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Endoscopic vs. Microscopic Tympanoplasty: A Comparative Analysis of Anatomical and Audiological Results from a Single-Center Experience in Yemen

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Abstract

Background: Tympanoplasty has been performed since the 1950s using microscopic techniques. Endoscopic Tympanoplasty (ET) was introduced in the late 1990s and has gained popularity for its benefits. This study aimed to compare the outcomes of audiological and anatomical results of ET to Microscopic Tympanoplasty (MT) conducted by a single surgeon. **Study Design:** This was a retrospective review of patients who underwent either MT or ET type-one tympanoplasty between January 2024 and December 2024. ET was performed using a Karl Storz endoscope. MT was performed via a conventional post-auricular approach using a Sensora Zeiss Microscope. In both Techniques, diluted epinephrine was injected, and the tragal cartilage grafts were sliced to be thin and positioned using the underlay technique. Data were analyzed using SPSS V.20.0. **Results:** The study included 80 patients, of whom 36 (45%) underwent MT and 44 (55%) underwent ET. Postoperatively, there was no statistically significant difference in pre- and post-operative PTA values, and the postoperative air bone gap (ABG) was statistically significant (P = 0.04). Grafting was considered successful in 41 patients (93.2%) in the ET group and 34 patients (94.4%) in the MT group. **Conclusion:** This study found comparable anatomical outcomes and hearing improvement for both techniques, and the postoperative ABG was better in the ET group.

Subject Areas

Otorhinolaryngology

Keywords

Microscopic Tympanoplasty, Endoscopic Tympanoplasty, Ear Surgery, Tympanic Membrane

1. Introduction

Tympanoplasty, the surgical repair of tympanic membrane perforation, has been performed since the 1950s using microscopic techniques, with either an endaural or post-auricular approach. Endoscopic Tympanoplasty (ET) was introduced in the late 1990s and has been applied to various ear surgeries, including tympanoplasty, stapedotomy, and ossicular reconstruction [1]. Endoscopic ear surgery gained popularity for its advantages, as a broader surgical view, improved outcomes, reduced operative and recovery time, and shorter postoperative hospital stay [2]. This study aimed to compare the results of the initial endoscopic tympanoplasties performed at Al-Balasi Hospital with the outcome results of Microscopic Tympanoplasty (MT). All the surgeries were performed by a single surgeon.

2. Methodology

A retrospective review of all patients who underwent tympanoplasty between January 2024 and December 2024 and followed up after one month, all patients included had pre- and postoperative Pure Tone Audiometry (PTA) at frequencies of 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz. Ethical consideration**:** This research received approval from the Dhamar University Medical Ethics Committee (03032025TUMEC-002). The approval was granted given the retrospective nature of this research and the implementation of strict measures to safeguard patient privacy and confidentiality. These measures included the anonymization of all data and the removal of all identifying information prior to analysis.

Surgical technique**:** All patients included in the study had a subtotal tympanic membrane perforation due to chronic suppurative otitis media and underwent tympanoplasty either ET or MT under general anesthesia. Surgeries were performed by a single surgeon using a 2.7 mm × 11 cm rigid 0˚ and 30˚ Karl Storz 24-inch Full HD endoscope for ET. The MT group underwent tympanoplasty via a conventional post-auricular approach using a Zeiss Sensora microscope. In both groups, to minimize bleeding and to ease tympanomeatal flap dissection, diluted epinephrine 1:100,000, 1:50,000 with 2% lidocaine or normal saline was injected for both microscopic and endoscopic approaches, respectively. In ET, it was injected into the external auditory canal at the junction between the cartilage and bony part or into the post-auricular region and posterior canal wall in the MT group. Adrenaline was used to achieve hemostasis in the cottonoid patties. Tragal cartilage grafts were used in both ET and MT, as they were prepared by incising the medial tragal skin to obtain the cartilage and perichondrium. The cartilage graft was sliced into thin sections. Subsequently, the Tympanic Membrane (TM)

remnant was freshened with cup forceps, the malleus was detached from the tympanic membrane, and the integrity of the ossicular chain was tested prior to grafting. Throughout the procedure, attention was paid to avoid trauma to the chorda tympani in the posterior region. The perforation was reconstructed using the underlay graft technique. To prevent medialization, it was positioned under fibrous annulus, medial or parallel to the malleus, with a perichondrial layer over it. In MT group, a post-auricular surgical incision was positioned 0.5 cm posterior to the auricle skin fold and the auricle was folded anteriorly to obtain visualization using a standard operating microscope. The post-auricular dissection continued through the muscle and periosteal layer, after which the tympanomeatal flap was lifted, providing access to the middle ear cavity and gaining entry into the external bony canal. Following the procedure**,** a post-auricular compression dressing was applied for a period of five days. For ET, the tympanic membrane edges were freshened before the transcanal incision 8 to 10 mm lateral to the tympanic annulus, using the lateral circumferential swing-door approach to facilitate access to the middle ear cavity. More concavity was available to make ossicular movement easier, and the sides of the cartilage were forced toward the promontory. Finally, the tympanomeatal flap was repositioned. A simple, non-compressive dressing was applied to the ET group following the surgical procedure in both techniques. Gel foam sponges were inserted into the middle and external auditory canals to promote fixation and healing of the tympanic membrane and graft. The gel foam sponges were removed from the external canal on the sixth postoperative day, non-absorbable sutures were used for closure, and suture removal took place on the tenth postoperative day.

Inclusion criteria: Patients undergoing type one tympanoplasty, who completed a one-month follow-up and had both preoperative and postoperative audiological assessments. Exclusion criteria: Patients with a retraction pocket, cholesteatoma, ossicular chain damage, fixation, or a history of prior surgery in the same ear were excluded.

3. Data Analysis

Audiological evaluations were compared by analyzing the preoperative and postoperative PTA and Air Bone Gap (ABG) values. Anatomical evaluations involved comparing the postoperative endoscopic examination records of the tympanic membrane. SPSS software version 20.0 was used for the statistical analysis. A p-value < 0.05, calculated with a 95% confidence interval was considered statistically significant. The results are presented as median and mean ± Standard Deviation (SD) for continuous variables and numbers with percentages for categorical variables. The chi-squared (χ^2) test was used to examine associations between categorical variables. For continuous data, the normality of distribution was assessed using the Shapiro-Wilk test. Based on the results, different tests were applied for different outcomes. For normally distributed data t-test was used to compare the mean preoperative PTA and ABG values. Conversely, for the non-normally

distributed postoperative PTA and ABG values the Mann-Whitney U test was employed to compare their median values.

4. Results

Eighty patients who underwent ET or MT between January 2024 and December 2024 were included. Patient assignment for either surgical approach was based on the time of presentation. To assess the comparability of the two groups, the following variables were compared: age, gender, pre- and post-operative PTA, and ABG values. Of study population, 56 (63.6%) were female and 24 (27.3%) were male, resulting in a female-to-male ratio of 2.3:1. Among the study population, 36 patients (45%) underwent MT and 44 patients (55%) underwent ET. The ET group comprised 27 women (61.4%) and 17 men (38.6%), with a mean age of 18.4 ± 6.5 years (range: 8 - 35 years). While the MT group comprised 29 women (80.6%) and 7 men (19.4%), with a mean age of 20.7 ± 9.6 years (range: 9 - 45 years). The Mann-Whitney U test revealed no statistically significant difference in age and gender distribution between the two groups (P = 0.4), (P = 0.06) respectively Table 1. ET Overall PTA median value postoperatively was 27.5 with ABG of 14.3 Table 2. Unpaired t-test showed no statistical difference between preoperative PTA values within either group (P = 0.3) (Table 1 and Figure 1). In addition, the observed differences in PTA measurements after one month between the ET and MT groups were not statistically significant (P = 0.1) (Table 2), and there was no statistically significant difference between the preoperative ABG values of the two groups (P = 0.9). However, a statistical significance was observed between the postoperative ABG values of the two groups (P = 0.04) (Table 2 and Figure 2).

Table 1. Demographic characteristics and laterality of study population.

		MT	ET	Total
Gender N(%)	Male	7(8.8%)	17(21.2%)	24 (30%)
	Female	29(36.3%)	27(33.7%)	56 (70%)
Laterality	Right N (%)	21(26.3%)	25 (31.2%)	46(57.5%)
	Left N (%)	15 (18.7%)	19(23.8%)	34 (42.5%)

Table 2. Pre- and post-operative values of hearing thresholds of two groups.

	MT	ET	MT	ET	T-test comparing P values
	Mean ± SD		Median		
preoperative PTA	48.46 ± 11.88	47.11 ± 13.05	50.0	46.0	0.3
preoperative ABG	32.18 ± 11.05	31.86 ± 9.86	31.0	31.0	0.9
					Mann-Whitney U test comparing P values
postoperative PTA	37.23 ± 17.7	32.4 ± 12.9	30.0	27.5	0.1
postoperative ABG	23.6 ± 13.5	18.4 ± 9.8	18.5	14.3	0.04

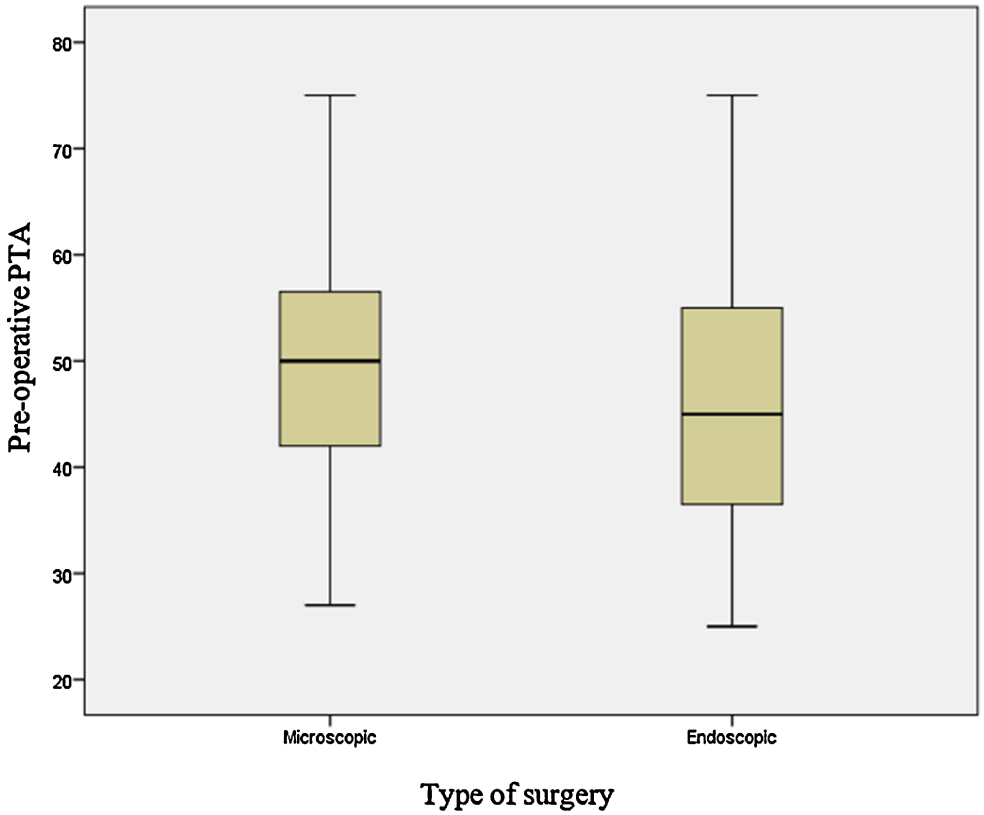

Figure 1. Boxplot comparing pre-operative PTA distribution between ET and MT Groups (P = 0.3).

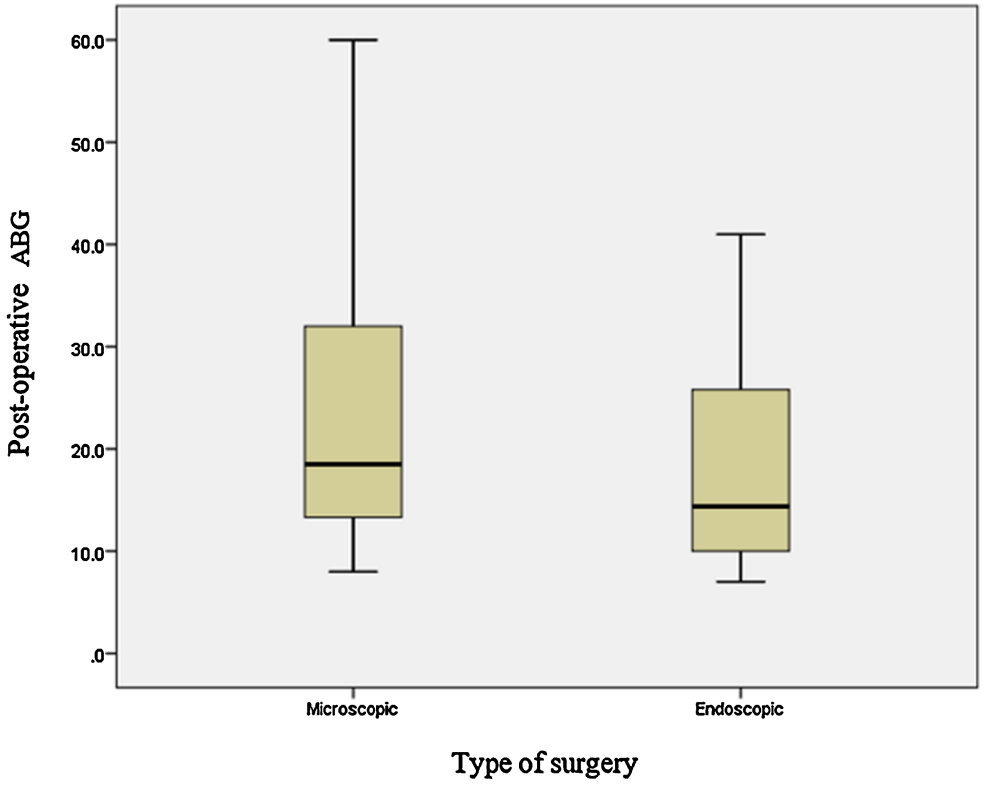

Figure 2. Boxplot comparing post-operative ABG findings between ET and MT Groups (P = 0.04).

Anatomical success was achieved in 41 patients (93.2%) in the ET group and 34 patients (94.4%) in the MT group Figure 3. When comparing the anatomical success rates there was no statistically significant difference between the two groups (P = 0.06) (Figure 3).

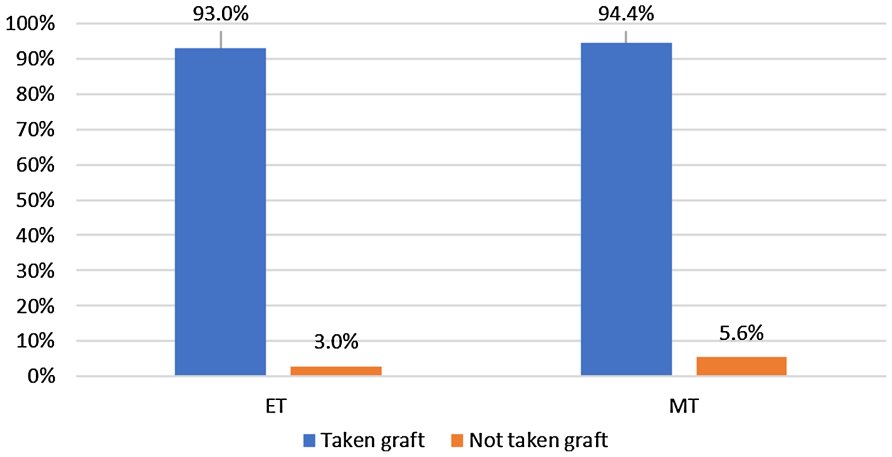

Figure 3. Graft anatomical success rates compared between ET and MT Groups (P = 0.06).

5. Discussion

This retrospective review compared the outcomes of ET and MT techniques using patient data. While the majority of studies comparing these techniques are also retrospective and often demonstrate significant clinical variability, the homogenous preoperative PTA, ABG values, and similarity in age and gender distribution of both groups strengthen the validity of our findings. The endoscopic approach is increasingly favored owing to its advantages over the traditional microscopic methods. Although the microscopic technique remains the traditional approach and despite its common use, it presents limitations, including prolonged operative time, limited visualization of the surgical field, and scarring from the incision. On the other hand, the endoscopic approach is gaining popularity owing to its reduced scarring and enhanced suitability for patients with narrow ear canals [3]-[6]. In our case, notable benefits included the enhanced angular view afforded by the otoendoscopy and concavity for free ossicular chain movement. We found no statistically significant differences in the preoperative ABG and hearing levels between the endoscopic and microscopic groups. However, there was a postoperative improvement in ABG in comparison to that in the MT group. These findings differ from those of other comparative studies showing comparable improvements in ABG [1].

Similarly, the disadvantages of endoscopic techniques include difficulty in bleeding management during tympanoplasty, which can be challenging owing to the characteristic single-handed operation. However, research exists on techniques to lessen these challenges [7], including the learning curve of ET for surgeons skilled in MT. ET has been reported to result in improved postoperative patient health and pain status, and similar graft success rates for both techniques [8] [9]. Our

results also demonstrated similar anatomical success rates in both groups. Anatomical success was defined as the absence of TM defects, retraction, and/or lateralization. In our study, postoperative defects were observed in both groups, although this finding was not statistically significant. They align with the results of a similar comparative study by Ulkumen and Zakir in their similar comparisons [2] [10]. A limitation of this study was the inability to achieve the planned sample size within the research timeframe. Many patients did not undergo postoperative PTA assessment beyond one month. This resulted in only one month of follow-up data. Consequently, the statistical power of the study was reduced. However, the retrospective nature of our study and the balanced distribution of cases between the two groups effectively diminished the selection bias.

6. Conclusion

This study found comparable anatomical outcomes between ET and MT techniques. While both approaches showed similar hearing improvement and graft success rates, endoscopic tympanoplasty offered other potential advantages for postoperative ABG values. The various advantages of ET increase the likelihood of a better future and the popularity of the endoscopic method over microscopic ear surgery.

Contribution of Authors

Both authors contributed equally to the conception and design of the study, data acquisition, interpretation, manuscript drafting, critical revision, and final approval. Additionally, Author Abdulkareem Al-Balasi provided supervision, and took lead in the final revision, while Author Dina Omer was responsible for data analysis. All authors agree to be accountable for all aspects of this work.

Conflicts of Interest

The authors declare no conflicts of interest.

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