

Outcomes of Transcanal Endoscopic Stapes Surgery

Vinusree K¹, JG Aishwarya², Nithya Venkataramani³, Satish Nair^{4*}

¹Consultant, Department of ENT-HNS, India

²Consultant, Department of ENT-HNS, India

³Consultant, Department of ENT-HNS, India

⁴Professor, Senior Consultant & Academic Head, Department of ENT-HNS, India

Citation: Vinusree K, JG Aishwarya, Nithya Venkataramani, Satish Nair. Outcomes of Transcanal Endoscopic Stapes Surgery. Annal of Otol Head and Neck Surg. 2026;5(5):1-9.

Received Date: 12 September, 2026; **Accepted Date:** 13 September, 2026; **Published Date:** 15 September, 2026

***Corresponding author:** Satish Nair, Department of ENT-HNS, Manipal Hospitals, HAL airport road, Bangalore, Karnataka, India

Copyright: © Satish Nair, Open Access 2026. This article, published in Annal of Otol Head and Neck Surg (AOHNS) (Attribution 4.0 International), as described by <http://creativecommons.org/licenses/by/4.0/>.

ABSTRACT

Objectives: The transcanal endoscopic approach for otosclerosis surgery has been used for the past twenty years. The endoscope offers a broad, panoramic view of the middle ear. In this study, we evaluated the functional and quality of life outcomes of transcanal endoscopic surgery for otosclerosis with a review of the literature.

Material and methods: This is a retrospective study comprising 45 patients diagnosed with conductive hearing loss who underwent transcanal endoscopic stapedotomy from June 2023 to May 2025. Hearing outcome was assessed according to the new standardised format for reporting hearing outcomes by AAO-HNS (2012). Patient-related quality of life (QOL) outcomes were evaluated in terms of postoperative pain scores and patient comfort scores.

Results: The study included 45 patients in the age group of 25 to 58 years. The preoperative mean air-bone gap (ABG) was 32.57 ± 8.15 dB HL (mean $\pm$ SD), and the postoperative mean air-bone gap (ABG) was 13.51 ± 5 dB HL. Nine (20%) patient's experienced temporary giddiness, one (2%) patient had a tympanic membrane perforation, and one (2%) patient developed sensorineural hearing loss postoperatively. The mean duration of surgery in minutes was 40.75 ± 8.05 . Mean postoperative pain scores (on a scale of 0-10) at 0th hours was 2.62 ± 1.05 , at 6th hour was 1.46 ± 0.91 , and at 24 hours after surgery was 0.28 ± 0.45 . The mean comfort score at time of discharge was 8.88 ± 0.65 . The mean MESVI score was 8 with the use of 0° endoscope.

Conclusion: Surgical management for otosclerosis evolved through many years. Endoscopic ear surgery provides similar audiological outcome with reduced complications and improved patient comfort.

INTRODUCTION

Endoscopic ear surgery is a minimally invasive technique used to manage various middle ear pathologies. The use of an endoscope to examine different ear pathologies was first adopted by several surgeons in the early 1990s. The endoscope, as the sole primary tool for ear surgery, was introduced by Muaaz Tarabichi, who published his experience with Transcanal Endoscopic Ear Surgery (TEES) for the clearance of cholesteatoma in 1997 [1-3].

The transcanal endoscopic approach has been utilised in otosclerosis surgery for the past twenty years. In cases with a narrow and tortuous external auditory canal, visualisation of the middle ear structures and instrumentation

is difficult with a transcanal microscopic approach and extensive drilling of the bony ear canal may be necessary at times for wider access. The endoscope offers a broad, panoramic view of the middle ear. The primary advantages of using endoscopes include reduced bone removal, improved handling of the chorda tympani, better visibility of the footplate area, and shorter operating time. However, surgeon is limited to a single-handed technique, which requires a good learning curve and expertise [1,3-5]. In this study, we evaluated the functional and quality-of-life outcomes of transcanal endoscopic surgery for otosclerosis, along with review of the literature.

METHODOLOGY

This is a retrospective study comprising 45 patients diagnosed with conductive hearing loss who underwent transcanal endoscopic stapedotomy from June 2023 to May 2025. Ethical clearance was obtained from the Institutional Ethics Committee. Patient demographics, complaints, and otoendoscopy findings were collected. The hearing outcome was assessed according to the new standardised format for reporting hearing outcomes by AAO-HNS, 2012 [6]. This includes pure-tone audiometry [Air Conduction (AC), Bone Conduction (BC) & Air-Bone gap (A-B gap) averages were measured at frequencies of 0.5, 1, 2, and 3 kHz], speech reception threshold (SRT), and Word recognition score (WRS). Patients were counselled about the options of surgery versus a hearing aid trial, including the potential advantages and disadvantages of each approach. Only those who opted for exploratory tympanotomy with stapedotomy and stapes piston insertion were included in the study. Patients with ossicular chain abnormalities other than stapes footplate fixation were excluded.

Surgical Technique

All cases were performed under general anaesthesia by the senior author. A 0-degree, 4mm endoscope of 18 cm in length, equipped with a camera and monitor system, was used. Tympanomeatal flap was elevated 5-6 mm lateral to the bony annulus from 12 o'clock to 6 o'clock. Minimal bone curettage was done in the posterior superior wall of the external auditory canal to visualise the base of the pyramidal eminence, incudo-stapedial (IS) joint, bony footplate, and horizontal part of the facial nerve. Mobility of the malleo-incudal joint and incudo-stapedial joint was assessed, the footplate examined and the diagnosis was confirmed.

The stapedial tendon was cut, the IS joint was dislocated, and the stapes superstructure was removed. The length of the piston was measured from the undersurface of the long process of the incus to the stapes footplate, with an additional 0.25 mm added to this measurement. Stapedotomy was done using a 0.5mm perforator. Fluoroplastic stapes piston of diameter 0.5 mm and appropriate length inserted into the stapes footplate and anchored to long process of incus and mobility of ossicles was confirmed. Chorda tympani was preserved in all cases. Tympanomeatal flap repositioned, and a medicated ear wick was placed in the EAC (Figure 1 A-D). The medicated ear wick was removed during the first follow-up visit, two weeks after the date of surgery.

Outcome measurement

The duration of surgery was calculated from the time of ear canal infiltration with local anaesthesia to the completion of ear canal packing with a medicated ear wick.

The visualization of the middle ear structure with a 0° endoscope was scored according to the middle ear structural visibility index (MESVI) (7).

Patient-related quality of life (QOL) outcomes were assessed in terms of postoperative pain scores and patient comfort scores using a numerical rating scale - 11 (NRS-11). All patients were treated with the same analgesics,

and postoperative pain was assessed at 0, 6, and 24 hours after surgery. Patient comfort score was evaluated at the time of discharge.

All patients were followed up for the next six months. Pure tone audiometry, speech reception threshold, and word recognition scores were assessed at the 3-month follow-up. The closure of the AB gap and improvement in WRS were evaluated. Any complications, such as giddiness or altered taste sensation, were noted.

R software, Version 4.5.0, was used for all statistical analyses. Continuous variables were expressed as mean, standard deviation (SD) and range, and were analyzed using a paired t-test. A p-value <0.05 was considered statistically significant.

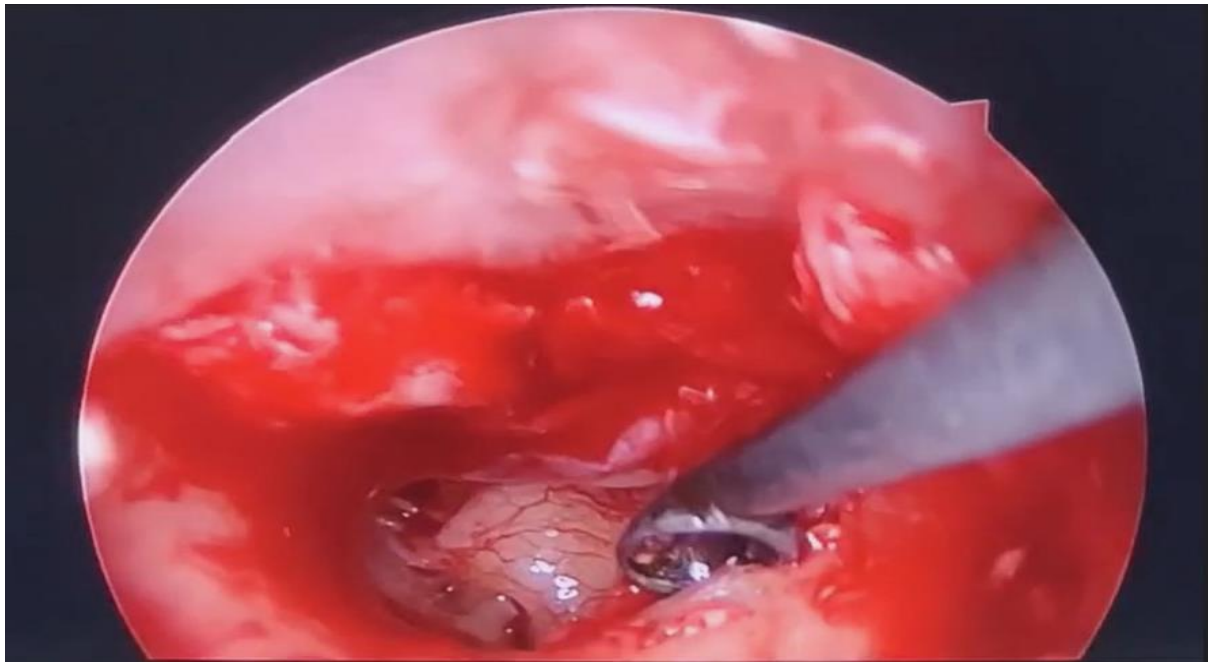


Figure 1A: Showing curettage of posterosuperior wall of bony ear canal

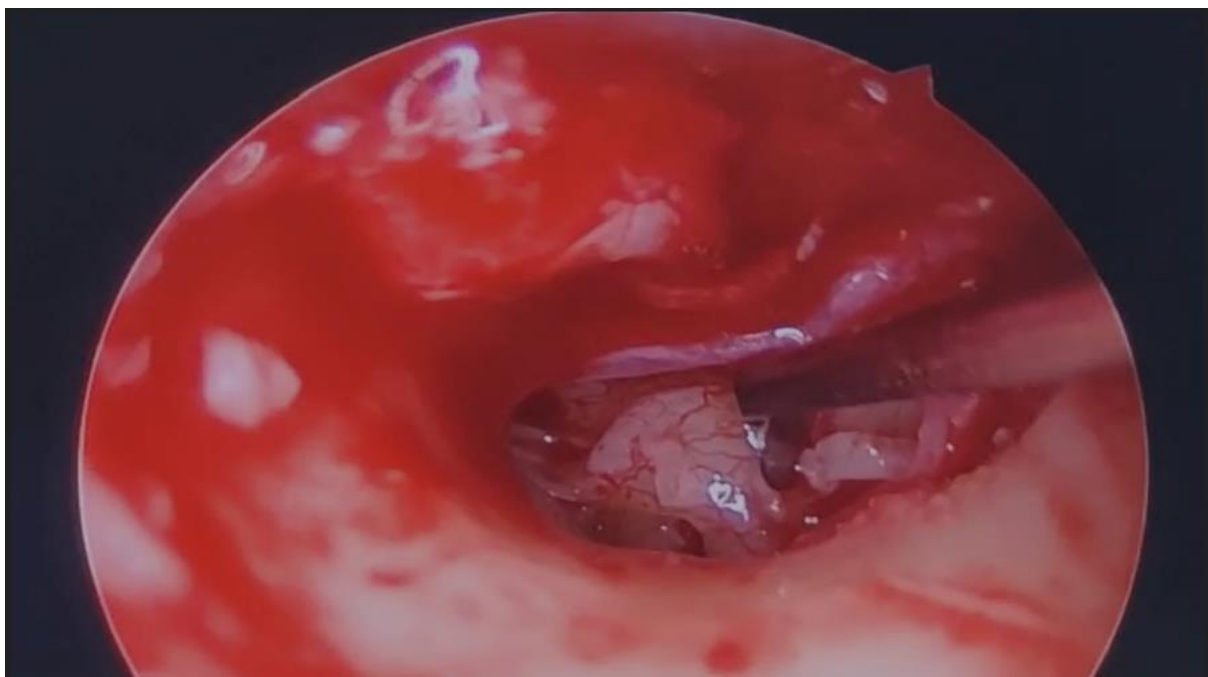


Figure 1B: Dislocation of is joint



Figure 1C: Shows measurement of stapes piston length

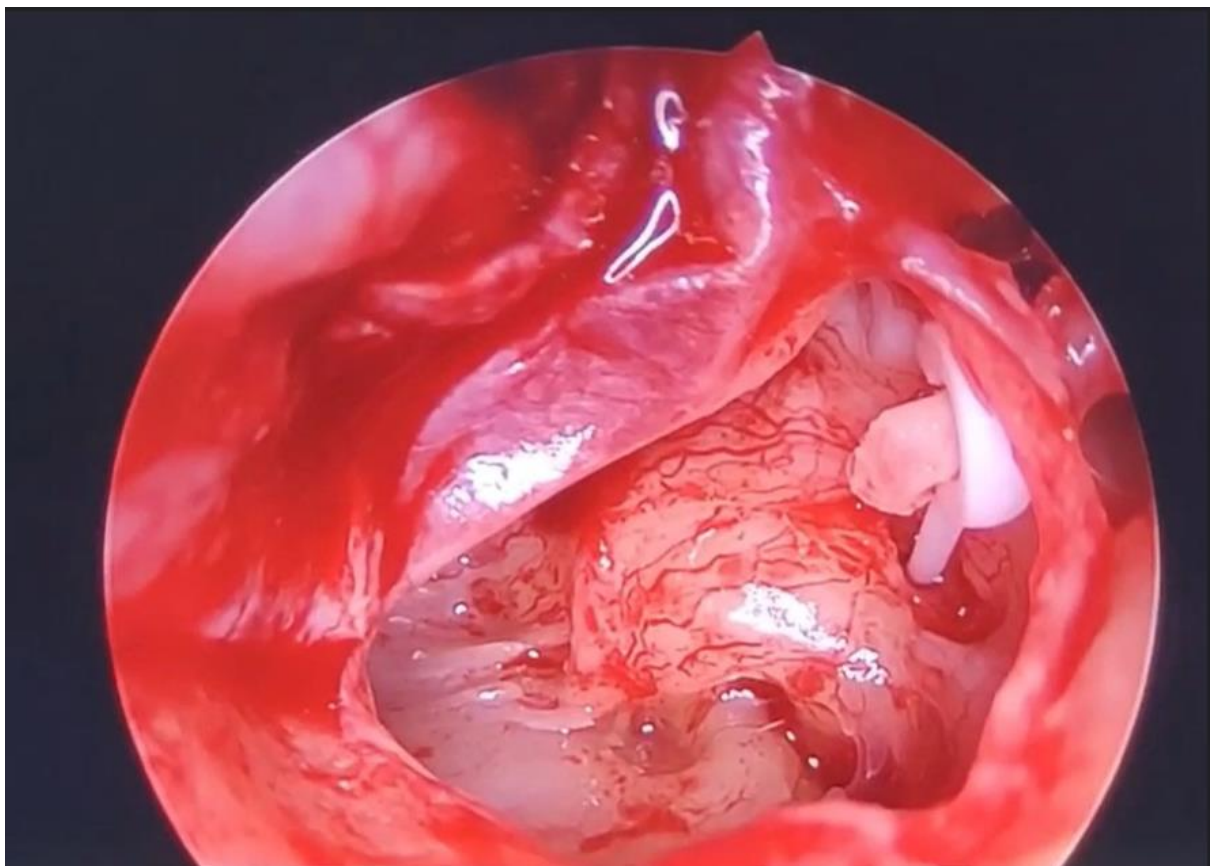


Figure 1D: Piston anchored to long process of incus.

Figure 1A-D: Debts surgical steps of stapedotomy

RESULTS

The study included 45 patients aged 25 to 58 years, with a mean age of 38. Of these, 24 (53%) were male and 21 (47%) were female. Among the 45 ears operated, 26 (58%) were on the right side and 19 (42%) on the left. In all patients, a fluoroplastic stapes piston was used.

The preoperative mean air-bone gap (ABG) was 32.57 ± 8.15 dB HL (mean $\pm$ SD), and the postoperative mean air-bone gap (ABG) was 13.51 ± 5 dB HL. Around 14 (31.1%) patients achieved closure of the air-bone gap to 10dB, 15 (33.3%) patients achieved closure of the air-bone gap between 11-20dB, and 16 (35.5%) patients had closure of air-bone gap between 21- 26dB. **Table 1** debits the audiological outcome. **Figures 2 and 3** show scatter plots representing preoperative and postoperative audiograms.

Table 1: Shows Audiological Outcome.

Sl.no	Parameters	Mean (SD)	95% Confidence Interval (CI)	P-value
1	Pre OP AC	46.35 (11.97)	(17.75, 22.86)	0.00*
	Post OP AC	26.04 (7.81)		
2	Pre OP BC	13.35 (5.90)	(-0.29, 0.56)	0.53
	Post OP BC	13.22 (5.29)		
3	Pre OP AB Gap	32.57 (8.15)	(16.53, 21.5)	0.00*
	Post Op AB Gap	13.51 (5.01)		
4	Pre OP WRS	92.77 (4.33)	(-5.71, -2.70)	0.00*
	Post OP WRS	96.97 (3.19)		
5	Pre OP SRT	48.66 (13.63)	(13.74, 20.41)	0.00*
	Post OP SRT	31.60 (9.42)		

		WORD RECOGNITION SCORE (%)									
		90-100	80-89	70-79	60-69	50-59	40-49	30-39	20-29	10-19	0-9
Pure Tone average (dB)	0-10										
	11-20										
	21-30	1									
	31-40	12	2								
	41-50	11	4								
	51-60	2	7								
	61-70		2	2							
	71-80		1	1							
	81-90										
	91-100										

Figure 2: Scattergram of pre-treatment hearing results. Air conduction pure-tone averages are represented on the y-axis, and word recognition scores are represented on the x-axis. Each number represents the number of patients whose audiometric data place them into a certain square.

		← IMPROVED WORD RECOGNITION SCORE (%) WORSONED →										
		≥50	40	30	20	10	NO CHANGE	-10	-20	-30	-40	-50
Closure of AB Gap(dB)	≥50					1						
	40				2	1						
	30				1	11	2					
	20					15	7					
	10					2	2					
	NO CHANGE											
	-10											
	-20											
	-30									1		
	-40											
	≥-50											

Figure 3: Posttreatment scattergram for patients with otosclerosis after endoscopic stapedotomy.

Temporary giddiness was observed in nine (20%) patients, with six (13%) recovering within 24 hours and the remaining three (7%) showing improvement over 2–3 weeks. All patients responded well to conservative management. One patient (2%) had tympanic membrane perforation in the posterosuperior quadrant, which healed over 6 weeks. One (2%) of patients developed sensorineural hearing loss postoperatively. An overhanging facial nerve was noted in two (4.4%) patients, but stapedotomy and insertion of the stapes piston were completed in both cases. No cases had permanent giddiness, taste alteration, facial paralysis, or CSF gusher.

The mean duration of surgery in minutes from our study was 40.75 ± 8.05 . Mean postoperative pain scores (on a scale of 0-10) at 0th hours were 2.62 ± 1.05 , at 6th hour were 1.46 ± 0.91 , and at 24 hours after surgery were 0.28 ± 0.45 . The mean comfort score at time of discharge was 8.88 ± 0.65 . The mean MESVI score was 8 with the use of a zero-degree endoscope.

DISCUSSION

The history of otosclerosis surgery spans several decades, evolving from early theoretical understandings to highly refined minimally invasive procedures. The first known description of a fixated stapes as a cause of deafness was provided by Valsalva in 1704. In 1853, Toynbee reported the ankylosis of the stapes and described the disease process of otosclerosis. Blake introduced hearing restoration procedures in 1892 and was the first to use the term

stapedectomy; however, due to lack of understanding of middle ear mechanics and inconsistent results, these surgeries were abandoned in the early 20th century [6,7].

In 1952, Rosen reintroduced the concept of stapes mobilisation and curettage of the scutum to improve surgical exposure, publishing his successful results in 1953. Later in 1956, John J Shea performed stapedectomy, which involved removing the entire stapes and replacing it with an artificial nylon prosthesis and a vein graft [8,9]. Stapedotomy is now considered as standard procedure due to better air-bone gap (ABG) closure and improved postoperative WRS.

The endoscope has emerged as a minimally invasive technique over the past two decades. The panoramic view of the endoscope helps in better visualisation of pathologies and anatomical variations, including deep recesses and mucosal folds [4,8] (Figure 4). The endoscopic technique is minimally invasive and reduces the need for canalplasty or unnecessary bone drilling for access. The major limitations of endoscopic ear surgery are the loss of depth perception and the single-handed technique, which can make the manipulation of prostheses and instruments more difficult. However, these challenges can be alleviated with the surgeon's skill and experience. [5,9-10]. The Middle Ear Visibility Index is a grading system used to assess the visibility of the middle ear, initially adapted for cholesteatoma surgery. Previous study showed a better MESVI score with endoscopic ear surgery compared to microscopic ear surgery [7].

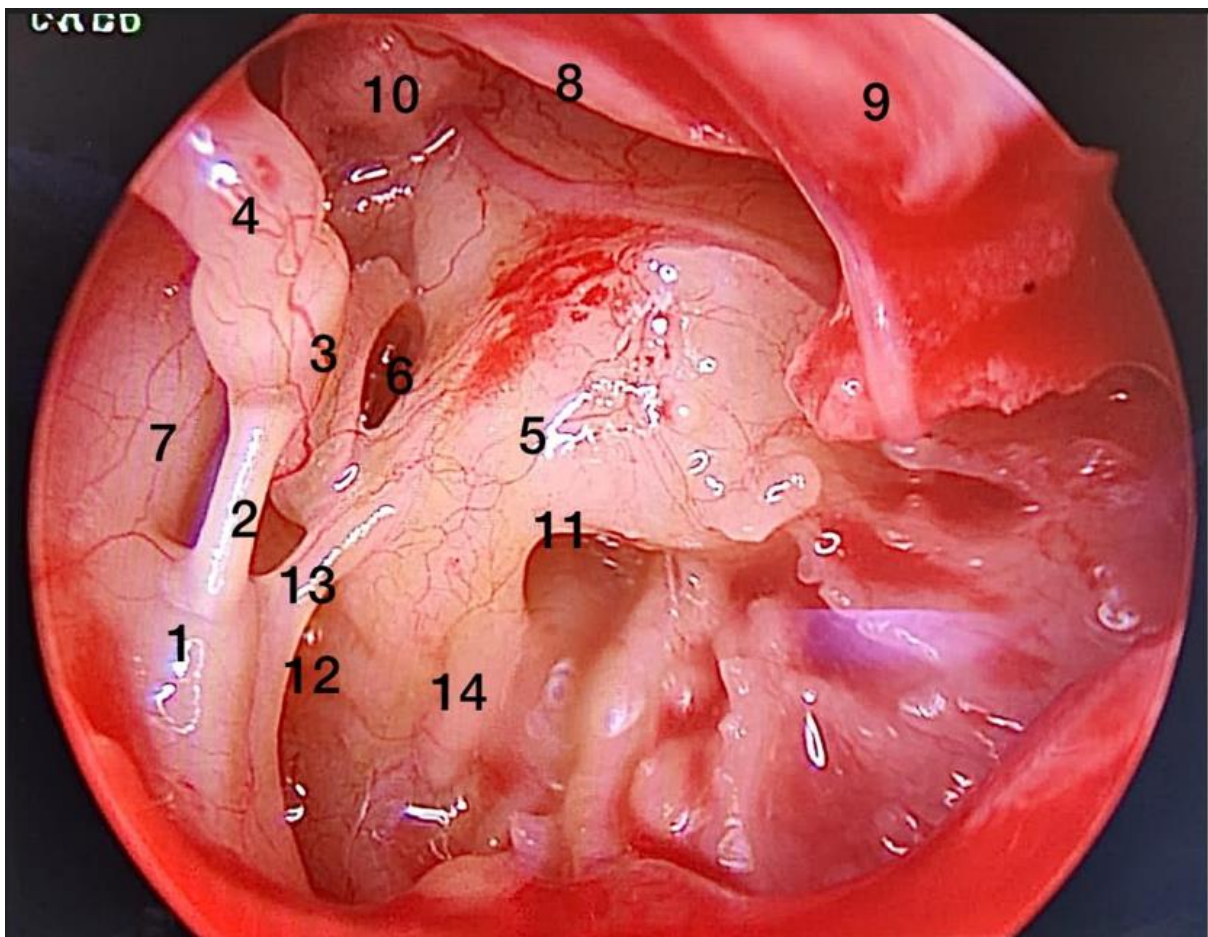


Figure 4: Shows panoramic view of the middle ear with a 0° endoscope after elevating the tympanomeatal flap. 1-pyramidal eminence, 2-stapedial tendon, 3-stapes head, 4-lenticular process, 5-promontory, 6-stapes footplate, 7-facial nerve, 8-handle of malleus, 9-tympanic membrane, 10-cochleariform process, 11-round window niche, 12-sinus tympani, 13-ponticulus, 14-subiculum.

The mean surgery time when comparing microscopic and endoscopic approaches for stapes surgery shows mixed and often inconsistent results in the literature. However, large-scale meta-analyses generally indicate no statistically significant difference in average operative time between the two methods. The actual duration can be influenced by various factors, prominently including the surgeon's experience and the inherent technical differences between the two modalities.

When comparing the complications of endoscopic and microscopic approaches to stapes surgery, a detailed literature search reveals that the endoscopic approach may offer advantages in terms of reduced certain complications. However, overall audiological outcomes are often similar [12-14]. The chorda tympani nerve damage or postoperative dysgeusia postoperatively are significantly less likely with the endoscopic approach, as reported in many systematic analyses and meta-analyses. A few meta-analyses even found that chorda tympani nerve injury occurred two to three times more frequently with microscopic ear surgery, and this finding was statistically significant. None of our patients in the study had taste alterations, which is comparable to other endoscopic stapedotomy approaches. This benefit is attributed to the endoscope's wide-angle visualization of key middle ear structures, such as the oval window niche and anterior crus, which requires less removal of posterosuperior bony canal wall and minimal manipulation of chorda tympani nerve (CTN)(11) [5,10,12-14].

Some meta-analyses have reported reduced postoperative pain with the endoscopic approach, possibly due to less bone removal [12,14]. There is no difference in the incidence of postoperative dizziness or vertigo between the endoscopic and microscopic techniques [13]. Although facial nerve injury is a rare but serious complication, it was not observed in either approach. The risk of facial paresis or paralysis is higher in cases with an overhanging facial nerve, although such occurrences are rare [12,13].

Early endoscopic procedures may be associated with longer operative times and slightly less favourable audiological results, primarily due to the learning curve involved in mastering one-handed techniques and two-dimensional visualization. However, outcomes improve significantly as surgeons gain experience, often matching or surpassing those of traditional microscopic surgery. The procedure is generally considered safe and effective, with a high success rate in improving conductive hearing loss. Various other studies and meta-analyses have demonstrated that endoscopic stapes surgery yields similar audiological outcomes and, in some cases, is superior to the conventional microscopic approach [4,11,14-15]. Sensorineural hearing loss after stapedotomy is seen with an incidence of 5–10%. The incidence of profound SNHL after stapedotomy is low, reported in approximately 1–2% of cases. This may result from excessive manipulation of the ossicular chain, trauma to the footplate, or perilymph leakage. In addition, postoperative complications such as infection or labyrinthitis may also contribute to hearing deterioration. Overall, although the risk of SNHL exists, careful surgical technique, adequate experience, and adherence to microsurgical principles significantly reduce the likelihood of this complication [16].

CONCLUSION

Surgical management for otosclerosis has evolved over the years, and the transition from microscopic techniques to endoscopic methods has occurred over the past two decades. Endoscopic stapedotomy, with its minimally invasive technique, confers equitable audiological outcomes, improved quality of life, and fewer complications.

REFERENCES

1. Tarabichi M. Endoscopic Middle Ear Surgery. Ann Otol Rhinol Laryngol. 1999;108(1):39-46.
2. Hunter JB, Rivas A. Outcomes Following Endoscopic Stapes Surgery. Otolaryngol Clin North Am. 2016;49(5):1215-25.
3. Isaacson B, Hunter JB, Rivas A. Endoscopic Stapes Surgery. Otolaryngol Clin North Am. 2018;51(2):415-28.
4. Bianconi L, Gazzini L, Laura E, De Rossi S, Conti A, Marchioni D. Endoscopic stapedotomy: safety and audiological results in 150 patients. Eur Arch Otorhinolaryngol. 2020;277(1):85-92.
5. Fang L, Xu J, Wang W, Huang Y. Would endoscopic surgery be the gold standard for stapes surgery in the future? A systematic review and meta-analysis. Eur Arch Otorhinolaryngol. 2021;278(4):925-32.
6. Gurgel RK, Jackler RK, Dobie RA, Popelka GR. A New Standardized Format for Reporting Hearing Outcome in Clinical Trials. Otolaryngol--head neck surg. 2012;147(5):803-7.
7. Das A, Mitra S, Ghosh D, Sengupta A. Endoscopic Versus Microscopic Management of Attic Cholesteatoma: A Randomized Controlled Trial. Laryngoscope. 2020;130(10):2461-6.
8. Poe DS. Laser-Assisted Endoscopic Stapedectomy: A Prospective Study. Laryngoscope. 2000;110(S95):1-30.
9. Vincent R, Sperling NM, Oates J, Jindal M. Surgical Findings and Long-Term Hearing Results in 3,050 Stapedotomies for Primary Otosclerosis: A Prospective Study with the Otology-Neurotology Database. Otol Neurotol. 2006;27(8):S25-47.
10. Bartel R, Sanz JJ, Clemente I, Simonetti G, Viscacillas G, Palomino L, et al. Endoscopic stapes surgery outcomes and complication rates: a systematic review. Eur Arch Otorhinolaryngol. 2021;278(8):2673-9.
11. Moneir W, Khafagy YW, Salem NN, Hemdan A. Endoscopic stapedotomy: classic versus reversal technique. Eur Arch Otorhinolaryngol. 2023;280(8):3653-9.
12. Koukkoullis A, Tóth I, Gede N, Szakács Z, Hegyi P, Varga G, et al. Endoscopic versus microscopic stapes surgery outcomes: A meta-analysis and systematic review. Laryngoscope. 2020;130(8):2019-27.
13. Pauna HF, Pereira RC, Monsanto RC, Amaral MSA, Hyppolito MA. A comparison between endoscopic and microscopic approaches for stapes surgery: a systematic review. J Laryngol Otol. 2020;134(5):398-403.
14. Das A, Mitra S, Ghosh D, Sengupta A. Endoscopic Stapedotomy: Overcoming Limitations of Operating Microscope. Ear Nose Throat J. 2021;100(2):103-9.
15. Kojima H, Komori M, Chikazawa S, Yaguchi Y, Yamamoto K, Chujo K, et al. Comparison between endoscopic and microscopic stapes surgery. Laryngoscope. 2014;124(1):266-71.
16. Quimby AE, Parekh M, Darwich NF, Hwa TP, Eliades SJ, Brant JA, et al. Rates of Sensorineural Hearing Loss and Revision Surgery After Stapedotomy: A Single-institution Experience Using the Nitinol Prosthesis. Otol Neurotol Open. 2022;2(4):e025.