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ORIGINAL ARTICLE

A Comparative Study of Functional and Anatomical Outcomes in Endoscopic versus Microscopic Type I Tympanoplasty for Chronic Otitis Media Mucosal Disease

Malavika Kozhiparambil Sajeevan,[1,*] Nalakath Kunjimon Bashir,[2] Anwar Sadath Choolakkaparambu Aboobakker[3] and Abdulla anchukandan[4]
[1]*ENT Consultant, Jeevika Hospital, Marathahalli, Bengalure 560037*
[2]*Consultant, Sheik Zayed Street, Mysaloon, Sahrjah, UAE*
[3]*Associate Professor in ENT, MES Medical College, Perinthalmanna, Kerala 679321.*
[4]*ENT consultant, UAE*

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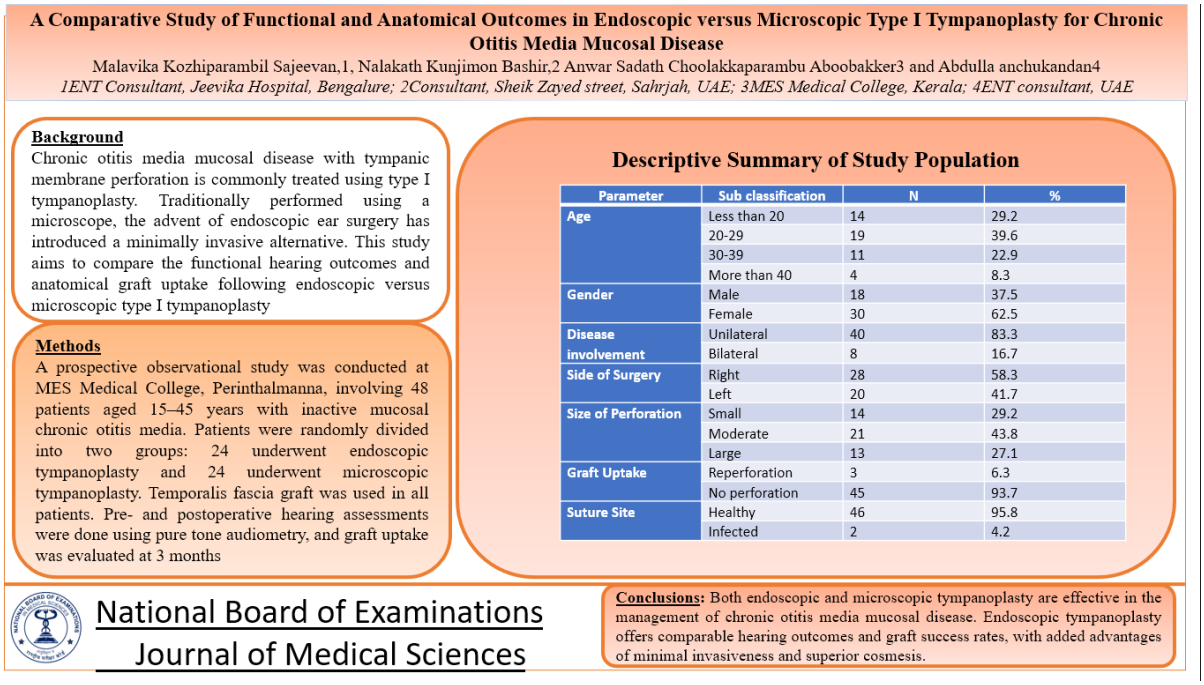
Abstract

Introduction: Chronic otitis media mucosal disease with tympanic membrane perforation is commonly treated using type I tympanoplasty. Traditionally performed using a microscope, the advent of endoscopic ear surgery has introduced a minimally invasive alternative. This study aims to compare the functional hearing outcomes and anatomical graft uptake following endoscopic versus microscopic type I tympanoplasty. **Materials and Methods:** A prospective observational study was conducted at MES Medical College, Perinthalmanna, involving 48 patients aged 15–45 years with inactive mucosal chronic otitis media. Patients were randomly divided into two groups: 24 underwent endoscopic tympanoplasty and 24 underwent microscopic tympanoplasty. Temporalis fascia graft was used in all patients. Pre- and postoperative hearing assessments were done using pure tone audiometry, and graft uptake was evaluated at 3 months. Statistical analysis was performed using SPSS with chi-square and t-tests applied; a p-value < 0.05 was considered significant. **Results:** The mean preoperative air-bone gap (ABG) was 29.71 ± 4.63 dB, which improved significantly postoperatively to 13.25 ± 1.99 dB ($p < 0.001$). The endoscopic and microscopic groups showed similar improvements in ABG ($p = 0.354$). Graft uptake was successful in 95.8% of endoscopic cases and 91.7% of microscopic cases ($p = 0.551$). Two cases of suture site infection were reported, both in the microscopic group. No major complications were observed. **Conclusion:** Both endoscopic and microscopic tympanoplasty are effective in the management of chronic otitis media mucosal disease. Endoscopic tympanoplasty offers comparable hearing outcomes and graft success rates, with added advantages of minimal invasiveness and superior cosmesis.

Keywords: Tympanoplasty, Endoscopic ear surgery, Chronic otitis media, Graft uptake, Hearing outcome

*Corresponding Author: Malavika Kozhiparambil Sajeevan
Email: Malks9591@gmail.com

Graphical Abstract



Introduction

Since the 1950s, microscopic tympanoplasty has been widely accepted as the standard surgical procedure for the repair of tympanic membrane perforations [1]. This technique, which can be performed through postauricular, endaural, or transcanal approaches, allows for precise reconstruction of the tympanic membrane and has consistently demonstrated high graft success rates. A postauricular incision, in particular, offers enhanced visibility and surgical access to the middle ear, making it the preferred route for most surgeons, especially in cases involving restricted ear canal access. The transcanal approach, on the other hand, is generally reserved for patients with smaller perforations and a naturally wider ear canal [2,3].

Despite its established efficacy, microscopic tympanoplasty is not without drawbacks. It typically involves a larger surgical field requiring a deep postauricular incision, general anesthesia, and extended operative time. These factors contribute to increased patient morbidity and longer recovery periods. Since the late 1990s, however, advancements in minimally invasive techniques have led to a significant increase in the use of endoscopic tympanoplasty as a viable alternative [4]. The primary distinction between the two approaches lies in the surgical field of view. While microscopic surgery is limited by the narrowest segment of the external auditory canal, endoscopy provides a panoramic, wide-angled visualization by bypassing these constraints.

Endoscopic tympanoplasty, performed transcanally using rigid endoscopes, offers several practical advantages over the conventional microscopic method. It eliminates the need for canaloplasty and postauricular incisions, and in many cases, can be performed under local anesthesia, thereby reducing surgical trauma and improving cosmetic outcomes [5-7]. Moreover, the

enhanced visualization afforded by the endoscope facilitates better access to hidden recesses of the middle ear, including the epitympanum, sinus tympani, and hypotympanum—areas often difficult to assess using the microscope [8,9]. These advancements have not only expanded the anatomical reach of transcanal ear surgery but also improved the surgeon's ability to assess and manage chronic otitis media more effectively.

Given these potential benefits, there is a growing body of literature exploring the outcomes of endoscopic versus microscopic tympanoplasty in terms of anatomical closure, functional hearing improvement, operative time, complication rates, and patient satisfaction. However, most comparative studies are limited by varying sample sizes, surgical techniques, and patient selection criteria. In this context, the present study was designed to evaluate the functional and anatomical outcomes of Type 1 tympanoplasty using both endoscopic and microscopic approaches in patients diagnosed with chronic otitis media mucosal disease. This study aimed to provide a comprehensive comparison between the two techniques in a uniform cohort of patients, thereby contributing to the ongoing discourse on the most effective and patient-friendly approach to tympanic membrane reconstruction.

Materials and Methods

This prospective observational study was conducted in the Department of Otorhinolaryngology at MES Medical College, Perinthalmanna, over a period of one year from January 2021 to January 2022. The study included patients presenting with chronic otitis media mucosal disease who fulfilled the inclusion criteria. Institutional Ethics Committee approval was obtained prior to the commencement of the study (IEC/MES/27/2020). A detailed patient information sheet outlining the study protocol, procedures, potential risks, and benefits was provided to each participant. Written informed consent was then obtained. Data was collected using a pre-validated study proforma.

The study included 48 patients between the ages of 15 and 45 years with inactive mucosal chronic otitis media, defined by a central tympanic membrane perforation with no active discharge for at least three months. Patients with atticoantral disease, previous tympanoplasty, sensorineural hearing loss, or an air-bone gap greater than 45 dB were excluded. Each patient underwent thorough clinical evaluation including history, general and systemic examination, and ENT examination. Preoperative investigations included tuning fork tests, X-rays of both mastoids, and pure tone audiometry. The average air conduction threshold was calculated using values at 500 Hz, 1000 Hz, and 2000 Hz.

Participants were randomly assigned into two equal groups of 24 patients each. One group underwent microscopic type I tympanoplasty, and the other underwent endoscopic type I tympanoplasty. All surgeries were performed under general anesthesia by the same surgical team using temporalis fascia grafts. In both techniques, the graft was placed using the underlay method.

In the microscopic group, a postauricular William Wilde's incision was made to harvest the graft, and a standard canal wall approach was used. A self-retaining retractor was inserted to provide exposure. The margins of the perforation

were freshened, and a tympanomeatal flap was elevated from the 6 o'clock to 12 o'clock position. The ossicular chain was assessed for mobility, and gelfoam was placed in the middle ear. The temporalis fascia graft was placed over the middle ear cavity and under the remnant tympanic membrane. Gelfoam was also placed in the external auditory canal, and closure was done in layers using 3-0 vicryl for subcutaneous tissue and 3-0 mersilk for skin.

In the endoscopic group, a similar sequence was followed under direct visualization using a 0-degree rigid endoscope through a transcanal route. The tympanomeatal flap was elevated after freshening the perforation. The handle of the malleus was skeletonized and middle ear inspected. Graft placement was done as underlay with support using gel foam. No postauricular incision or retractor was used in the endoscopic approach. The external canal was packed with gel foam, and skin closure was completed with simple sutures.

Postoperative care was standardized. Patients received intravenous antibiotics for one day preoperatively and continued on oral antibiotics postoperatively for one week. Dressings were removed after one week, and suture removal was performed. Follow-up was done at one week, three weeks, and three months. Graft uptake was assessed via otoscopic and oto-endoscopic examination. Postoperative hearing assessment was done using PTA at the third month. Functional outcome was measured by the change in air-bone gap.

Data were entered into Microsoft Excel and analysed using SPSS software (trial version). Descriptive statistics were used to summarize demographic variables. Categorical variables were analysed using the Chi-square test or Fisher's Exact Test where applicable. Continuous variables were analysed using independent sample t-tests and paired t-tests. A p-value < 0.05 was considered statistically significant.

Results

The study population comprised 48 patients, with 29.2% aged less than 20 years, 39.6% aged 20–29 years, 22.9% aged 30–39 years, and 8.3% above 40 years. A majority of participants were female (62.5%), while males accounted for 37.5%. Most patients had unilateral disease involvement (83.3%) and underwent surgery on the right ear (58.3%). Regarding perforation size, 43.8% had moderate perforations, 29.2% had small perforations, and 27.1% had large perforations. Graft uptake was successful in 93.7% of cases, while reperforation was noted in 6.3%. The suture site was healthy in 95.8% of the cases, with infection observed in 4.2% (Table 1).

Table 1. Descriptive Summary of Study Population

Parameter	Sub classification	N	%
Age	Less than 20	14	29.2
	20-29	19	39.6
	30-39	11	22.9
	More than 40	4	8.3
Gender	Male	18	37.5
	Female	30	62.5
Disease involvement	Unilateral	40	83.3
	Bilateral	8	16.7
Side of Surgery	Right	28	58.3
	Left	20	41.7
Size of Perforation	Small	14	29.2
	Moderate	21	43.8
	Large	13	27.1
Graft Uptake	Reperforation	3	6.3
	No perforation	45	93.7
Suture Site	Healthy	46	95.8
	Infected	2	4.2

When comparing the microscopic and endoscopic groups, no statistically significant differences were noted in gender distribution ($p = 0.233$), disease status ($p = 0.439$), side of surgery ($p = 1.000$), size of perforation ($p = 0.571$), graft uptake ($p = 0.551$), or suture site status ($p = 0.149$). Both groups were found to be comparable across these baseline categorical variables (Table 2).

Table 2. Comparison Between Endoscopic and Microscopic Groups (Categorical Variables)

Parameter	Sub classification	Microscopic Group		Endoscopic group		CSV	P Value
		F	%	F	%		
Gender	Male	11	45.8	7	29.2	1.422	0.233
	Female	13	54.2	17	70.8		
Disease status	Bilateral	3	12.5	5	20.8	0.6	0.439
	Unilateral	21	87.5	19	79.2		
Side of Surgery	Left	10	41.7	10	41.7	0	1
	Right	14	58.3	14	58.3		
Size of Perforation	Small	7	29.2	7	29.2	1.121	.571
	Moderate	9	37.5	12	50		
	Large	8	33.3	5	20.8		
Graft Uptake	Reperforation	2	8.3	1	4.2	0.356	0.551
	No perforation	22	91.7	23	95.8		
Suture Site	Healthy	22	91.7	24	100	2.087	0.149
	Infected	2	8.3	0	0		

Significant improvement in hearing was observed postoperatively across all patients. The mean preoperative air-bone gap (ABG) was 29.71 ± 4.63 dB, which reduced to 13.25 ± 1.99 dB postoperatively ($p < 0.001$). In the microscopic group, ABG reduced from 29.09 ± 5.01 dB to 12.98 ± 2.02 dB ($p < 0.001$), and in the endoscopic group, from 29.24 ± 4.32 dB to 13.52 ± 1.95 dB ($p < 0.001$), indicating a statistically significant functional improvement in both groups (Table 3).

Table 3. Comparison of Preoperative vs Postoperative Air Bone Gap

Parameter	**Group**	**Mean**	**SD**	**Mean difference**	**t value**	**p-value**
Overall	Pre operative	29.71	4.63	15.9	33.98	<0.001
	Post operative	13.25	1.99			
Microscopic Group	Pre operative	29.09	5.01	16.11	22.25	<0.001
	Post operative	12.98	2.02			
Endoscopic Group	Pre operative	29.24	4.32	15.72	**25.87**	<0.001
	Post operative	13.52	1.95			

Between-group comparisons showed no statistically significant differences in age ($p = 0.472$), preoperative ABG ($p = 0.912$), or postoperative ABG ($p = 0.354$) between the microscopic and endoscopic groups, confirming that both groups were similar in demographic and functional outcomes (Table 4).

Table 4. Comparison Between Groups on Age and ABG (Pre-op and Post-op)

Parameter	Group	Mean	SD	Mean difference	t value	p-value
AGE	Microscopic Group	27.08	6.63	1.625	0.724	0.472
	Endoscopic Group	25.46	8.75			
Preoperative ABG	Microscopic Group	29.09	5.01	0.14	-0.111	0.912
	Endoscopic Group	29.24	4.31			
Postoperative ABG	Microscopic Group	12.98	2.02	0.54	-0.936	0.354
	Endoscopic Group	13.52	1.95			

No major postoperative complications such as facial palsy, vertigo, or sensorineural hearing loss were reported in either group. The only observed complication was minimal suture site infection in two patients, both of whom belonged to the microscopic group. Additionally, no cases of graft lateralization or blunting were reported.

Discussion

Tympanoplasty is a widely performed procedure for the management of chronic otitis media mucosal disease with tympanic membrane perforation. In this study, we compared the anatomical and functional outcomes of endoscopic versus microscopic type I tympanoplasty. The distribution of disease characteristics such as side of surgery, disease laterality, and size of perforation were similar in both groups, thereby ensuring a balanced comparison.

In our study, the endoscopic group showed a higher proportion of females (70.8%) compared to the microscopic group (54.2%). The mean age was slightly lower in the endoscopic group (25.45±8.75 years) compared to the microscopic group (27.08±6.63 years), but these differences were not statistically significant. This is comparable to the findings of Jyothi et al., who reported a mean age of 28.5 years in the endoscopic group and 31.4 years in the microscopic group, with similar gender distributions [10]. Likewise, Yang et al. found no statistically significant differences in age or gender between the two groups [11].

The size of tympanic membrane perforation was also similar in both groups, with 43.8% having moderate perforations. Our findings are consistent with the study

by Faruq et al., who also reported no statistically significant association between the size of perforation and surgical outcomes [12].

The mean preoperative AB gap was 29.09 dB in the microscopic group and 29.24 dB in the endoscopic group, and both groups showed statistically significant improvement postoperatively (12.98 dB and 13.52 dB respectively). The mean AB gap closure was 16.11 dB for the microscopic group and 15.72 dB for the endoscopic group, indicating similar functional outcomes. These findings are in agreement with the results of Jyothi et al., where the AB gap closure was 19.54 dB in the microscopic group and 16.16 dB in the endoscopic group [10]. Similar observations were made by Faruq et al. [12] and Maran et al. [13], who documented comparable improvements in AB gap with both approaches.

Regarding anatomical outcomes, the graft uptake rate was 91.7% in the microscopic group and 95.8% in the endoscopic group, with no statistically significant difference. Faruq SAS et al. also reported similar graft uptake rates between groups and concluded that both techniques are equally effective [12]. Better results were also observed in studies done by Harugop et al. [14], Raj et al. [15] and Lakpathi et al. [16]. Patel et al. [17] observed 68% graft uptake. In our study, 2 patients (8.3%) in the microscopic group developed suture site infections, whereas no such complications were observed in the endoscopic group. This may be attributed to the minimally invasive nature of endoscopic tympanoplasty, which avoids postauricular incisions.

Thus, this study demonstrates that both microscopic and endoscopic tympanoplasty are safe and effective techniques for type 1 tympanoplasty, with comparable graft success rates and hearing outcomes. While the endoscopic approach may offer advantages in terms of reduced soft tissue trauma and better cosmetic outcomes, the choice of technique can be individualized based on surgeon expertise and case-specific anatomical considerations.

This study is limited by its relatively small sample size and single-center design. Future multi-center randomized controlled trials with larger sample sizes and long-term follow-up are recommended to further validate these findings.

Conclusion

The present study demonstrates that both endoscopic and microscopic type I tympanoplasty techniques are effective in achieving favorable anatomical and functional outcomes in patients with chronic otitis media mucosal disease. The graft uptake rates and improvement in air-bone gap were statistically similar between the two groups. Although minor suture site infections were observed in the microscopic group, no major complications occurred in either group. Endoscopic tympanoplasty offers the added advantages of a minimally invasive approach, better cosmetic results, and comparable outcomes to conventional microscopic surgery. Thus, endoscopic tympanoplasty is a viable and equally effective alternative to microscopic tympanoplasty for selected cases of tympanic membrane repair.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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