Section: Otorhinolaryngology

Original Research Article

IMPACT OF ENDOSCOPIC AND MICROSCOPIC TECHNIQUES ON ANATOMICAL GRAFT INTEGRATION AND AUDIOLOGICAL RECOVERY FOLLOWING TYPE I TYMPANOPLASTY

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ABSTRACT

Background: Aim: To compare the endoscopic and microscopic approaches to type 1 tympanoplasty with respect to graft integration and postoperative auditory outcomes.

Materials and Methods: A prospective randomized observational study was conducted involving 100 patients attending the ENT outpatient department of a tertiary care teaching hospital who required surgical intervention for inactive mucosal chronic otitis media. The enrolled participants were randomly assigned to two cohorts: Cohort A underwent endoscopic type 1 tympanoplasty, while Cohort B underwent microscopic type 1 tympanoplasty. The postoperative outcomes including complete graft integration and audiometric improvement were compared between the two cohorts. Additionally, intraoperative parameters such as surgical runtime, postoperative complaints including pain and dizziness were assessed and analysed between the two cohorts.

Results: A total of 100 patients were randomly allocated into two cohorts. Comparative analysis revealed no significant difference between the cohorts with respect to postoperative dizziness, graft integration rates and improvement in audiometric outcomes. However postoperative pain was significantly higher in microscopic type 1 tympanoplasty cohort. Additionally, the duration of surgery was significantly shorter in the endoscopic cohort compared with the microscopic cohort.

Conclusion: In the evaluated cohorts of patients with mucosal chronic otitis media, endoscopic and microscopic type 1 tympanoplasty demonstrated equivalent outcomes in terms of successful graft integration and audiometric restoration. Although both modalities achieved comparable surgical outcomes, endoscopic type 1 tympanoplasty was associated with lower postoperative pain scores and a shorter operative duration than microscopic type 1 tympanoplasty.

Keywords: Endoscopic, Microscopic, Type 1 Tympanoplasty, Tragal Cartilage Perichondrium Composite Graft.

INTRODUCTION

To manage chronic otitis media, clinicians frequently utilize tympanoplasty to resolve tympanic membrane perforations and reconstruct middle ear mechanics, which critically mitigates recurrent infectious episodes and enhances audiometric outcomes. Historically, microscopic tympanoplasty has served as the definitive benchmark intervention. This enduring status is primarily attributed to its capacity to deliver stereoscopic depth perception, robust binocular visualization, and high-fidelity magnification throughout the operative procedure.[1] Anatomical access to anterior tympanic membrane perforations inherently escalates procedural difficulty from an operative perspective. To optimize visualization of this anterior sector, traditional

microscopic tympanoplasty necessitates canaloplasty and an auxiliary incision. Consequently, this conventional methodology inherently inflicts extensive tissue trauma, leading to pronounced postoperative distress and permanent cosmetic scarring.[2]

Over the past two decades, endoscopic tympanoplasty has gained extensive acceptance among otologic surgeons as a less invasive therapeutic modality. The utilization of endoscopes delivers an expansive, panoramic field of view across the tympanic cleft. This asset facilitates superior illumination of anatomically obscured recesses—specifically the anterior epitympanum, facial recess, and sinus tympani—which frequently present exposure deficits during traditional microscopic interventions.[3] Because of this optimized visualization, clinicians can reliably execute a strictly trans-canal technique, effectively precluding the necessity for postauricular incisions and significantly mitigating perioperative morbidity.[4]

Notwithstanding these benefits, inherent constraints continue to characterize endoscopic otologic interventions. Because the clinician must dedicate one hand exclusively to manipulating the endoscope, the procedure demands a single-handed execution style that introduces substantial technical challenges, particularly for novice operators. Furthermore, documented obstacles include the absence of binocular depth perception and a demanding learning trajectory. Consequently, the present investigation was initiated to evaluate and contrast the functional and operative efficacy of endoscopic type 1 tympanoplasty (ETT) against traditional microscopic type 1 tympanoplasty (MTT).

MATERIALS AND METHODS

This prospective investigation spanned from January 2023 through December 2025, enrolling individuals who presented to the outpatient clinic within the Department of Otorhinolaryngology at Santiniketan Medical College & Hospital, Bolpur, West Bengal, India. This study involved a cohort of 100 male and female patients, aged 15 to 50, presenting with inactive mucosal chronic otitis media, intact ossicular chains, and sufficient cochlear reserve. Candidates underwent comprehensive clinical evaluations comprising a thorough medical history along with systemic, general, and regional physical examinations. The localized assessment encompassed a rigorous otorhinolaryngological evaluation of the larynx, pharynx, paranasal sinuses, nose, and ear. Critically, individuals presenting with concurrent external auditory canal pathology, explicit ossicular chain dysfunction, complications of chronic otitis media, tympanosclerosis, cholesteatoma, concomitant sinonasal pathology, or significant systemic illnesses were disqualified from participation. For patients presenting with active otorrhea, conservative medical management was instituted initially; these individuals were only deemed eligible once a dry ear state was sustained for a minimum duration of 6 weeks. Any intraoperative or preoperative requirement for ossiculoplasty served as a definitive exclusion criterion. Audiological deficits were verified via pure-tone audiometry utilizing masking protocols where indicated, specifically extracting the baseline, four-frequency (0.5, 1, 2, and 4 kHz) air-bone gap values.

Data Collection

Following the receipt of institutional review board approval, this prospective randomized trial was executed at a tertiary care academic medical centre across three year time frame. The study population comprised individuals aged 15 years and older who presented to the otolaryngology outpatient clinic and were subsequently scheduled for tympanoplasty following an initial diagnostic assessment. Prior to enrolment, formal written informed consent was secured from each participant. Conversely, candidates presenting with concurrent squamosal type chronic otitis media or active otorrhea were systematically barred from study entry.

Allocation of the 100 enrolled participants was handled through automated, computer-generated simple randomization sequences. This protocol divided the cohort equally into two distinct therapeutic arms: Cohort A which underwent endoscopic type 1 tympanoplasty (ETT) (Fig 3), and Cohort B managed via traditional microscopic type 1 tympanoplasty (MTT) (Fig 4).

Across both cohorts, operative interventions were executed under local anaesthesia using injection lignocaine 2% with 1:100000 adrenaline given in the intra-aural and periauricular area. Harvested tragal cartilage perichondrium composite was used exclusively as the tympanic membrane graft (Fig 1 & 2).

The patients were classified as per basis of age and gender. Intraoperative data regarding surgical runtime and postoperative complications like postoperative pain score and dizziness were recorded. At 6 and 12 weeks anatomical graft integration rate and audiological outcome were also recorded.

Underlay technique was adopted in every case. Apart from the surgical access route, the operative protocols remained uniform between the two treatment arms, with the microscopic approach requiring a postauricular incision that necessitated cutaneous suturing upon closure. Following graft placement, the external auditory canal was packed with povidone-iodine saturated gel foam, and both cohorts received identical, standardized postoperative antibiotic and analgesic regimens.

Among patients presenting with bilateral ear disease, surgical intervention was undertaken sequentially, with one ear operated on at a time. To minimise inter-surgeon variability, all procedures included in the study were performed by a single surgeon, and a uniform surgical technique was consistently employed throughout the study period.

Patient reported morbidity was quantified on the first and tenth postoperative days, specifically measuring dizziness and pain via a Visual Analogue Scale (VAS). Additionally, the surgical site was closely monitored for any evidence of wound dehiscence or localized infection. During the subsequent follow-up intervals at 6 weeks and 12 weeks (Fig 5 & 6), the structural integrity and healing status of the tympanic membrane graft were evaluated along with definitive postoperative pure-tone audiometry thresholds.

Figure 1: Harvesting Tragal Cartilage Perichondrium Composite graft

Figure 2: Tragal Cartilage Perichondrium Composite graft

Figure 3: Endoscopic Tympanoplasty

Figure 4: Microscopic Tympanoplasty

Figure 5: Endoscopic Tympanoplasty 6 weeks follow up

Figure 6: Microscopic Tympanoplasty 12 weeks follow up

Statistical Analysis

Statistical analyses were performed using SAS software in conjunction with SPSS version 20. While continuous parametric metrics were reported as means accompanied by standard deviations, categorical data were represented as percentage frequencies. Groups were compared using Pearson's chi-square test for categorical variables, Student t test for continuous parametric variables. p value <0.05 was considered statistically significant. To execute adjusted comparative analyses, multivariable logistic regression and repeated-measures regression frameworks were implemented to calculate odds ratios (ORs) and adjusted mean differences, respectively. The resulting data are presented alongside 95% confidence intervals (CIs), adjusted mean variances, and corresponding p-values. For all statistical models, a alpha level of $p < 0.05$ denoted statistical significance, whereas a value of $p < 0.01$ was designated as highly significant.

RESULTS

A total cohort of 100 subjects was enrolled in this investigation and distributed evenly between the two comparative treatment arms Cohort A- Endoscopic type 1 tympanoplasty (ETT) and Cohort B- Microscopic type 1 tympanoplasty (MTT).

The study reported a mean age of 29.5 years for Cohort A and 28.7 years for Cohort B. Demographic data showed Cohort A was 60% female and 40% male, while Group B was 62% female and 38% male. (Chart 1 & 2)

Chart 1: Classification of cases on the basis of Age Group

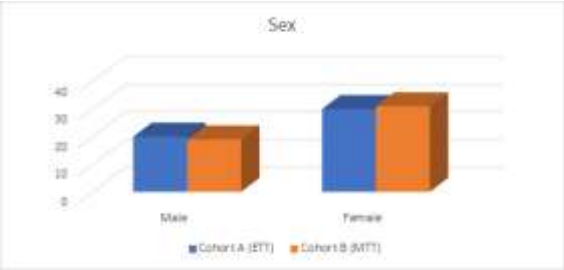

Chart 2: Classification of cases on the basis of Sex

An evaluation of surgical runtime revealed a statistically significant disparity between the two cohorts. Within the endoscopic treatment arm, the surgical timeframe spanned 45 to 90 minutes for 43 out of 50 (86%) of the cases, whereas 7 out of 50 (14%) exceeded 90 minutes. Conversely, inside the microscopic cohort, 27 out of the 50 (54%) procedures were completed within the 45 to 90 minute window, while 23 out of 50 (46%) required more than 90 minutes. This marked reduction in operative runtime in favour of the endoscopic approach over the traditional microscopic methodology was verified statistically (Pearson Chi-square test $p < 0.001$; Chart 3).

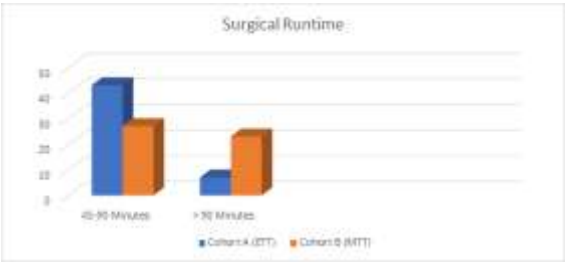

Chart 3: Distribution of cases on the basis of Surgical Runtime

Comparative assessments demonstrated that the endoscopic cohort experienced significantly lower levels of early postoperative pain than the microscopic cohort. This divergence in patient-reported morbidity was verified statistically on both the first postoperative day ($p = 0.001$) and the tenth postoperative day (Chi Square test $p < 0.001$, Chart 4)

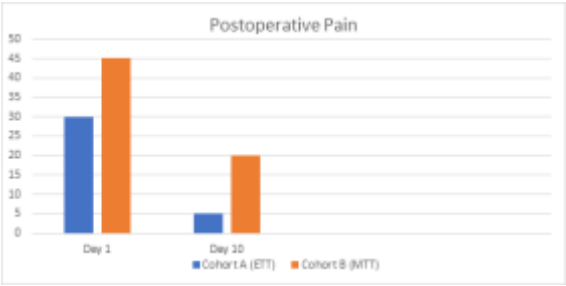

Chart 4: Distribution of cases on the basis of Postoperative Pain

Regarding postoperative dizziness, intergroup comparisons revealed no statistically significant differences between the two cohorts on either day 1 or day 10 of the convalescent period (Fisher's exact test, $p = 1.0$, Chart 5)

Chart 5: Distribution of cases on the basis of Postoperative Dizziness.

An analysis of anatomical outcomes demonstrated that Cohort A achieved successful graft integration

rates of 88% at 6 and 12 weeks follow-up intervals respectively. Conversely, Cohort B exhibited successful complete structural healing rates of 84% at 6 and 12 weeks. Statistical modelling confirmed that this variance in overall surgical success between the two cohorts did not reach significance [p value 0.85, odds ratio- 1.11 (CL=0.32- 3.82), Chart 6, Table 1].

Chart 6: Distribution of cases on the basis of Graft Integration

Table 1: Comparison of cases on the basis of Graft Integration

Technique	Successful Closure	Failed Closure	Success %	P value	Odds Ratio
Cohort A (ETT)	44	6	88	0.85	1.11 (CL=0.32- 3.82)
Cohort B (MTT)	42	8	84		
Total	86	14	86		

At the 6 weeks postoperative milestone, the mean reduction in the air–bone gap reached 10.8 dB for the endoscopic cohort and 11.7 dB for the microscopic cohort and at 12 weeks mean reduction in air–bone gap was 12.3 dB and 12.8 dB respectively between the two cohorts. This marginal variation in audiometric gain between them did not yield a statistically significant difference between the two treatment arms. [at 6 weeks gain = 0.9 dB, p=0.06 and at 12 weeks gain= 0.5 dB, p= 0.12). [Table 2 & 3]

Table 2: Comparison of preoperative hearing status with audiological status at 6 & 12 weeks

Follow Up	Technique	Cases	Preop AB gap (dB)	Postop AB gap (dB)	Audiometric gain (dB)	P value
At 6 weeks	Cohort A (ETT)	50	33.3	22.6	10.8	0.0001
	Cohort B (MTT)	50	33.4	21.7	11.7	
At 12 weeks	Cohort A (ETT)	50	33.3	21.0	12.3	<0.0001
	Cohort B (MTT)	50	33.4	20.5	12.8	

Table 3: Comparison of audiometric gain at 6 & 12 weeks

Follow Up	Technique	Cases	Audiometric gain (dB)	Audiometric gain among two cohorts (dB)	P value
At 6 weeks	Cohort A (ETT)	50	10.8	0.9	0.06
	Cohort B (MTT)	50	11.7		
At 12 weeks	Cohort A (ETT)	50	12.3	0.5	0.12
	Cohort B (MTT)	50	12.8		

In summary, comparative data indicate that endoscopic type 1 tympanoplasty achieved therapeutic equivalence to the traditional microscopic approach regarding both complete anatomical graft integration and audiometric rehabilitation. Crucially, however, the endoscopic modality demonstrated clear superiority by requiring a significantly shorter surgical runtime and inducing markedly lower levels of postoperative patient discomfort.

DISCUSSION

Within developing nations, chronic otitis media represents a highly prevalent otorhinolaryngological pathology, exhibiting a disproportionate incidence among low socioeconomic populations. This epidemiological trend is frequently exacerbated by factors such as demographic overcrowding, sub-optimal hygiene conditions, and widespread health illiteracy. Clinically, active otorrhea manifests as the primary symptomatic complaint, followed sequentially by conductive hearing deficit.[14]

Chronic otitis media (COM) is clinically characterized by sustained inflammatory pathology

within the mastoid cavity or middle ear cleft, manifesting as recurrent or continuous otorrhea lasting two to six weeks through a perforated tympanic membrane or an enduring structural defect of the pars tensa.[6] To manage the mucosal subtype of this disease, otologic surgeons frequently employ either microscopic or endoscopic tympanoplasty, balancing the distinct technical compromises and therapeutic advantages inherent to each approach.

This investigation was initiated to evaluate and contrast the audiometric gains and successful graft integration rates between endoscopic and microscopic type 1 tympanoplasty techniques. The experimental design entailed a prospective analysis of 100 individuals diagnosed with mucosal chronic otitis media, presenting with heterogeneous disease severities and concurrent conductive hearing loss. Within this 100-patient cohort exhibiting tympanic membrane perforations, a balanced allocation was utilized: 50 subjects underwent endoscopic type 1 tympanoplasty, while the remaining 50 were managed via the microscopic type 1 approach. Critically, structural reconstruction was standardized across both cohorts using a tragal cartilage-perichondrium composite graft deployed via a uniform underlay technique.

Thus the primary objective of this investigation was to evaluate and contrast the clinical efficacy of endoscopic versus microscopic techniques in the management of mucosal chronic otitis media. Specifically, the comparative framework evaluated surgical runtime and short-term outcomes like postoperative pain and dizziness. Audiometric rehabilitation and successful graft integration at the 6 and 12 weeks postoperative milestone were also assessed.

Statistical modelling revealed a significant disparity in operative runtime, with the endoscopic approach requiring less time to complete than the traditional microscopic method. This finding aligns closely with the data reported by Choi et al.[7] Conversely, Harugop et al,[8] observed an inverse trend where microscopic interventions demonstrated a shorter duration, a variation that those investigators attributed to the steep technical learning curve inherently associated with initial endoscopic proficiency.

An analysis of subjective morbidity revealed that the endoscopic cohort experienced significantly mitigated postoperative pain relative to the microscopic cohort on both the first and tenth postoperative days. This observed trajectory in pain reduction parallels the outcomes previously documented by Choi et al.[7] Furthermore, regarding early postoperative dizziness, intergroup comparisons on days 1 and 10 demonstrated comparable patterns, with variations failing to reach statistical significance. This alignment in vestibular outcomes is consistent with the findings established by Kaya et al.[9] Consistent with prior literature, the current data demonstrated that individuals in the endoscopic type 1 tympanoplasty (ETT) cohort reported significantly mitigated postoperative pain scores relative to those managed via the microscopic type 1 tympanoplasty (MTT) approach.[10] This observed attenuation in patient reported morbidity was primarily attributed to the minimally invasive nature of the endoscopic modality, which successfully circumvented both external canaloplasty and auxiliary skin incisions.

Endoscopic tympanoplasty faces significant challenges due to its single-handed technique, which complicates effective suctioning and lens clearing during significant intraoperative bleeding.[13] To mitigate these issues, this study employed preoperative epinephrine injections near the eardrum and the use of adrenaline-soaked cotton pellets for improved haemostasis.

In the current investigation, both anatomical graft integration rates and air–bone gap (ABG) reductions within the endoscopic type 1 tympanoplasty (ETT) cohort demonstrated equivalence to those observed in the microscopic type 1 tympanoplasty (MTT) cohort. Furthermore, the overall graft survival percentages achieved across both therapeutic arms align with values reported in prior literature.[11,12,15]

Intergroup analysis revealed no statistically significant variance regarding anatomical graft survival between the two treatment cohorts. Specifically, the endoscopic arm (Cohort A) achieved graft stabilization rates of 88% at the 6 and 12 weeks postoperative evaluations. In comparison, the microscopic arm (Cohort B) exhibited healing rates of 84% at 6 and 12 postoperative weeks.

Furthermore, intergroup comparisons revealed no statistically significant variance regarding audiological rehabilitation, as measured by air–bone gap reductions. At the 6 weeks postoperative milestone, the mean reduction in the ABG reached 10.8 dB for the endoscopic arm (Cohort A) and 11.7 dB for the microscopic arm (Cohort B), and at 12 weeks it is 12.3 dB and 12.8 dB respectively. [at 6 weeks gain = 0.9 dB, p=0.06 and at 12 weeks gain= 0.5 dB, p= 0.12). This equivalent functional trajectory in hearing restoration aligns with the empirical outcomes previously documented in independent investigations by Choi et al,[7] Harugop et al,[8] Kaya et al,[9] and Purva Artham et al.[15]

CONCLUSION

In conclusion, comparative analysis between endoscopic and microscopic type 1 tympanoplasty techniques demonstrates therapeutic equivalence regarding anatomical graft integration and audiometric rehabilitation. However, the endoscopic approach offers significantly shorter operative duration minimizes surgical tissue trauma and postoperative complications. Consequently, endoscopic tympanoplasty represents a viable and effective alternative to the traditional microscopic standard.

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