Original Article

Comparison of Endoscopic Tympanoplasty with Microscopic Tympanoplasty

Nousheen Qureshi[1], Muhammad Musharaf Baig[2], Misbah Parvez[3], Sundas Masood[4], Memoona Afzal[5]

[1] Associate Professor, Department of ENT, Holy Family Hospital, Rawalpindi.
[2] Professor, Department of ENT, Holy Family Hospital, Rawalpindi.
[3,5] Post-graduate Trainee, Department of ENT, Holy Family Hospital, Rawalpindi.
[4] Medical Officer, Department of ENT, Holy Family Hospital, Rawalpindi.

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Corresponding Author
Dr. Nousheen Qureshi,
Associate Professor,
Department of ENT,
Holy Family Hospital,
Rawalpindi
Email: naushi2@yahoo.com

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Abstract

Introduction: Minimally invasive surgery has recently been developed along with endoscopic techniques. Endoscopic Ear Surgery is becoming popular with its anatomic and physiologic concepts. Tympanoplasty is one of the commonest operations performed for the middle ear. While using the endoscope we can place the graft accurately while avoiding unnecessary post or endaural incision and soft tissue dissections which are mandatory during tympanoplasty using a microscope. Our study was aimed to compare the outcomes of endoscopic and microscopic tympanoplasty in terms of graft uptake, hearing outcome, and postoperative pain.

Material and Methods: This is a retrospective comparative study of 63 patients who underwent Type 1 tympanoplasty at ENT Department, Holy Family Hospital, Rawalpindi from March 2017 to March 2020. The subjects were classified into 2 groups; Endoscopic Tympanoplasty (ET: n=30), Microscopic Tympanoplasty (MT: n=33). Type 1 Tympanoplasty was the procedure done on patients of both groups.

Demographic data, perforation size of the tympanic membrane at preoperative state, pure tone audiometric results preoperatively and 3 months postoperatively, operation time, sequential postoperative pain scale (NRS-11), and graft success rate were evaluated.

Results: The perforation size of the tympanic membrane in the Endoscopic group and Microscopic group was nearly the same (p=0.877). Pre and post-operative air-bone gaps including air and bone conduction thresholds were not significantly different between the two groups. The graft success rate in the Endoscopic and Microscopic groups were 93.3% and 63.3% respectively. Values were significantly different (p=0.0046). Immediate and 6 hours postoperative pain was similar in both the groups; however pain on 1st postoperative day was significantly lower in the endoscopic group.

Conclusion: We can do minimal invasive tympanoplasty with the help of endoscopes with a better graft success rate, less per-operative time, and less post-operative pain.

Keywords: Endoscopy, Tympanoplasty, Minimal Invasive Surgical Procedure, Chronic Suppurative Otitis Media.

Introduction

Chronic Suppurative Otitis Media is one of the commonest problems in otology, which leads to permanent changes in the tympanic membrane or structures in the middle ear.[1]

Chronic Suppurative Otitis Media is of two types: Tubotympanic and Atticoantral. In tubotympanic disease the perforation in the tympanic membrane is central, and to repair the tympanic membrane, we need to wait for three months for the ear to become inactive (non-discharging), then we do Tympanoplasty. Type 1 Tympanoplasty is the surgical procedure done to repair the perforation of the tympanic membrane while assessing the middle ear functional status. This procedure was first performed by Berthold (1878) and later popularized by Wullstein and Zollner (1950).[2]

A binocular microscope was used by Gunner Holmgren in 1922. However this type of microscope was not popular due to poor light quality, limited field of vision, instability, and very short focal distance until a new model appeared in 1951 which was perfected by Littman and Zeiss Company that replaced all other models.[3]

The microscope gives us the advantage of magnified vision, good depth perception, and utilizes two hand techniques. However, conventional microscopic tympanoplasty with a postauricular incision remains the most effective procedure for patients with Chronic Otitis Media, especially in cases of anterior or larger tympanic membrane perforations as well as an anterior bony overhang. This conventional procedure results in surgical scar and significant post-operative pain to the patient. It also has the disadvantage of giving straight-line vision and it cannot visualize the corners of the operative field.[4] Jaimin Patel and colleagues performed a comparative study between endoscopic and microscopic tympanoplasty and he writes in his paper that despite various technological advancements in operating microscope basic limitations could not be resolved.[5]

Endoscopic tympanoplasty is a minimally invasive surgery as it gives a direct approach to the middle ear through transcanal incision thus avoiding unnecessary incisions and dissection of soft tissue. It provides better visualization of hidden areas in the middle ear cavity including the anterior and posterior epitympanic spaces, sinus tympani, facial recess, and hypotympanum, which are rarely seen by a microscope. The first reported case of endoscopic tympanoplasty was by el-Guindy in 1992.[6] Since 2009 Daniele Marchioni and coworkers have published several papers on endoscopic middle ear anatomy and they have suggested a nomenclature and new classification of structures according to practical aspects.[7,8,13]

The endoscope also addresses the ventilatory pathways (isthmus of the middle ear) to restore normal function of the middle ear which the microscopic technique fails to do so.[6] Endoscopymediated procedures can decrease residual cholesteatoma and recurrences during surgeries for cholesteatoma removal.[8,9]

The use of an endoscope is rapidly increasing in otological and neuro-otological surgery for the last two decades. Middle ear surgeries, including tympanoplasty, have increasingly utilized endoscope as an adjunct to or as a replacement for the operative microscope.

Superior visualization, direct trans-canal approach to the middle ear, wide-angle view, easy access to disease in the middle ear are the main advantages of using an ear endoscope.[4]

The objectives of the present study were to compare the outcome of endoscopic and microscopic Type 1 tympanoplasty in terms of graft uptake, hearing outcome, and postoperative pain.

Materials and Methods

We performed a retrospective comparative study on 63 patients (23 males and 40 females) who underwent type 1 tympanoplasty from March 2017 to March 2020 in ENT Department Holy Family Hospital Rawalpindi. The patients were included in the study after taking institutional permission and written informed consent from all patients. The subjects were classified into two groups: The endoscopic tympanoplasty group (ET: n=35) and the Microscopic tympanoplasty group (MT: n=30). Patients having chronic inactive otitis media with 3 months dry ear having central tympanic perforation (varying from small to large size) and an air-bone gap less than 40 db were included in our study. All patients fulfilling the above criteria presenting to us in the mentioned three years were included in the study.

Patients with active mucosal ear disease, cholesteatoma, ossicular discontinuity, narrow ear canal, and less than 20 years of age and more than 50 years of age were not included in our study. Allocation of the two treatment groups was done by two independent surgeons who were blinded to the study.

For endoscopic surgery, we used Karl Storz instruments. 0, 30, and 45 degrees, 3 mm wide 14 cm long Hopkins Rod endoscopes were used as seen in Figure 3. Similarly, endoscopic ear instruments were used to do the procedure. All endoscopic surgeries were performed by direct visualization on the monitor. We used Moller Wedel (Germany) Microscope which is available in our ENT department. For microscopic surgery, we used microscopic instruments.

All the procedures were performed by two surgeons. All Patients were operated on under general anesthesia with informed written consent. All tympanoplasty was type 1, where repair of the tympanic membrane was done and graft was placed medial to the tympanic membrane.

In the Endoscopic procedure surgical technique was performed with a transvaginal incision made 5 mm lateral to the annulus endoscopically-Figure 4. The graft used was either temporalis fascia or cartilage perichondrium and the graft was harvested by making a 1.5 cm incision in the hairline just above the helix

Post aural route was used in microscopic tympanoplasty to approach the Middle ear. Temporalis fascia was used as a graft material in all the cases, harvested through post aural incision.

Combined Steps which were done in endoscopic and microscopic surgery were as follows:

1. Margins of perforation were freshened with a straight pick or sickle knife.
2. After elevation of tympanomeatal flap, middle ear inspection was done checking the state of the ossicles and their integrity.
3. The eustachian tube opening was unplugged and cleared.
4. Round window reflex checked.
5. Middle ear ventilation pathways could only be checked in an endoscopic procedure.
6. An autologous graft was placed medial to the tympanic membrane remnant with the placement of gel foam and BIPP pack in the ear canal for 10-12 days in both cases.

Per operatively we collected the following data: we used a metallic caliper as shown in Figure 5 and figure 4 to measure the width of the external auditory canal and the perforation size, both in the endoscopic and microscopic procedure.

Postoperatively mastoid bandage was applied in every case of microscopic tympanoplasty, however, it was not required in endoscopic tympanoplasty as no post aural incision was made. Post-operative follow-up was done after 2 weeks where bismuth iodoform paste pack (BIPP) was removed with an endoscopic examination of the ear to see the status of the tympanic membrane.

Pure tone audiometric results preoperatively were compared after 3 months with pure tone audiometry done postoperatively. The graft success rate was evaluated in both Endoscopic and Microscopic patients. 15 $\pm$ 5 db was taken as standard improvement in the air-bone gap. Data was collected on a Performa which contained the patient's relevant clinical and demographic details.

Independent t-tests will be used to compare the post-op pain between the two groups.

Chi-square test will be used to compare graft success rate between two groups.

95% confidence level will be taken for all statistical tests in the study for the significance level.

Results

Out of 63 patients, 30 underwent endoscopic tympanoplasty and 33 patients underwent microscopic tympanoplasty. The female to male ratio in the endoscopic group was 2:1 and in a microscopic group, it was 2: 1.3 (as shown in Table 1). In the first group, out of 33 patients (<30 years of age), 16 underwent endoscopic tympanoplasty and 17 underwent microscopic tympanoplasty. Whereas in the second group out of 30 patients (>30 years of age) 14 underwent endoscopic tympanoplasty and 16 underwent microscopic tympanoplasty. The patients included in our study were between 20 to 45 years of age. The ages did not differ significantly (p-value=0.885) as shown in Table no 1. Preoperative pure tone audiometry in both groups showed the air-bone gap to be similar between the two groups. The average preoperative air-bone gap in the endoscopic group was 32 ± 1.5 db whereas the average air-bone gap and in the microscopic group was 30 ± 2.5 db.

Out of 63 patients, 7 patients had small (<3 mm) Tympanic membrane perforations, 26 patients had medium-sized (3-7 mm) tympanic membrane perforations and 30 patients had large-sized (>7 mm) tympanic membrane perforations. Tympanic membrane perforation size distribution between endoscopic and microscopic groups is shown in Figure 1. Mean operative time was the same in both the endoscopic and microscopic groups (80 ± 10 minutes).

External auditory canal width was shorter in the endoscopic group (3.9 ± 0.7 mm) than in the microscopic group (4.3 ± 0.6 mm), and external auditory canal widening was not required in the

endoscopic group but had to be done in 11 (33%) patients with the microscopic group. It was because anterior perforations could not be seen adequately with a microscope through a post aural approach.

Immediately and 6 hours after surgery, pain scale scores were not significantly different between the two groups. A pain scale score of 1 day after surgery was significantly lower in the endoscopic group calculated by independent t-test (p-value 0.010) as shown in Table 2. The endoscopic group displayed a 0.8 ± 1.0 pain score and the microscopic group was 1.5 ± 1.3 at 1 day after surgery.

The average air-bone gap post-operative in both endoscopic and microscopic group was 15-20 db.

Out of 63 patients undergoing both endoscopic and microscopic tympanoplasty 49 patients had successful graft uptake while in 14 patients the graft failed. 28 patients (93.3%) of total patients undergoing endoscopic tympanoplasty had successful graft uptake and 21 (63.6%) of total patients undergoing microscopic tympanoplasty had a successful graft uptake. Only 2 patients who had endoscopic tympanoplasty did not have successful graft uptake. The graft uptake was significantly high in the endoscopic group than the microscopic group (p-value 0.0046) as shown in Figure 2.

The distribution of age, gender, and perforation size of patients having unsuccessful graft uptake is shown in Table 3.

Table 1: Age and gender distribution of participants across both groups

		Total	*Endoscopy n=30*	*Microscopy N=33*	*P-value*
Age	**< 30**	33	16	17	**0.885**
	>30	30	14	16	
Gender	**Male**	23	10	13	**0.617**
	Female	40	20	20	

Table 2: Post-op Pain Scores 24 Hours Post-operatively

Post-op pain (24 hours)	*Endoscopy N=30*	*Microscopy N=33*	*P-value*
Mean (SD)	0.8 ±1.0	1.5±1.3	0.010*

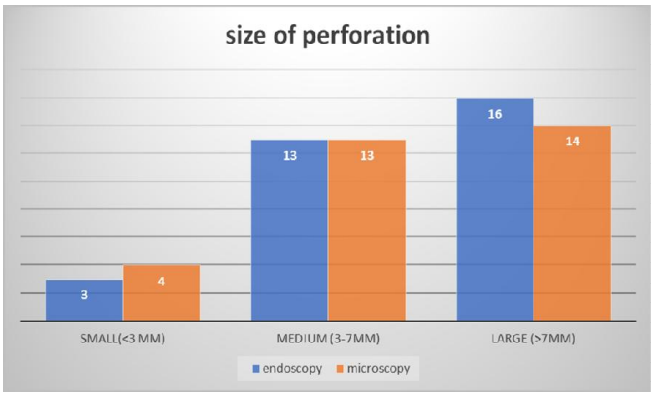

Figure 1: Size of tympanic membrane perforation in both groups

Chi-square P-value p= 0.877

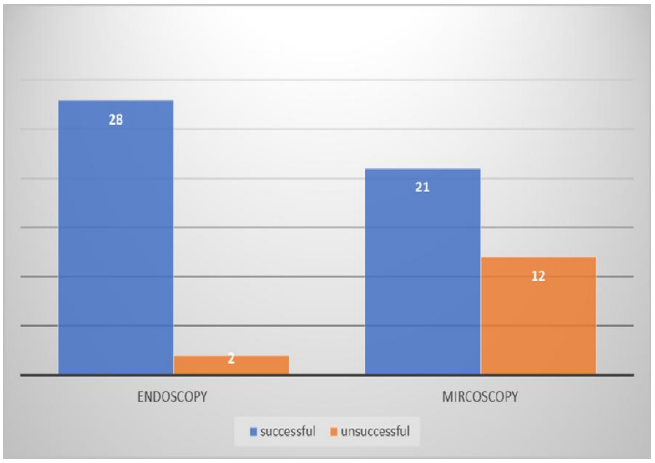

Figure 2: Graft uptake in both groups

Chi-square P-value p=0.0046*

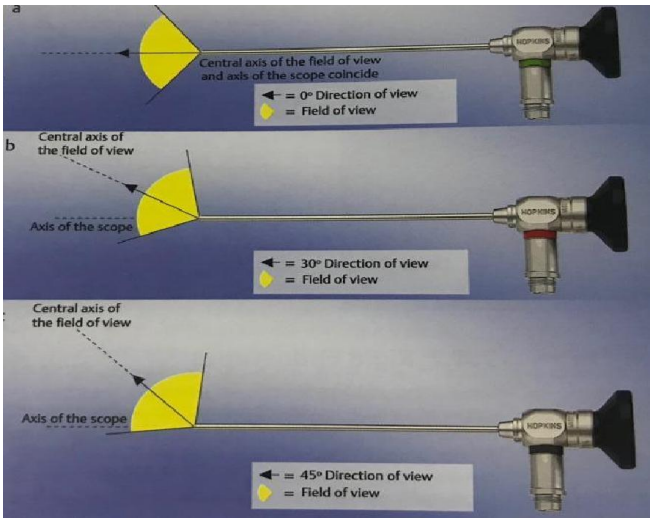

Figure 3: Endoscopes used in Ear Endoscopic Procedures

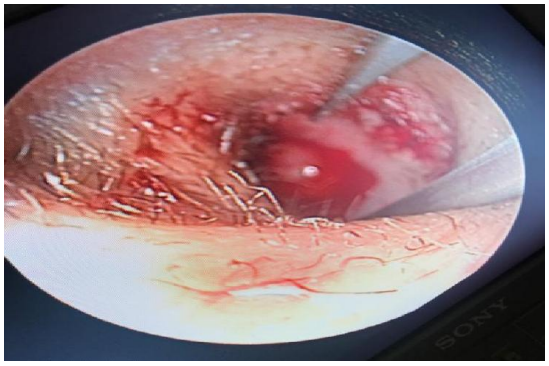

Figure 4: Calliper measuring width of the external canal

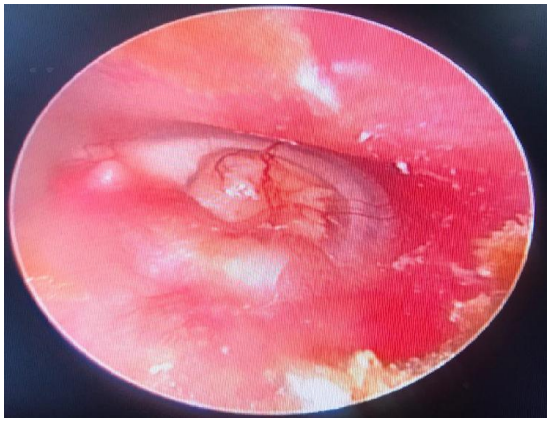

Figure 5: Cartilage graft is taken up postoperatively

Discussion

Advantages of endoscopic ear surgery compared to conventional Microscopic surgery include avoiding vertical endaural, post aural incision, and mastoidectomies in securing the surgical view.[10,11] Endoscopic visualization has significantly improved due to high definition (HD) video imaging and wide-field endoscopy. The quality of endoscopic images is equal or even superior to microscopic visualization in some aspects.[12] In a study by Choi et al. (2016) he compared endoscopic and microscopic tympanoplasty in terms of graft success rate and mean operative time, showed 100% graft uptake in the endoscopic group (n=25) and 98.5% (n=48) in the microscopic group, which was not statistically significant (p=0.304), with a mean, follow up of 6.4 months (range 3–11 months). In his study, the mean operative time in the microscopic group was 88.9 $\pm$ 28.5 minutes, as compared to 68.2 $\pm$ 22.1 minutes in the endoscopic group (p=0.002). It revealed that endoscope use had reduced the operative time significantly, which resulted in less exposure to general anaesthesia.[14] Several studies have already proven that the endoscope significantly reduces the operative time due to its wider vision, and there is no need to perform postoperative suturing.[15] This has accelerated recovery time and reduced the hospital stay, thus lowering making it financially viable for patients of developing countries like ours. Newer high definition cameras have provided better image quality to access blind sacs, middle ear spaces that would be impossible to visit by microscope.[15]

The use of an endoscope is rapidly increasing in otological and neuro-otological surgery in the last two decades. Middle ear surgeries, including tympanoplasty, have increasingly utilized endoscope as an adjunct to or as a replacement of the operative microscope.

Superior visualization, direct transcanal approach to the middle ear, wide-angle view, easy access to disease in the middle ear are the main advantages of using an ear endoscope.[4]

Conclusion

With the use of an endoscope, minimal invasive tympanoplasty is possible with better graft success rate and less postoperative pain as compared to a microscope.

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