

Hearing Threshold Improvement Following Endoscopic Tympanoplasty in Patients With Safe-Type Chronic Suppurative Otitis Media: A Retrospective Pre–Post Study

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ABSTRACT:

Chronic suppurative otitis media (CSOM) is a chronic inflammatory disorder of the middle ear that is commonly associated with persistent tympanic membrane perforation and impaired hearing. Endoscopic tympanoplasty has increasingly been adopted as a minimally invasive surgical technique because it enables broad visualization of the middle-ear structures through the external auditory canal. **Objective:** This study aimed to assess the change in hearing thresholds before and after endoscopic tympanoplasty in patients with safe-type CSOM treated at a tertiary referral hospital in Indonesia. **Methods:** We conducted a retrospective observational study using a pre–post design at the Department of Otorhinolaryngology–Head and Neck Surgery, Dr. Soetomo General Hospital, Surabaya, Indonesia. Of the 24 patients who underwent the procedure during the study period, nine fulfilled the inclusion criteria. We evaluated hearing thresholds using pure-tone audiometry. We used the Shapiro–Wilk test to assess data normality, followed by a paired *t*-test for normally distributed paired observations. We set statistical significance at $p < 0.05$. **Results:** We included nine patients in the final analysis. Six patients (66.66%) were female, while three (33.33%) were male. The most frequently represented age group was 41–50 years. Endoscopic tympanoplasty was performed on the left ear in five patients (55.55%) and the right ear in four patients (44.44%). Mean hearing threshold improved from 46.11 dB preoperatively to 35.63 dB postoperatively, a mean improvement of 10.48 dB. The difference between preoperative and postoperative hearing thresholds was statistically significant ($p = 0.003$). A very strong

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correlation was observed between preoperative and postoperative measurements ($r = 0.965$). **Conclusion:** Endoscopic tympanoplasty was associated with a significant improvement in hearing thresholds among patients with safe-type CSOM in this single-center retrospective study.

Keywords: chronic suppurative otitis media; endoscopic tympanoplasty; hearing threshold; pure-tone audiometry; hearing impairment; otologic surgery

Introduction

Chronic suppurative otitis media (CSOM) is a persistent inflammatory disorder of the middle ear characterized by tympanic membrane perforation and recurrent or persistent otorrhea. A major clinical consequence is hearing impairment, which may result from chronic inflammation, tympanic membrane damage, middle-ear pathology, or disruption of the ossicular chain.^{1,2} The disease remains an important health concern, particularly in developing countries, where socioeconomic conditions, environmental factors, recurrent upper respiratory tract infections, and unequal access to healthcare may contribute to persistent middle-ear disease.¹

Hearing impairment associated with CSOM may adversely affect communication, social functioning, educational performance, and occupational activities. Pure-tone audiometry (PTA) is routinely employed to objectively evaluate hearing sensitivity and quantify the severity of hearing impairment. In patients with CSOM, conductive hearing loss is common because pathological changes in the tympanic membrane and middle-ear structures can interfere with normal sound transmission.^{2,3}

Treatment of CSOM may involve medical management and surgical intervention, depending on disease characteristics and response to treatment. Tympanoplasty is performed when reconstruction of the tympanic membrane is required, with the primary objectives of establishing a stable, dry ear, restoring tympanic membrane integrity,

preserving existing hearing, and improving auditory function when possible.⁴

In recent years, endoscopic tympanoplasty has gained increasing attention as a minimally invasive alternative to conventional microscopic surgery. The transcanal endoscopic technique provides a wide-angle view of the middle-ear cavity and may facilitate visualization of anatomical areas that are challenging to access with a conventional microscope.^{5,6} The approach may also reduce the need for extensive soft-tissue dissection and, in selected cases, eliminate the requirement for a postauricular incision.

Several previous studies have reported favorable audiological outcomes following endoscopic tympanoplasty. Aliyeva et al. reported significant improvement in hearing-related parameters after endoscopic type I tympanoplasty, with a high anatomical success rate.⁷ Meta-analyses comparing endoscopic and microscopic type I tympanoplasty have generally reported comparable graft success and hearing outcomes between the two techniques, while the endoscopic approach may provide advantages in operative time, postoperative pain, cosmetic outcomes, or the need for canalplasty.^{5,6,8-10}

However, hearing outcomes following tympanoplasty may be influenced by several clinical and surgical factors, including preoperative hearing status, ossicular-chain condition, tympanic membrane perforation characteristics, middle-ear pathology, and surgical technique.¹¹ Therefore, local evaluation of postoperative hearing outcomes remains relevant, particularly in tertiary referral settings where patient characteristics and referral patterns

may differ from those reported in other populations.

Despite the increasing use of endoscopic techniques, evidence regarding their audiological outcomes in Indonesian patients remains relatively limited. In particular, data concerning changes in hearing thresholds among patients with safe-type CSOM undergoing endoscopic tympanoplasty at Dr. Soetomo General Hospital have not been extensively documented. Local clinical evidence is important because patient characteristics, disease severity, referral patterns, and healthcare accessibility may differ across populations.

Accordingly, this study evaluated changes in hearing thresholds before and after endoscopic tympanoplasty in patients with safe-type CSOM treated at Dr. Soetomo General Hospital, Surabaya, Indonesia, between January 2024 and June 2025.

2. Methodology

2.1 Study Design and Setting

This investigation employed a retrospective observational study with a pre–post analytical design. The study was conducted at the Department of Otorhinolaryngology–Head and Neck Surgery, Dr. Soetomo General Hospital, Surabaya, Indonesia.

The study population comprised patients diagnosed with safe-type CSOM who underwent endoscopic tympanoplasty between January 2024 and June 2025. We obtained data retrospectively from patients' medical records.

The Ethics Committee of Dr. Soetomo General Hospital approved the study under approval number **2083/LOE/301.4.2/VIII/2025**. The study protected patient identity and confidentiality throughout the study and data analysis.

2.2 Study Participants

We used total sampling of medical records that met the study criteria during the specified study period.

Patients were eligible for inclusion if they:

1. had been diagnosed with safe-type CSOM;
2. underwent endoscopic tympanoplasty at Dr. Soetomo General Hospital between January 2024 and June 2025; and
3. had complete pure-tone audiometry data recorded both before and after surgery.

We excluded patients with incomplete medical records, particularly those without complete postoperative audiometric assessment.

A total of 24 patients underwent endoscopic tympanoplasty during the study period. After applying the eligibility criteria, 15 patients were excluded because complete preoperative and postoperative audiometric data were unavailable. Therefore, the final analysis consisted of nine patients.

2.3 Audiological Evaluation

The principal outcome of this study was the change in hearing threshold following endoscopic tympanoplasty. We evaluated hearing using pure-tone audiometry before and after surgery.

The PTA documented in the medical records was used as the primary audiological parameter. Preoperative and postoperative hearing thresholds were then compared to determine the magnitude and direction of hearing changes after the procedure.

2.4 Statistical Analysis

Descriptive analysis summarized patient characteristics, including age, sex, residence, and operated ear. Given the small sample size, we used the Shapiro–Wilk test to assess data normality. For paired observations that satisfied the assumption of normality, a paired *t*-test was performed to compare preoperative and postoperative hearing thresholds. Statistical analyses were conducted using SPSS version 25.0. A two-tailed *p* value below 0.05 was considered statistically significant.

3. Results

3.1 Patient Characteristics

We included nine patients with safe-type CSOM and complete preoperative and postoperative audiometric records in the analysis. The mean age was 32 years, with ages ranging from 13 to 53 years. The 41–50-year age group represented the largest proportion of participants, accounting for

three patients (33.33%). Six patients (66.66%) were female and three (33.33%) were male. Most participants originated from outside Surabaya, with seven patients (77.77%) residing outside the city and two patients (22.22%) residing in Surabaya. Regarding the operated ear, five patients (55.55%) underwent surgery on the left ear and four patients (44.44%) on the right ear.

Table 1. Baseline characteristics of patients undergoing endoscopic tympanoplasty

Characteristic	n	%
Sex		
Female	6	66.66
Male	3	33.33
Age group		
11–20 years	2	22.22
21–30 years	2	22.22
31–40 years	1	11.11
41–50 years	3	33.33
51–60 years	1	11.11
Residence		
Surabaya	2	22.22
Outside Surabaya	7	77.77
Operated ear		
Right	4	44.44
Left	5	55.55

Percentages were calculated based on nine patients.

3.2 Changes in Hearing Thresholds

Individual audiometric measurements demonstrated an overall reduction in hearing thresholds following endoscopic tympanoplasty. Preoperative PTA values ranged from 20.00 to 103.75 dB, whereas postoperative values ranged from 7.50 to 83.75 dB. The mean hearing

threshold declined from 46.11 dB preoperatively to 35.63 dB postoperatively, corresponding to a mean improvement of 10.48 dB. After surgery, several patients improved their hearing classification, including transitions from moderate or severe impairment to milder categories or normal hearing.

Table 2. Individual preoperative and postoperative hearing thresholds

Patient	Preoperative PTA (dB)	Postoperative PTA (dB)	Change (dB)
1	20.00	17.50	-2.50
2	38.75	36.25	-2.50
3	26.25	22.50	-3.75
4	27.50	7.50	-20.00
5	103.75	83.75	-20.00
6	70.00	58.25	-11.75
7	51.25	37.50	-13.75
8	31.25	27.50	-3.75
9	46.25	30.00	-16.25
Mean	46.11	35.63	-10.48

A negative change indicates a reduction in hearing threshold and therefore an improvement in hearing sensitivity.

3.3 Comparison of Preoperative and Postoperative Measurements

The Shapiro–Wilk test was applied to determine whether the paired data fulfilled the normality assumption. Based on the documented statistical analysis, the data were considered appropriate for

parametric paired analysis. The paired *t*-test showed a statistically significant difference between preoperative and postoperative hearing thresholds ($p = 0.003$). We also observed a very strong correlation between the preoperative and postoperative measurements ($r = 0.965$).

Table 3. Comparison of hearing thresholds before and after surgery

Parameter	Preoperative	Postoperative	Mean difference	<i>p</i> -value
Hearing threshold (dB)	46.11	35.63	10.48	0.003

*Paired *t*-test; statistical significance was defined as $p < 0.05$.*

4. Discussion

The findings indicate that hearing thresholds improved significantly after endoscopic tympanoplasty in patients with safe-type CSOM. The mean hearing threshold decreased from 46.11 dB preoperatively to 35.63 dB postoperatively, resulting in an average improvement of 10.48 dB. This finding suggests a potential benefit of endoscopic tympanoplasty on postoperative auditory function in the studied population.

The observed improvement can be explained by the underlying pathophysiology of hearing impairment in CSOM. Chronic inflammation and

structural abnormalities in the middle ear may interfere with normal sound transmission. Tympanic membrane perforation, inflammatory changes, granulation tissue, and ossicular chain abnormalities can contribute to conductive hearing loss.^{1,2} Surgical reconstruction of the tympanic membrane may therefore improve sound transmission by restoring the structural integrity of the middle-ear system.⁴

The present findings are consistent with previously reported outcomes of endoscopic tympanoplasty. Aliyeva et al. reported significant improvement in hearing-related outcomes following endoscopic type I tympanoplasty, including a reduction in the mean air-bone gap

from 36.7 ± 7.6 dB to 15.0 ± 3.8 dB.⁷ Other studies have also reported favorable postoperative audiological outcomes following endoscopic tympanoplasty.¹²

In the present study, we also observed improvement in hearing classification. Several patients moved from more severe categories toward mild impairment or normal hearing after surgery. This pattern supports the observed reduction in the overall mean hearing threshold and indicates that the postoperative improvement was observed across several individual patients rather than being attributable exclusively to a single observation.

The potential benefits of endoscopic tympanoplasty may also be related to the technical characteristics of the procedure. Endoscopic surgery provides a wide-angle view of the middle-ear cavity and facilitates visualization of anatomical structures that may be difficult to inspect using a conventional microscopic approach.^{5,6} In selected patients, the transcanal approach may also minimize soft-tissue disruption and avoid the need for a postauricular incision.

The predominance of patients from outside Surabaya in this study is consistent with Dr. Soetomo General Hospital's role as a tertiary referral center. Seven of the nine patients included in the analysis resided outside Surabaya. This observation may reflect the referral pattern for patients requiring specialized otologic management in the region.

Female patients constituted two-thirds of the study population. However, this finding should be interpreted cautiously because of the limited sample size. The present study was not designed to evaluate sex as a determinant of CSOM or postoperative hearing outcomes, and the observed distribution may simply reflect the characteristics of the available medical records.

The very strong correlation between preoperative and postoperative measurements ($r = 0.965$) suggests that patients with relatively poorer baseline hearing tended to retain relatively poorer postoperative thresholds. However, this

correlation should not be interpreted as evidence of treatment efficacy. The magnitude of postoperative change and the paired statistical comparison are more directly relevant to evaluating changes in hearing thresholds.

Several limitations should be considered when interpreting these findings. First, the study included only nine patients, substantially limiting statistical power and external generalizability. Second, the retrospective design restricted the investigators' ability to control for potential confounding variables. Third, only nine of the 24 patients who underwent endoscopic tympanoplasty had complete preoperative and postoperative audiometric records. Excluding 15 patients because of incomplete postoperative data introduces the possibility of selection bias.

In addition, the authors did not fully evaluate several potentially important clinical factors, including the extent of tympanic membrane perforation, disease duration, Eustachian tube function, middle-ear condition, ossicular-chain integrity, and the interval between surgery and postoperative audiometric evaluation. These variables may influence postoperative hearing outcomes and should therefore be incorporated into future research.^{11,12}

Consequently, these results should be interpreted as preliminary evidence rather than definitive proof of the effectiveness of endoscopic tympanoplasty. Larger prospective studies, preferably involving multiple centers, are needed to validate these findings. Future research should also consider standardized postoperative follow-up, direct comparison with microscopic tympanoplasty, and evaluation of both functional and anatomical outcomes.

5. Conclusion

In this single-center retrospective study, endoscopic tympanoplasty was associated with a statistically significant improvement in hearing thresholds among patients with safe-type CSOM. The mean hearing threshold decreased from 46.11 dB before surgery to 35.63 dB after surgery, an average improvement of 10.48 dB with a

statistically significant paired comparison ($p = 0.003$).

These findings provide preliminary local evidence supporting the potential audiological benefit of endoscopic tympanoplasty for patients with safe-type CSOM. Nevertheless, the small sample size, retrospective design, and incomplete

postoperative audiometric records require cautious interpretation. Further well-designed prospective studies involving larger populations and standardized outcome assessment are necessary to confirm these findings and determine the long-term effectiveness of endoscopic tympanoplasty.

6. References

- Bhutta MF, Leach AJ, Brennan-Jones CG. Chronic suppurative otitis media. *Lancet*. 2024;403(10441):2339-2348. doi:10.1016/S0140-6736(24)00259-9.
- Verhoeff M, van der Veen EL, Rovers MM, Sanders EAM, Schilder AGM. Chronic suppurative otitis media: a review. *Int J Pediatr Otorhinolaryngol*. 2006;70(1):1-12. doi:10.1016/j.ijporl.2005.08.021.
- Matsuda Y, Kurita T, Ueda Y, Ito S, Nakashima T. Effect of tympanic membrane perforation on middle-ear sound transmission. *J Laryngol Otol Suppl*. 2009;(31):81-89.
- Lewis A, Vanaelst B, Hua H, Choi BY, Jaramillo R, Kong K, et al. Success rates in restoring hearing loss in patients with chronic otitis media: a systematic review. *Laryngoscope Investig Otolaryngol*. 2021;6(3):522-530. doi:10.1002/liv.2.576.
- Crotty TJ, Cleere EF, Keogh IJ. Endoscopic versus microscopic type-1 tympanoplasty: a meta-analysis of randomized trials. *Laryngoscope*. 2023;133(7):1550-1557. doi:10.1002/lary.30479.
- Wang TC, Shih TC, Chen CK, Hsieh VCR, Lin DJ, Tien HC, et al. Endoscopic versus microscopic type I tympanoplasty: an updated systematic review and meta-analysis. *Otolaryngol Head Neck Surg*. 2024;170(3):675-693. doi:10.1002/ohn.597.
- Aliyeva A, Hashimli R. Endoscopic type 1 tympanoplasty: evaluation of clinical success and hearing improvement. *Medeni Med J*. 2024;39(4):268-274. doi:10.4274/MMJ.galenos.2024.88278.
- Elnahal KB, Hassan MA, Maarouf AM. Comparison of endoscope-assisted and microscope-assisted type I tympanoplasty: a systematic review and meta-analysis. *Eur Arch Otorhinolaryngol*. 2024;281(5):2243-2252. doi:10.1007/s00405-023-08305-1.
- Gkrinia E, Ntziovara AM, Brotis AG, Tzimkas-Dakis K, Saratziotis A, Korais C, et al. Endoscopic versus microscopic tympanoplasty: a systematic review and metanalysis. *Laryngoscope*. 2024;134(8):3466-3476. doi:10.1002/lary.31365.
- Szentágothai J, et al. Endoscopic type I tympanoplasty is as effective as microscopic type I tympanoplasty but less invasive—a meta-analysis. *Clin Otolaryngol*. 2019;44(5):718-726.
- Yuan Y, Luo Y, Wu C, Zhang W, et al. Prognostic factors of hearing outcome in patients with chronic suppurative otitis media following tympanoplasty: a retrospective cohort study. *Ann Transl Med*. 2022;10(21):1169. doi:10.21037/atm-22-4800.
- Yue L, Liu X, Liu H, Ma H. Hearing results following endoscopic type I tympanoplasty in medium and large perforations. *Braz J Otorhinolaryngol*. 2025;91(1):101509.