Original Article

A Comparative Study between Endoscopic Tympanoplasty and Microscopic Tympanoplasty

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Abstract

Background: Chronic tympanic membrane perforation secondary to chronic otitis media is a common otological condition requiring surgical repair to achieve a dry ear and improve hearing. Microscopic tympanoplasty has traditionally been considered the standard technique; however, endoscopic tympanoplasty has emerged as a minimally invasive alternative with potential advantages in visualization, cosmesis, and recovery. The aim is to compare the anatomical, functional, and patient-related outcomes of endoscopic tympanoplasty and microscopic tympanoplasty. **Material and Methods:** A prospective comparative study was conducted in the Department of Otorhinolaryngology at Santosh Medical College and Hospitals over 18 months. A total of 50 patients with chronic tympanic membrane perforation were included and divided into two groups: endoscopic tympanoplasty (n=25) and microscopic tympanoplasty (n=25). Preoperative assessment included otoscopy, tuning fork tests, and pure tone audiometry. Postoperative outcomes including graft uptake, hearing improvement, complications, and patient satisfaction were evaluated and compared. **Results:** Successful graft uptake was achieved in 96% of patients in the endoscopic group and 92% in the microscopic group (p=1.000). Postoperative air–bone gap was lower in the endoscopic group (11.54 ± 9.45 dB vs 16.88 ± 10.92 dB). Mean hearing improvement was greater with endoscopic tympanoplasty (15.86 ± 3.87 dB vs 13.66 ± 5.06 dB), although statistically insignificant. Postoperative complications were fewer in the endoscopic group. Cosmetic satisfaction was higher among endoscopic patients (88% vs 60%), and fewer hospital visits were required (84% vs 52%, p=0.032). **Conclusion:** Endoscopic tympanoplasty provides anatomical and functional outcomes comparable to microscopic tympanoplasty while offering additional benefits of reduced postoperative morbidity, better cosmetic satisfaction, and faster recovery. It represents an effective minimally invasive alternative for tympanic membrane reconstruction.

Keywords: Endoscopic tympanoplasty; Microscopic tympanoplasty; Chronic otitis media; Tympanic membrane perforation; Graft uptake; Hearing outcome; Air–bone gap.

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Introduction

Chronic perforation of the tympanic membrane secondary to chronic otitis media (COM) remains a significant otological problem, particularly in developing countries such as India. COM is characterized by persistent inflammation of the middle ear cleft with recurrent or continuous otorrhoea through a perforated tympanic membrane, often resulting in conductive hearing loss, impaired communication, reduced quality of life, and socioeconomic consequences. The World Health Organization has recognized COM as a major public health concern, with India being among the countries with a high disease burden and an estimated prevalence of approximately 5.2%.[1] The disease commonly affects individuals during their productive years, thereby contributing to considerable personal and societal impact.[2] Tympanoplasty is the established surgical procedure for the management of chronic tympanic membrane perforations, with the primary objectives of achieving a safe, dry ear and improving hearing function. It involves reconstruction of the tympanic membrane with or without ossicular chain reconstruction depending on the middle ear status.[3] Since its introduction and standardization by Wullstein in 1956, microscopic tympanoplasty has remained the conventional gold-standard technique for several decades.[4] The microscopic approach provides excellent magnification, stereoscopic visualization, and allows precise bimanual instrumentation through postauricular, endaural, or transcanal approaches.[5] However, conventional microscopic tympanoplasty may require extensive soft tissue dissection, larger incisions, and canaloplasty, particularly in cases with anterior, subtotal, or marginal perforations, which may increase postoperative pain, wound morbidity, and visible scarring.[6] With advancements in

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minimally invasive otologic surgery, endoscopic ear surgery (EES) has emerged as an alternative approach for tympanic membrane repair. Tarabichi introduced the application of endoscopy in middle ear surgery during the 1990s, and since then, endoscopic tympanoplasty has gained widespread acceptance due to its ability to provide enhanced visualization of anatomical areas that are difficult to access with the microscope.[7] The wide-angle view of the endoscope allows improved visualization of the anterior tympanic membrane, tympanic annulus, sinus tympani, hypotympanum, and other hidden recesses without requiring a postauricular incision.[8] This transcanal minimally invasive approach facilitates better assessment of perforation margins, graft placement, and inspection of the middle ear cavity, especially in anterior and subtotal perforations.[9] Despite its advantages, endoscopic tympanoplasty has certain technical limitations. Unlike microscopic surgery, endoscopic procedures are generally performed using a single-handed technique because one hand is required to hold the endoscope, limiting the ability for simultaneous suction and instrumentation.[10] The absence of binocular vision results in reduced depth perception compared with the microscope. Additional concerns include lens fogging, restricted working space, and possible thermal effects from the light source during prolonged procedures.[11] However, improvements in high-definition imaging systems, angled endoscopes, and modern cold-light technology have significantly reduced these limitations and expanded the applicability of endoscopic techniques.[12] Recent evidence suggests that endoscopic tympanoplasty provides anatomical and functional outcomes comparable to conventional microscopic tympanoplasty. Crotty et al. (2023), in a systematic review and meta-analysis, demonstrated no significant difference between endoscopic and microscopic techniques regarding graft uptake and postoperative air–bone gap closure, while highlighting advantages of endoscopic surgery including reduced operative time and improved cosmetic outcomes.[13] Bishnoi et al. (2023), in an Indian comparative study involving 60 patients, reported graft success rates of 93.3% in the endoscopic group and 90% in the microscopic group, with comparable hearing improvement between both techniques.[14] Similarly observed equivalent graft integration and hearing outcomes but emphasized reduced postoperative pain, shorter recovery duration, and greater patient satisfaction with endoscopic tympanoplasty.[15] Gkrinia et al. (2024) further supported the efficacy and safety of endoscopic approaches, reporting comparable surgical success with additional benefits of shorter hospitalization and improved postoperative comfort[16]. Indian studies have also demonstrated encouraging results with endoscopic tympanoplasty. Kumar et al. (2021) and Singh et al. (2022) reported significantly shorter operative duration with endoscopic techniques compared with conventional microscopic surgery, while maintaining graft success rates exceeding 90% and similar postoperative hearing outcomes.[17,18] These findings suggest that endoscopic tympanoplasty can provide effective disease eradication and functional restoration while offering advantages associated with minimally invasive surgery. The transcanal endoscopic approach eliminates external incisions, thereby reducing postoperative scar formation and wound-related complications.[19] Furthermore, in selected cases, it can be performed under local anesthesia, supporting day-care surgery and reducing healthcare costs.[20] However, widespread adoption of endoscopic tympanoplasty requires appropriate equipment availability, surgeon training, and familiarity with single-handed surgical techniques, which remain limitations in many developing healthcare settings.[21] Although both microscopic and endoscopic tympanoplasty have demonstrated favorable graft uptake and hearing outcomes, controversy remains regarding their comparative operative efficiency, learning curve, patient satisfaction, and long-term effectiveness. Existing literature is predominantly based on single-center studies with limited sample sizes and variable follow-up periods. Therefore, the present comparative study was undertaken to evaluate and compare endoscopic tympanoplasty and microscopic tympanoplasty in terms of surgical outcomes, hearing improvement, operative parameters, postoperative recovery, and complications in patients undergoing tympanic membrane reconstruction.

Materials and Methods

Study Design and Setting: The present study was conducted as a prospective cross-sectional comparative study in the Department of Otorhinolaryngology at Santosh Medical College and Hospitals. The study was carried out over a period of 18 months. The study population included patients presenting to the ENT outpatient department with complaints suggestive of chronic tympanic membrane perforation and conductive hearing loss.Prior approval was obtained from the Institutional Ethics Committee before initiation of the study. Written informed consent was obtained from all participants after explaining the nature, objectives, and possible outcomes of the surgical procedures. All patients fulfilling the predefined eligibility criteria were enrolled in the study.

Study Population and Data Collection: Patients attending the ENT outpatient department with chronic tympanic membrane perforation due to chronic otitis media or trauma were screened for eligibility. Detailed clinical history, otological examination, and relevant investigations were performed for all recruited patients.

Inclusion Criteria

Patients fulfilling the following criteria were included in the study:

1. Patients with central tympanic membrane perforation secondary to chronic otitis media or traumatic perforation.
2. Patients presenting with conductive hearing loss due to chronic otitis media or trauma.
3. Patients with inactive or quiescent chronic otitis media.
4. Patients aged 15–60 years of either sex.

Exclusion Criteria

Patients were excluded if they had:

1. Active ear discharge at the time of surgery.
2. Evidence of mastoiditis.
3. Sensorineural hearing loss.
4. Presence of cholesteatoma.

Study Methodology: After obtaining ethical clearance, all

eligible patients satisfying the inclusion criteria were recruited. A detailed clinical evaluation was performed, including history taking, otoscopic examination, and tuning fork tests.

Preoperative assessment included:

- Otoscopic examination to evaluate the site and size of tympanic membrane perforation.
- Tuning fork tests for assessment of hearing status.
- Pure tone audiometry (PTA) to determine the degree and type of hearing loss and calculate the preoperative air–bone gap (ABG).
- Routine preoperative investigations as per institutional protocol.

Based on otoscopic findings and clinical assessment, patients were selected for tympanoplasty. The patients were allocated to either endoscopic tympanoplasty or microscopic tympanoplasty groups according to a computer-generated randomization table.

All patients underwent tympanic membrane repair using the allocated surgical technique. Postoperative follow-up was performed at regular intervals to assess surgical outcomes.

The following postoperative parameters were evaluated and compared between the two groups:

- Percentage of graft uptake.
- Improvement in hearing thresholds.
- Postoperative air–bone gap closure.
- Postoperative hospital stay.
- Postoperative complications.

The outcomes of endoscopic and microscopic tympanoplasty were compared to determine differences in anatomical and functional success.

Statistical Analysis: Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables including age, preoperative and postoperative air–bone gap, hearing improvement, and duration of hospital stay were expressed as mean ± standard deviation (SD). Categorical variables such as graft uptake rate and postoperative complications were presented as frequencies and percentages.

The distribution of continuous variables was assessed using the Shapiro–Wilk test for normality. For comparison between the two groups, normally distributed continuous variables were analyzed using the independent samples t-test, whereas non-normally distributed variables were compared using the Mann–Whitney U test.

Within-group comparison of preoperative and postoperative hearing parameters was performed using the paired t-test for normally distributed data and the Wilcoxon signed-rank test for non-parametric data.

Categorical variables between the endoscopic and microscopic tympanoplasty groups were compared using the Chi-square test or Fisher's exact test, wherever appropriate.

A p-value <0.05 was considered statistically significant for all analyses.

Results

The present prospective comparative study included 50 patients undergoing tympanoplasty for chronic tympanic membrane perforation. Patients were equally divided into two groups: endoscopic tympanoplasty group (n=25) and microscopic tympanoplasty group (n=25). Baseline demographic characteristics, clinical profile, operative parameters, and postoperative outcomes were compared between the two group.

The age distribution of patients was comparable between the two groups. The majority of patients belonged to the 41–50 years age group, accounting for 8 patients (32.0%) in both the endoscopic and microscopic groups. The remaining age categories showed a similar distribution, with no statistically significant difference between the groups (p = 0.972) [Table 1].

The mean distribution of sex showed a female predominance in the endoscopic group, where females constituted 15 patients (60.0%), whereas the microscopic group had a higher proportion of male patients (15 patients, 60.0%). However, this difference was not statistically significant (p = 0.148) [Table 1].

Regarding residence, patients in the endoscopic group were more frequently from urban areas (52.0%), whereas the microscopic group predominantly included patients from rural areas (84.0%). The difference in residence distribution between the two groups was statistically significant (p = 0.009) [Table 1].

Table 1: Demographic characteristics of study population

Parameter	Endoscopic (n=25)	Microscopic (n=25)	p value
Age group (years), n (%)			0.972
≤20	3 (12.0%)	2 (8.0%)	
21–30	5 (20.0%)	4 (16.0%)	
31–40	5 (20.0%)	6 (24.0%)	
41–50	8 (32.0%)	8 (32.0%)	
51–60	4 (16.0%)	5 (20.0%)	
>60	0	0	
Sex, n (%)			0.148
Male	10 (40.0%)	15 (60.0%)	
Female	15 (60.0%)	10 (40.0%)	
Residence, n (%)			0.009*
Urban	13 (52.0%)	4 (16.0%)	
Rural	12 (48.0%)	21 (84.0%)	

The duration of ear discharge was assessed among patients in both groups. In the endoscopic group, discharge duration of more than 1 year was observed in 12 patients (48.0%), followed by 6–12 months in 7 patients (28.0%). In the microscopic group, the most common duration was 6–12 months (40.0%), followed by more than 1 year (32.0%). The difference in duration of ear discharge was statistically insignificant (p = 0.495) [Table 2].

Preoperative dry ear duration was also comparable between both groups. A dry ear period of less than 1 month was observed in 64.0% of patients in the endoscopic group and 52.0% in the microscopic group. No significant difference was noted between the groups (p = 0.368) [Table 2].

The distribution of tympanic membrane perforation sites was comparable between both groups. The anterosuperior quadrant was the most commonly involved site in both groups, accounting for 48.0% of cases in the endoscopic group and 40.0% in the microscopic group. The difference in perforation site distribution was not statistically significant (p = 0.547) [Table 2].

Table 2: Clinical characteristics of patients

Clinical parameter	Endoscopic (n=25)	Microscopic (n=25)	p value
Duration of ear discharge, n (%)			0.495
<6 months	6 (24.0%)	7 (28.0%)	
6–12 months	7 (28.0%)	10 (40.0%)	
>1 year	12 (48.0%)	8 (32.0%)	
Duration of dry ear, n (%)			0.368
<1 month	16 (64.0%)	13 (52.0%)	
1–2 months	6 (24.0%)	5 (20.0%)	
>2 months	3 (12.0%)	7 (28.0%)	
Site of perforation, n (%)			0.547
Anterosuperior quadrant	12 (48.0%)	10 (40.0%)	
Anteroinferior quadrant	6 (24.0%)	6 (24.0%)	
Posterosuperior quadrant	5 (20.0%)	5 (20.0%)	
Posteroinferior quadrant	2 (8.0%)	2 (8.0%)	

Temporalis fascia was the most frequently used graft material in both groups. It was used in 19 patients (76.0%) in the endoscopic group and 21 patients (84.0%) in the microscopic group. Tragal perichondrium was used in patients with previous ear surgery. The difference in graft material selection between the two groups was not statistically significant (p = 0.725) [Table 3, Figure 1].

Table 3: Operative characteristics

Parameter	Endoscopic (n=25)	Microscopic (n=25)	p value
Graft material used, n (%)			0.725
Temporalis fascia	19 (76.0%)	21 (84.0%)	
Tragal perichondrium	6 (24.0%)	4 (16.0%)	

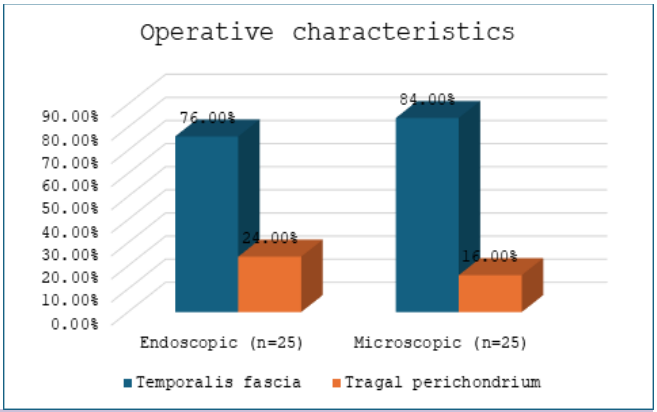

Figure 1: Operative characteristics

Successful graft uptake was achieved in 24 patients (96.0%) in the endoscopic group and 23 patients (92.0%) in the microscopic group. Graft failure occurred in 1 patient (4.0%) in the endoscopic group and 2 patients (8.0%) in the microscopic group. Although graft success was slightly higher in the endoscopic group, the difference was statistically insignificant (p = 1.000) [Table 4].

Postoperative complications were observed more frequently in the microscopic group. Pain occurred in 4 patients (16.0%) in the microscopic group compared with 2 patients (8.0%) in the endoscopic group. Fever, ear discharge, and temporomandibular joint arthralgia were also higher in the microscopic group. However, the difference in complication rates between the groups was not statistically significant (p = 0.218) [Table 4].

Table 4: Postoperative surgical outcomes

Outcome	Endoscopic (n=25)	Microscopic (n=25)	p value
Graft uptake			1.000
Successful	24 (96.0%)	23 (92.0%)	
Failure	1 (4.0%)	2 (8.0%)	
Postoperative complications			0.218
Pain	2 (8.0%)	4 (16.0%)	
Fever	1 (4.0%)	3 (12.0%)	
Ear discharge	1 (4.0%)	3 (12.0%)	
TMJ arthralgia	0	2 (8.0%)	

Preoperative hearing status was comparable between the two groups. The mean preoperative air–bone gap was 27.40 ±

10.03 dB in the endoscopic group and 30.54 ± 9.09 dB in the microscopic group (p = 0.252).

At 12 weeks postoperatively, the mean air–bone gap decreased to 11.54 ± 9.45 dB in the endoscopic group and 16.88 ± 10.92 dB in the microscopic group. The mean hearing improvement was greater in the endoscopic group (15.86 ± 3.87 dB) compared with the microscopic group (13.66 ± 5.06 dB); however, the difference did not reach statistical significance (p = 0.091) [Table 5, Figure 2].

Table 5: Comparison of postoperative hearing outcomes at 12 weeks

Hearing parameter	Endoscopic (Mean ± SD)	Microscopic (Mean ± SD)	p value
Preoperative AB gap (dB)	27.40 ± 10.03	30.54 ± 9.09	0.252
Postoperative AB gap (dB)	11.54 ± 9.45	16.88 ± 10.92	0.071
Hearing improvement (dB)	15.86 ± 3.87	13.66 ± 5.06	0.091

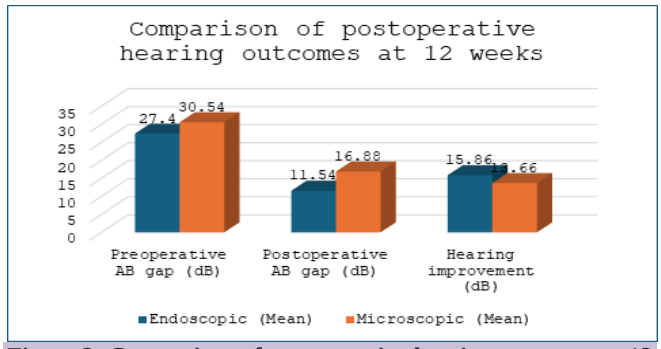

Figure 2: Comparison of postoperative hearing outcomes at 12 weeks

Patient satisfaction parameters showed better postoperative recovery outcomes in the endoscopic group. Early return to work was reported by 20 patients (80.0%) in the endoscopic group compared with 14 patients (56.0%) in the microscopic group. Good cosmetic satisfaction was observed in 22 patients (88.0%) undergoing endoscopic tympanoplasty compared with 15 patients (60.0%) undergoing microscopic tympanoplasty.

A significantly higher proportion of patients in the endoscopic group required fewer hospital visits (≤3 visits) compared with the microscopic group (84.0% vs 52.0%, p = 0.032) [Table 6, Figure 3].

Table 6: Patient satisfaction after surgery

Satisfaction parameter	Endoscopic (n=25)	Microscopic (n=25)	p value
Early return to work	20 (80.0%)	14 (56.0%)	
Good cosmetic satisfaction	22 (88.0%)	15 (60.0%)	
≤3 hospital visits	21 (84.0%)	13 (52.0%)	0.032*

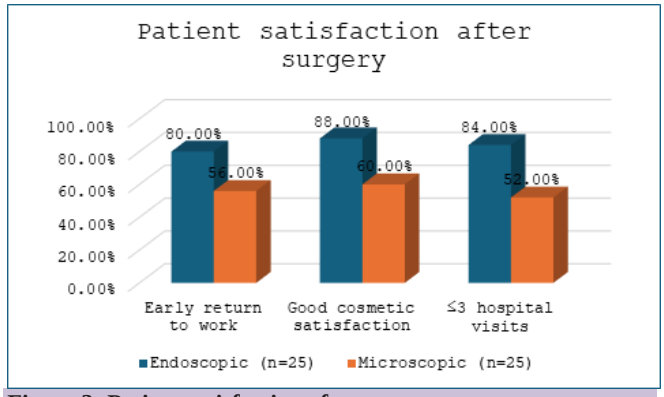

Figure 3: Patient satisfaction after surgery

Discussion

The present prospective comparative study was conducted to evaluate and compare the anatomical, functional, and patient-related outcomes of endoscopic and microscopic tympanoplasty in patients with chronic tympanic membrane perforation due to chronic otitis media. The study assessed demographic characteristics, clinical profile, graft uptake, hearing improvement, postoperative complications, and patient satisfaction outcomes between both surgical techniques. In the present study, the majority of patients belonged to the 41–50 years age group (32% in both groups), with no significant difference in age distribution (p = 0.972), indicating comparable baseline characteristics. Similar findings were reported by Huang et al.22 (2016), who observed mean ages of 36.8 ± 11.2 years in the endoscopic group and 37.4 ± 10.6 years in the microscopic group. Jyothi et al,[23] (2017) also reported comparable mean ages of 28.5 years and 31.4 years in endoscopic and microscopic groups, respectively. The present study showed female predominance in the endoscopic group (60%) and male predominance in the microscopic group (60%), with no significant difference (p = 0.148). Similar observations were reported by Kaya et al,[24] (2017) and Jyothi et al,[23] suggesting that age and sex do not significantly influence tympanoplasty outcomes. In the present study, discharge duration of more than one year was observed in 48% of endoscopic cases and 32% of microscopic cases, without significant difference (p = 0.495). Huang et al,[22] reported mean disease duration of 14.6 ± 7.3 months and 15.1 ± 8.0 months in endoscopic and microscopic groups, respectively, showing similar chronicity. The most common perforation site in the present study was the anterosuperior quadrant, observed in 48% of endoscopic cases and 40% of microscopic cases (p = 0.547). Huang et al,[22] reported anterior perforations in 46% of endoscopic and 42% of microscopic cases, while Kaya et al,[24] demonstrated comparable outcomes of both techniques even in technically challenging anterior perforations. The improved visualization offered by endoscopy may provide an advantage in such cases. Temporalis fascia was the most commonly used graft material in the present study, used in 76% of endoscopic cases and 84% of microscopic cases (p = 0.725). Similar findings were reported by Jyothi et al,[23] where temporalis fascia was used in

all cases, and by Huang et al,[22] where fascia was used in more than 90% of patients. The graft uptake rate was 96% in the endoscopic group and 92% in the microscopic group, with no statistically significant difference (p = 1.000). Jyothi et al,[23] reported graft success rates of 91.67% and 93.33% in endoscopic and microscopic groups, respectively. Huang et al,[22] also demonstrated comparable graft success between both techniques. These findings confirm that both approaches provide excellent anatomical results. In the present study, preoperative air–bone gap was comparable between groups (27.40 ± 10.03 dB in endoscopic vs 30.54 ± 9.09 dB in microscopic group; p = 0.252). At 12 weeks, postoperative air–bone gap improved to 11.54 ± 9.45 dB and 16.88 ± 10.92 dB, respectively. Mean hearing improvement was greater in the endoscopic group (15.86 ± 3.87 dB vs 13.66 ± 5.06 dB), although statistically insignificant (p = 0.091). Similar results were reported by Jyothi et al.23 who observed hearing gains of 14.6 dB in the endoscopic group and 13.9 dB in the microscopic group. Pap et al,[25] (2019) also reported no significant difference in hearing improvement between the two techniques. The present findings suggest comparable functional outcomes with a favorable trend toward endoscopic surgery. The present study demonstrated fewer postoperative complications in the endoscopic group, with pain occurring in 8% of patients compared with 16% in the microscopic group. Jyothi et al,[23] reported lower postoperative pain scores in the endoscopic group (VAS 2.1 ± 0.8 vs 4.6 ± 1.2), while Kaya et al,[24] also observed reduced postoperative discomfort with endoscopic surgery. Patient satisfaction outcomes favored the endoscopic approach. Cosmetic satisfaction was reported in 88% of endoscopic patients compared with 60% of microscopic patients, and fewer hospital visits were required in the endoscopic group (84% vs 52%, p = 0.032). Similar benefits, including faster recovery and improved cosmetic outcomes, were reported by Kaya et al,[24] and Jyothi et al.[23]

Conclusion

Endoscopic and microscopic tympanoplasty demonstrated comparable graft uptake rates and successful anatomical outcomes in patients with chronic tympanic membrane perforation. Both techniques provided significant hearing improvement, with no statistically significant difference in postoperative air–bone gap closure; however, endoscopic tympanoplasty showed a favorable trend toward better hearing gain. Endoscopic tympanoplasty was associated with fewer postoperative complications, reduced morbidity, and improved cosmetic outcomes compared with microscopic tympanoplasty. Patients undergoing endoscopic tympanoplasty demonstrated better satisfaction with faster recovery and fewer postoperative hospital visits. Endoscopic tympanoplasty can be considered an effective minimally invasive alternative to conventional microscopic tympanoplasty, particularly in appropriately selected patients.

Limitations: The study was conducted with a relatively small sample size of 50 patients and from a single tertiary-care center, which may limit the generalizability of the findings. The follow-up duration was limited to the early postoperative period; therefore, long-term graft stability and hearing outcomes could not be assessed. The study focused mainly on type I tympanoplasty, and outcomes may differ in more complex middle ear pathologies requiring ossicular reconstruction.

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Conflicts of interest

There are no conflicts of interest.

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