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RESEARCH ARTICLE

Multiparametric Comparative Study of Endoscopic versus Microscopic Tympanoplasty-A 6-Year KAHER Journey

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Abstract

Background: Tympanoplasty is a commonly performed surgical procedure for the repair of tympanic membrane perforations in chronic otitis media. With the growing adoption of minimally invasive techniques, endoscopic tympanoplasty has emerged as an alternative to the conventional microscopic approach. Comparative evaluation of these techniques is essential to determine their clinical effectiveness.

Objective: To compare endoscopic and microscopic tympanoplasty in terms of graft uptake rate, operative time, need for canaloplasty, postoperative hearing improvement, postoperative pain, hospital stay, cosmetic outcomes, and patient satisfaction.

Methods: This prospective comparative study was conducted in the Department of ENT & HNS at KAHER's JNMC, Belgaum, India, from October 2016 to April 2024. A total of 140 patients with dry central tympanic membrane perforations due to chronic suppurative otitis media were included and divided into two groups: Endoscopic Tympanoplasty (ET) (n=70) and Microscopic Tympanoplasty (MT) (n=70). Clinical and surgical parameters including graft uptake, operative time, need for canaloplasty, hearing gain (Pure Tone Audiometry), postoperative pain (Visual Analogue Scale), hospital stay, and cosmetic satisfaction (COST scale) were evaluated. Statistical analysis was performed using the independent t-test and Chi-square test.

Results: Both groups were comparable in demographic characteristics and perforation size. Graft uptake success rate was identical in both groups (88.57%). Endoscopic tympanoplasty demonstrated significantly shorter operative time (47.79 ± 4.69 min vs. 78.07 ± 17.92 min), smaller incision size, reduced postoperative pain, shorter hospital stays, and better cosmetic outcomes ($p < 0.0001$). Canaloplasty was required in 17.14% of the microscopic group but none in the endoscopic group ($p = 0.0001$). Although hearing gain was slightly higher in the microscopic group (23.18 ± 9.23 dB) compared to the endoscopic group (20.02 ± 9.93 dB), the difference was not statistically significant ($p = 0.0538$).

Conclusion: Both endoscopic and microscopic tympanoplasty are effective techniques for tympanic membrane repair with comparable graft uptake and hearing outcomes. However, endoscopic tympanoplasty offers advantages such as shorter operative time, minimal invasiveness, reduced postoperative pain, shorter hospital stays, and superior cosmetic outcomes.

Keywords: Endoscopic tympanoplasty, Microscopic tympanoplasty, Chronic otitis media, Tympanic membrane perforation, Hearing outcomes

Introduction

Tympanoplasty is the most common surgery performed for Chronic Otitis Media (COM) and the most conventional technique [1]. Endoscopic and microscopic tympanoplasty represent two cornerstone techniques in otologic surgery for the repair of tympanic membrane perforations [2]. Each modality offers unique advantages and challenges, and their comparative evaluation is essential to guide surgical decisionmaking [3].

Microscopic tympanoplasty has long been regarded as the gold standard for tympanic membrane repair. Utilizing an operating microscope, this technique provides binocular stereoscopic vision and superior depth perception, which facilitate meticulous manipulation of graft materials and ossicular reconstruction when needed [1,4]. Approaches include post aural and trans canal routes; while the post aural approach affords ample working space and exposure, it necessitates larger incisions and greater soft-tissue dissection, potentially increasing postoperative pain and recovery time [5]. The trans canal microscopic approach, though less invasive, may be limited by narrow ear canals and restricted angles of view [6]. Reported success rates for graft uptake typically range from 85% to 95% in primary cases, with complication rates-including hematoma, infection, and residual perforation-remaining low [7].

Endoscopic tympanoplasty has emerged over the past two decades as a minimally invasive alternative. Highdefinition rigid endoscopes provide a wideangle, panoramic view of the entire tympanic membrane and middleear recesses through a trans canal approach, often without the need for external incisions [2,8]. This enhanced visualization allows surgeons to address anterior perforations and hidden recesses, such as the sinus tympani, more effectively than with the microscope alone [9]. Benefits include reduced tissue trauma, shorter operative times, and improved cosmetic outcomes, as well as quicker postoperative recovery [10]. However, endoscopic techniques require onehanded surgical skills since one hand holds the endoscope and a learning curve to manage challenges such as endoscope fogging, bleeding that obscures the lens, and limited depth perception [11]. Success rates for endoscopic tympanoplasty have been reported between 80% and 93%, with comparable complication profiles to microscopic approaches [12,13].

The main objective of the study is to study the graft success rate, Operative time, need for canaloplasty, post operative audiological outcomes, Postoperative pain (visual analogue scale), Cosmesis and patient satisfaction (standardized questionnaire) by systematically assessing these parameters, we seek to provide robust, evidencebased recommendations for selecting the optimal tympanoplasty technique tailored to patient needs and surgical context.

Materials and Methods

This was a prospective, comparative study done from October 2016 to April 2024. Inclusion Criteria included subjects with dry, central tympanic membrane perforation due to CSOM with conductive hearing loss, willing to give consent for the study. Exclusion Criteria included subjects with marginal or attic perforations, patients with cholesteatoma, otitis externa, otomycosis, uncontrolled diabetes mellitus, revision cases, and those with upper respiratory tract infections at the time of surgery and patients with other complication following CSOM. A total of 140 patients who fulfilled the inclusion criteria were enrolled in the study and equally divided into two groups. Patients were allocated into the endoscopic or microscopic tympanoplasty groups based on the operating surgeon's preference and availability of endoscopic equipment during the study period. Randomization was not performed. Due to the nature of surgical intervention, blinding of the surgeon was not feasible; however, postoperative outcome assessment was performed using standardized objective measures to minimize observer bias.The patient's details and examination findings were recorded and were subjected to respective surgical procedures.The sample size was determined based on previously published studies comparing endoscopic and microscopic tympanoplasty outcomes. Assuming a moderate effect size of 0.5, a power of 80%, and a significance level of 0.05, the minimum sample size required for each group

was calculated to be approximately 64 patients. To improve statistical robustness and account for potential follow-up loss, a total of 140 patients were included in the study, with 70 patients in each group. Surgical Technique The surgeries were performed either under local or general anaesthesia. Temporalis fascia was used as graft material in both groups. Intraoperative findings, duration of surgery was documented for the procedures done in both groups A and B.

Endoscopic Tympanoplasty

In endoscopic tympanoplasty, a zero-degree, 18 cm long, 4 mm wide rigid Hopkins's rod endoscope with camera and monitor was used. Temporalis fascia graft was harvested through a 2–3 cm supraauricular incision in the hairline above the helix. Margins of the perforation freshened, tympanomeatal flap elevated, ossicular status assessed, middle ear disease clearance done. A 30-degree endoscope was used in cases with overhangs, for close-up and angled views. Medicated Gelfoam placed in the middle ear, underlay technique used to place the graft and the tympanomeatal flap was repositioned. Medicated gel foam placed in the external auditory canal. Frequent withdrawal of the endoscope was done to avoid the heat-induced caloric effect or thermal injuries.

Microscopic Tympanoplasty

All of the conventional microscopic tympanoplasties were performed using Carl Zeiss Microscope via the postauricular approach with post-aural William Wilde's incision. Temporalis fascia graft harvested, posterior meatotomy done, margins of the perforation freshened, canaloplasty done whenever required, tympanomeatal flap elevated, ossicular status assessed, middle ear disease clearance was done, medicated Gel foam placed in the middle ear and underlay technique used to place the graft and secured by doing anterior tucking and the tympanomeatal flap was repositioned. Medicated gel foam placed in the external auditory canal and wound closure done. The Mastoid dressing was done and advised care accordingly.

Post-operative Follow-Up

Subjects in both groups were followed up for a minimum period of 06 months. Postoperative follow ups were done on 1st week, 1st month, 3rd month and 6th month. Tympanic membrane uptake on 3rd month and Pure Tone Audiometry (PTA) on 6th month post-operatively. An intact mobile tympanic membrane with closure of air–bone gap less than or equal to 15 dB at 6 months post-surgery was considered as a good outcome. The surgical techniques like graft success rate, Operative time, need for canaloplasty;post operative audiological outcomes; Postoperative pain (visual analogue scale);post operative complications like wound infection gaping and Cosmesis and patient satisfaction (standardized questionnaire using cost scale) were studied compared between both the groups.

Results

A total of 140 patients were included in the study, with 70 patients each in the endoscopic and microscopic tympanoplasty groups. The mean age was 37.36 ± 13.55 years in the endoscopic group and 37.99 ± 13.31 years in the microscopic group, with no statistically significant difference between them (Chi-square = 0.3670, $p = 0.9960$). The most common age group in both groups was 21–30 years (27.14%). In terms of gender distribution, the endoscopic group included 23 males (32.86%) and 47 females (67.14%), while the microscopic group had 24 males (34.29%) and 46 females (65.71%), which was also not statistically significant (Chi-square = 0.0320, $p = 0.8580$) as shown in table 1. Thus, both groups were demographically comparable in terms of age and gender.

In the present study, the side of tympanic membrane involvement was comparable between the two groups, with left-sided perforations seen in 52.86% of patients in the endoscopic group and 50.00% in the microscopic group, and right-sided perfora-

tions in 47.14% and 50.00%, respectively (Chi-square = 0.1140, p = 0.7350). Similarly, the size of perforation showed no significant difference between the groups. Small central perforations (SCP) were observed in 21.43% of the endoscopic group and 25.71% of the microscopic group, medium central perforations (MCP) in 25.71% and 22.86%, and large central perforations (L-CP) in 52.86% and 51.43%, respectively (Chi-square = 0.4040, p = 0.8170). These findings indicate that both groups were well--matched in terms of side and size of perforation.

In the comparison between endoscopic and microscopic tympanoplasty, canaloplasty was required in 17.14% of patients in the microscopic group, whereas none of the patients in the endoscopic group needed it—a difference that was statistically significant (Chi-square = 13.1250, p = 0.0001). Graft uptake success was identical in both groups, with 88.57% showing successful graft take post-surgery (p = 1.0000).

Table 2: Comparison of Endoscopic Group and Microscopic Group Different Parameters by Independent T Test.

Numerical parameters	Endoscopic		Microscopic		Effect size	t-value	p-value
	Mean	SD	Mean	SD			
Duration of surgery (minutes)	47.79	4.69	78.07	17.92	-2.68	-13.6772	0.0001*
Incision size in cms	3.03	0.47	5.29	0.49	-4.7	-27.7894	0.0001*
Post op pain	2.36	0.68	3.44	0.83	-1.44	-8.471	0.0001*
Hospital stay	1.07	0.26	2.16	0.58	-2.58	-14.2816	0.0001*
Cosmetic outcome	19.99	2.12	17.79	3.25	0.82	4.7439	0.0001*
Hearing gain	20.02	9.93	23.18	9.23	-0.33	-1.9513	0.0538

*p<0.05

The endoscopic group demonstrated significantly better outcomes in several perioperative parameters: shorter duration of surgery (47.79 ± 4.69 vs. 78.07 ± 17.92 minutes), smaller incision size (3.03 ± 0.47 cm vs. 5.29 ± 0.49 cm), lower postoperative pain scores (2.36 ± 0.68 vs. 3.44 ± 0.83), shorter hospital stay (1.07 ± 0.26 vs. 2.16 ± 0.58 days), and better cosmetic outcomes (19.99 ± 2.12 vs. 17.79 ± 3.25), all with p values < 0.0001. Although hearing gain was slightly higher in the microscopic group (23.18 ± 9.23 dB) compared to the endoscopic group (20.02 ± 9.93 dB), the difference was not statistically significant (p = 0.0538) as shown in table2, figure 1. These results highlight the minimally invasive advantages of endoscopic tympanoplasty with comparable graft uptake and hearing outcomes.

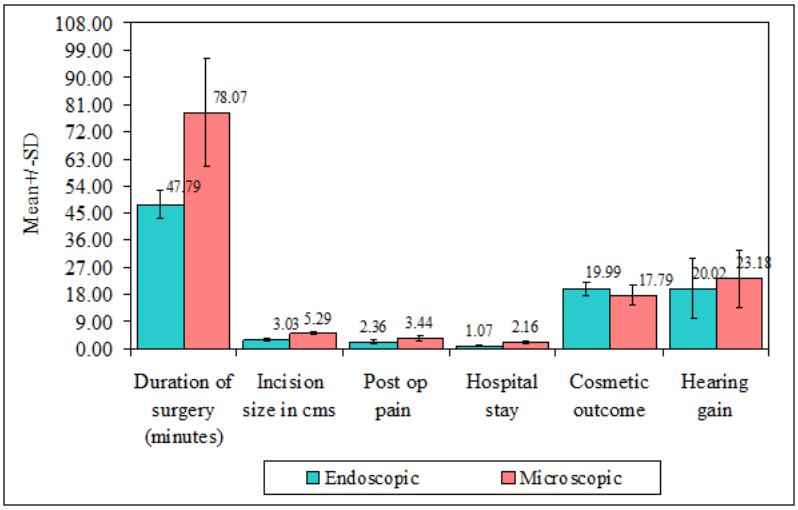

Figure 1: Comparison of Endoscopic Group and Microscopic Group Different Parameters

COSMETIC OUTCOME SCALE FOR TYMPANOPLASTY (COST Scale)

Scoring Domains	Description
1. Scar Visibility	How noticeable is the scar (if any)?
2. Symmetry	Does the operated ear look similar to the unoperated one?
3. Satisfaction with appearance	Overall satisfaction with cosmetic outcome
4. Social confidence	Has the scar or appearance affected your confidence in public?
5. Pain or discomfort from scar area	Ongoing physical sensations at site (tightness, itching, discomfort)

Scoring Key (per item):

1 = Very dissatsified
2 = Dissatisfied
3 = Neutral
5 = Satisfied
4 = Very satisfied
5 = Very satisified

Total Score: 5 to 25		Interpretation
22–25	Excellent	cosellet cosmetic ourcoie
18–21	Good cosmetic	outcome
14–17	Fair cosmetic	outcome

Figure 2: Cost Scale Used for Cosmetic Outcome Analysis

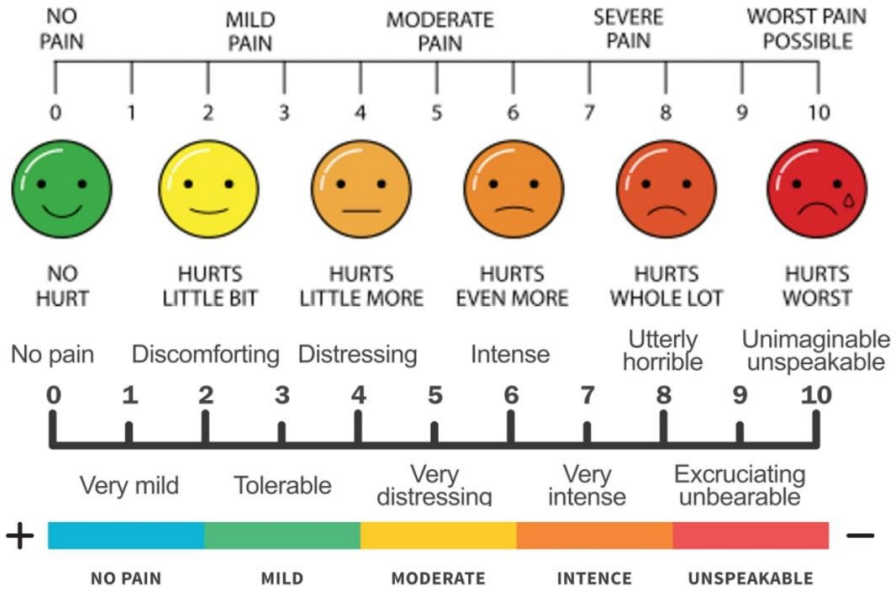

Figure 3: Visual Analogue Scale Used Post Operative Pain Measurement

Discussion

The present study compared the outcomes of endoscopic versus microscopic tympanoplasty in terms of various demographic and surgical parameters. The results indicate that both techniques are comparable in terms of demographic characteristics, such as age, gender, side of involvement, and size of perforation, as well as graft uptake. However, significant differences were noted in several perioperative aspects, such as the need for canalplasty, duration of surgery, incision size, postoperative pain, hospital stay, and cosmetic outcomes, all favoring the endoscopic approach.

Our study found no significant differences in age and gender distribution between the two groups. This is consistent with previous studies, such as the work by Desai et al., who reported similar demographic distributions in patients undergoing tympanoplasty in India [15]. The lack of significant differences in these parameters ensures that any observed differences in surgical outcomes between the two groups can be attributed to the surgical technique itself, rather than patient characteristics.

A significant finding in our study was that canalplasty was required in 17.14% of patients in the microscopic group, whereas none of the patients in the endoscopic group required this procedure. Canalplasty is typically performed in cases where the ear canal is narrow or when better visualization is needed during the surgery. Previous studies, including Harugop et al. [16], have demonstrated that endoscopic tympanoplasty, with its superior visualization and minimal invasiveness, often negates the need for additional procedures like canalplasty. As noted by Harugop et al., endoscopic tympanoplasty allows for better access to the tympanic membrane and middle ear structures without the need for extensive surgical modification, reducing the need for canalplasty.

Significant differences were observed in the duration of surgery and incision size between the two groups, with the endoscopic group having shorter surgeries and smaller incisions. Endoscopic techniques are known for their minimally invasive nature, which leads to reduced operative time and smaller incisions. This finding aligns with studies by Gupta et al. [17] and Harugop et al. [16], who emphasized the reduced surgical time and minimal tissue dissection required in endoscopic tympanoplasty. The smaller incision also contributes to less postoperative discomfort and a more favorable cosmetic result, which has been consistently reported in studies comparing endoscopic and microscopic approaches [18].

The endoscopic group experienced significantly less postoperative pain and a shorter hospital stay. This can be attributed to the minimal tissue manipulation and smaller incisions in the endoscopic approach, which result in less postoperative inflammation and faster recovery. These findings are consistent with the work of Sood et al. 19 and Harugop et al. [16], who found that endoscopic tympanoplasty is associated with reduced postoperative pain and quicker recovery compared to the microscopic technique. The shorter hospital stay in the endoscopic group is an important advantage, as it reduces healthcare costs and minimizes the risk of hospital-acquired infections.

The cosmetic outcomes, as assessed by the COST scale, were significantly better in the endoscopic group, with a higher proportion of patients reporting excellent results. The smaller incisions and the ability to avoid extensive dissection contribute to better cosmetic outcomes, which is a key advantage of endoscopic tympanoplasty. Previous studies, including Harugop et al. [16], have reported similar results, where patients who underwent endoscopic procedures reported higher satisfaction with the appearance of their ear post-surgery. This is particularly important for patients concerned about the aesthetic impact of ear surgery, which is often a consideration, especially in young patients.

In the present study, hearing gain was slightly higher in the microscopic group compared to the endoscopic group; however, the difference did not reach statistical significance ($p = 0.0538$). This borderline p-value suggests a possible trend toward improved hearing outcomes with the microscopic approach. The lack of statistical significance may be attributable to sample size

limitations or variability in preoperative hearing levels. With a larger sample size or longer follow-up, this difference might reach statistical significance. Nevertheless, the overall comparable hearing outcomes indicate that both techniques are effective in restoring auditory function. This suggests that both approaches are equally effective in terms of hearing restoration. Similar findings have been reported in other studies, including those by Kumar et al. [20], who found no significant difference in hearing outcomes between endoscopic and microscopic tympanoplasty. The slight difference observed in our study may be due to patient-specific factors such as the size of the perforation, the middle ear pathology, or other variables not accounted for in the study.

Conclusion

Our study suggests that both endoscopic and microscopic tympanoplasty are effective surgical approaches for tympanic membrane repair, with comparable outcomes in terms of graft uptake and hearing restoration. However, the endoscopic technique offers significant advantages in terms of reduced operative time, smaller incision size, minimized postoperative pain, shorter hospital stays, and improved cosmetic outcomes. Additionally, the endoscopic approach eliminates the need for canaloplasty in many cases, further reducing surgical invasiveness. Given these benefits, endoscopic tympanoplasty is a preferable option, especially for patients seeking quicker recovery, better cosmesis, and minimal tissue disruption. The results of this study support the growing evidence in favor of endoscopic tympanoplasty as a viable and effective alternative to the microscopic technique in the management of tympanic membrane perforations. Although microscopic tympanoplasty remains the traditional gold standard, the findings of the present study support the increasing role of endoscopic tympanoplasty as a minimally invasive and cosmetically superior alternative with comparable functional outcomes.

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