeries. Author 2: (Tajamul Hussain R) contributed in surgical work. Author 3: (Monga J) contributed in result compilation and analysis. Author 4 (Naik SM) contributed in final proof reading of the manuscript.

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