International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Researcher Article *DOI: 10.61336/im/26-11-52*

Spectrum of High-Resolution Computed Tomography Temporal Bone Findings in Squamosal Chronic Otitis Media: A Cross-Sectional Study for Preoperative Surgical Planning.

Dr. Mugheer Ahmad[1*], Dr. Sachin Khanduri[2], Dr. Tariq Imam[3], Dr. S.M. Faiz[4], Dr. Saddam[5], Dr. Mameeza[6], Dr. Abdul Rehman[7], Dr. Tanzeel Danish[8].

[1]*Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[2]*Professor & HOD, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[3]*Assistant Professor, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[4]*Professor, Department of ENT, Era's Lucknow Medical College, Lucknow, India.*
[5]*Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[6]*Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[7]*Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*
[8]*Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.*

Correspondence:
Dr. Mugheer Ahmad.
Postgraduate, Department of Radio-diagnosis, Era's Lucknow Medical College, Lucknow, India.

Received: 01-09-2026
Revised: 21-10-2026
Accepted: 12-11-2026
Published: 23-11-2026

Abstract

Background: Squamosal chronic otitis media (COM), often associated with cholesteatoma, is characterized by progressive bone erosion, leading to complications and hearing loss. High-Resolution Computed Tomography (HRCT) of the temporal bone provides detailed osseous anatomy. This study aimed to evaluate the spectrum of HRCT findings in squamosal COM, focusing on disease extension and bony erosions, and to interpret their clinical implications for surgical management. ***Methods:*** This cross-sectional study included 64 patients (aged 18-55 years) clinically diagnosed with unilateral squamosal COM. After informed consent, all patients underwent HRCT of the temporal bone using a 384-slice CT scanner with 0.5-0.6 mm slices and multiplanar reconstructions. Images were evaluated for soft tissue involvement, ossicular erosion, scutum erosion, mastoid opacification, and complications like facial canal and tegmen erosion. The study adhered to STROBE guidelines. ***Results:*** The mean patient age was 34.72±11.26 years, with a male predominance (56.3%). Otorrhea (96.9%) and hearing impairment (92.2%) were the most common complaints. HRCT revealed attic involvement in 85.9% and scutum erosion in 81.3% of cases. Ossicular erosion was seen in 75% of patients, with incus being the most frequently eroded ossicle (68.8%), followed by stapes (54.7%) and malleus (43.8%). Mastoid opacification and mesotympanum involvement were observed in 79.7% and 78.1%, respectively. Tegmen erosion (18.8%), facial canal erosion (15.6%), and lateral semicircular canal fistula (3.1%) were also detected. These findings directly correlated with the need for mastoidectomy, ossiculoplasty, facial nerve monitoring, and awareness of intracranial risk. ***Conclusions:*** HRCT of the temporal bone provides a detailed and clinically-actionable roadmap of disease extension and bony destruction in squamosal COM. It is an essential preoperative tool that helps predict surgical complexity, choose the appropriate approach (canal wall up/down), anticipate complications, and improve patient safety.

Keywords: Chronic Otitis Media, Squamosal, Cholesteatoma, Temporal Bone, HRCT, Preoperative Planning.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

Chronic otitis media (COM) is a persistent inflammatory condition of the middle ear, with squamosal COM (attico-antral type) representing its more aggressive form, frequently associated with cholesteatoma.[1-3] Cholesteatoma, described as "skin in the wrong place," is a noncancerous, keratinizing squamous epithelial cyst within the temporal bone that exhibits progressive, destructive behaviour through pressure effects and enzymatic osteolysis.[4-6] This relentless expansion leads to erosion of the ossicular chain, facial nerve canal, tegmen tympani, and semi-circular canals, resulting in conductive or sensorineural hearing loss, facial paralysis, labyrinthine fistulas, and potentially life-threatening intracranial complications like meningitis or brain abscess.[7-9]

While clinical otoscopy can diagnose squamosal COM, it provides limited insight into the submucosal and bony extent of the disease. This information is critical for surgical decision-making, as the primary treatment is complete surgical

eradication. High-Resolution Computed Tomography (HRCT) of the temporal bone has emerged as the imaging modality of choice due to its high spatial resolution, allowing for thin-section (0.5-0.6 mm) visualization of the complex temporal bone anatomy.[10-12] HRCT precisely delineates soft tissue opacification within the middle ear clefts (Prussak's space, epitympanum, sinus tympani), assesses mastoid pneumatization, and, most importantly, identifies bony erosions of the scutum, ossicles, facial canal, tegmen, and labyrinth.[13-15] This information is invaluable for the otologic surgeon to select the surgical approach (canal wall up vs. canal wall down mastoidectomy), plan for ossicular reconstruction, anticipate the need for facial nerve monitoring, and warn the patient about potential risks such as sensorineural hearing loss. The primary objective of this study was, therefore, to evaluate the spectrum of HRCT temporal bone findings in cases of squamosal COM, specifically to map the extension of the disease and identify bony erosions, and to interpret these findings in the context of preoperative surgical planning.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, cross-sectional study conducted in the Department of Radio-diagnosis at Era's Lucknow Medical College, Lucknow, over a period of 24 months.

Study Population

The study population comprised all patients aged between 18 and 55 years who presented to the department with a clinical diagnosis of unilateral squamosal type of chronic otitis media.

Sampling and Sample Size

Consecutive sampling was employed. The sample size (n=64) was calculated using a formula for difference in proportions based on a previous study, with 80% power and 95% confidence interval, considering the proportion of ossicular erosion (90%) and scutum erosion (84%).[16]

Inclusion and Exclusion Criteria

Patients aged 18-55 years with a clinical diagnosis of squamosal COM were included. Patients with congenital ear disease, mucosal COM, previous temporal bone surgery, trauma history, or pregnant patients were excluded.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Era's Lucknow Medical College (Approval number/date - to be inserted). All procedures were in accordance with the Helsinki Declaration of 1975, as revised in 2000. Written informed consent was obtained from all participants or their legal guardians prior to enrolment.

STROBE Guidelines

This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies.

Data Collection

Demographic details (age, sex), clinical presentation (otalgia, otorrhea, hearing loss, etc.), and side of involvement were recorded for each patient.

HRCT Imaging Protocol

All patients underwent HRCT of the temporal bone using a 384-slice multidetector CT scanner (Siemens SOMATOM Perspective, Siemens Healthineers, Germany). Patients were positioned supine with the head immobilized. Non-contrast, thin-section axial images were acquired from the superior margin of the petrous apex to the mastoid tip using the following parameters: slice thickness 0.6 mm, reconstruction interval 0.3 mm, tube voltage 120 kVp, tube current 200-250 mAs (automatic modulation), matrix 512 x 512, and a limited temporal bone field of view (18-22 cm). A high-resolution bone algorithm was used for reconstruction. Axial images were subsequently reformatted into coronal and sagittal planes using multiplanar reformation (MPR).

Image Analysis

All HRCT datasets were analysed by a senior radiologist on a dedicated workstation using Syngo.via software (Siemens Healthineers). Each scan was systematically evaluated for:

1. Soft Tissue Involvement: Presence and location in the attic, Prussak's space, mesotympanum, sinus tympani, aditus ad antrum, and mastoid air cells.
2. Bony Erosions: Erosion of the scutum, ossicular chain (malleus, incus, stapes), tegmen tympani, facial nerve canal, lateral semi-circular canal (fistula), and sinus plate.
3. Mastoid Pathology: Degree of pneumatization (sclerotic, diploic, or pneumatic) and opacification.

4. Clinical Implications: Findings were interpreted for their surgical relevance (e.g., attic involvement suggesting canal wall down procedure, ossicular erosion indicating need for ossiculoplasty).

Statistical Analysis

Data was entered into MS-Excel 2023 and analysed using IBM SPSS Statistics version 25.0. Descriptive statistics were used. Categorical variables were presented as frequencies (n) and percentages (%). Continuous variables (age) were presented as mean ± standard deviation (SD) and median with interquartile range (IQR).

RESULTS

A total of 64 patients with squamosal COM were enrolled. The age of patients ranged from 18 to 55 years, with a mean age of 34.72 ± 11.26 years. The majority of patients (35.9%) were in the 21-30 years age group. There was a male predominance (56.3% male, 43.8% female), with a male-to-female ratio of 1.29:1. The right ear was more frequently involved (59.4%) than the left (40.6%). The most common presenting complaints were otorrhea (96.9%), hearing impairment (92.2%), and ear inflammation (90.6%) (Table 1).

Table 1: Clinical Profile of Study Participants (n=64)

Characteristic	Category	Number (n)	Percentage (%)
Age Group	≤20 years	4	6.3
	21-30 years	23	35.9
	31-40 years	17	26.6
	41-50 years	12	18.8
	>50 years	8	12.5
Sex	Male	36	56.3
	Female	28	43.8
Side Involved	Right	38	59.4
	Left	26	40.6
Presenting Complaint*	Otorrhea	62	96.9
	Hearing Impairment	59	92.2
	Inflammation	58	90.6
	Earfulness	43	67.2
	Otalgia	24	37.5
*Multiple responses possible.			

HRCT Findings

The detailed HRCT findings are summarized in Table 2.

Table 2: Spectrum of HRCT Temporal Bone Findings (n=64)

Category	HRCT Finding	Number (n)	Percentage (%)
Disease Localization	Attic involvement	55	85.9
	Mesotympanum involvement	50	78.1
	Sinus tympani involvement	14	21.9
	External auditory canal involvement	5	7.8
Mastoid & Middle Ear	Mastoid opacification	51	79.7
	Scutum erosion	52	81.3
	Widening of aditus ad antrum	31	48.4
Ossicular Erosion	Any ossicular erosion	48	75.0
	Incus erosion	44	68.8
	Stapes erosion	35	54.7
	Malleus erosion	28	43.8
Complications	Tegmen tympani/antri erosion	12	18.8
	Facial nerve canal erosion	10	15.6
	Lateral semicircular canal fistula	2	3.1

Attic involvement was the most common site of soft tissue disease (85.9%), followed by mesotympanum (78.1%). Scutum erosion, a hallmark of pars flaccida cholesteatoma, was observed in 81.3% of patients. Ossicular chain erosion was present in 75% of cases, with the incus being the most frequently eroded ossicle (68.8%), followed by the stapes (54.7%) and malleus (43.8%). Mastoid opacification was seen in 79.7% of cases, indicating significant mastoid disease. High-risk findings such as tegmen erosion (18.8%), facial nerve canal erosion (15.6%), and lateral semicircular canal fistula (3.1%) were also identified. The clinical implications of these findings for surgical planning are outlined in Table 3.

Table 3: Clinical Implications of HRCT Findings for Preoperative Surgical Planning

HRCT Finding	Frequency (%)	Clinical Interpretation & Surgical Implication
Attic involvement	85.9%	Suggests pars flaccida cholesteatoma; favours canal wall down (CWD) or careful canal wall up (CWU) with close follow-up.
Scutum erosion	81.3%	Pathognomonic for attic cholesteatoma; confirms diagnosis and need for atticotomy.
Ossicular erosion (Incus 68.8%, Stapes 54.7%)	75.0%	Indicates need for ossiculoplasty; predicts type of reconstruction (e.g., PORP, TORP).
Mastoid opacification	79.7%	Confirms mastoid disease extension; tympanoplasty alone is insufficient; mastoidectomy is required.
Sinus tympani involvement	21.9%	High-risk hidden area; increases risk of residual disease; requires wide exposure (e.g., posterior tympanotomy).
Tegmen erosion	18.8%	High risk of intracranial complications (meningitis, encephalocele); requires careful technique, possible neurosurgical backup.
Facial canal erosion	15.6%	Mandates intraoperative facial nerve monitoring to prevent iatrogenic injury.
LSCC fistula	3.1%	Risk of sensorineural hearing loss/vertigo during surgery; requires special precautions (e.g., "leave behind" matrix).
LSCC: Lateral Semicircular Canal; PORP: Partial Ossicular Replacement Prosthesis; TORP: Total Ossicular Replacement Prosthesis		



Figure 1. HRCT temporal bone (axial view) image shows an axial CT image of the temporal bone, demonstrate Complete Opacification of right mastoid Air cells

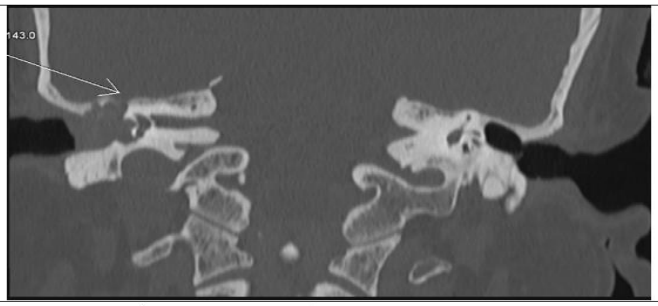


Figure 2. HRCT temporal bone (coronal view) image shows coronal CT image of the temporal bone, demonstrate erosion of tegmen tympani

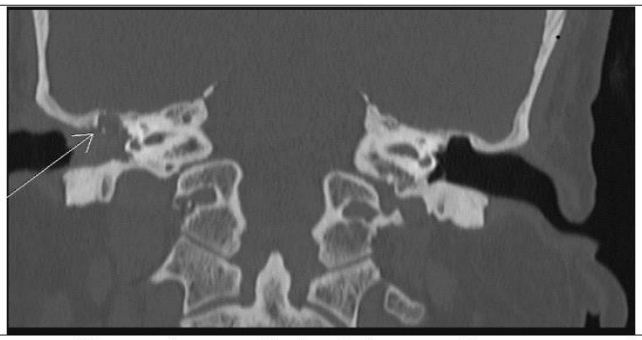


Figure 3. HRCT temporal bone (coronal view) image shows coronal HRCT image of the temporal bone, demonstrate scutum erosion

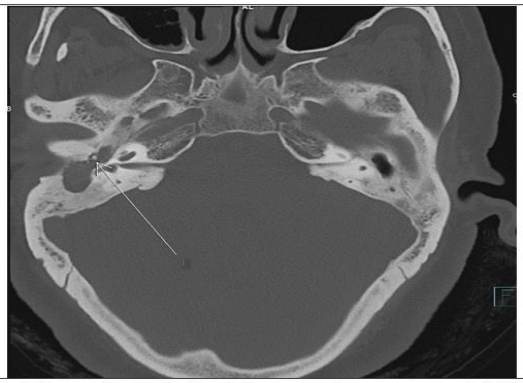


Figure 4. HRCT temporal bone (axial view) image shows an axial CT image of the temporal bone focussing on the middle ear cavity and, demonstrate ossicular disruption

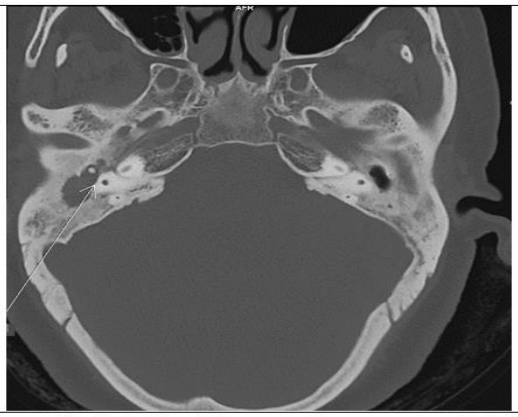


Figure 5. HRCT temporal bone (axial view) image shows an axial HRCT image of the temporal bone, demonstrate widening of aditus and antrum

DISCUSSION

The primary objective of this study was to delineate the spectrum of HRCT findings in squamosal COM and to emphasize its critical role in preoperative planning. Our results demonstrate that HRCT consistently identifies the extent of soft tissue disease and accurately detects bony erosions that are not clinically appreciable. The high rates of attic involvement (85.9%), scutum erosion (81.3%), and ossicular chain erosion (75%) in our cohort are consistent with the aggressive, osteolytic nature of cholesteatoma and align with findings from recent large series.[16-19] The predominance of incus erosion (68.8%) is a well-known phenomenon due to its tenuous blood supply and anatomical position, and this finding on HRCT directly informs the surgeon that ossiculoplasty will be necessary.[20-22]

The utility of HRCT extends beyond simple diagnosis to actionable surgical planning. For instance, the presence of extensive attic disease and scutum erosion (Table 3) typically necessitates a canal wall down (CWD) mastoidectomy or a very careful canal wall up (CWU) procedure to ensure complete disease clearance.[23] Conversely, the detection of disease in hidden recesses like the sinus tympani (21.9% of our cases) is a crucial HRCT finding, as this area is a common site for residual cholesteatoma. Its presence alerts the surgeon to use a wider surgical approach, such as a posterior tympanotomy, to access this area.[24] Furthermore, the identification of mastoid opacification in 79.7% of our patients confirms that the disease is not confined to the middle ear, making simple tympanoplasty insufficient and a mastoidectomy mandatory.[25]

Perhaps the most significant contribution of HRCT is in identifying patients at high risk for surgical complications. The detection of tegmen erosion (18.8%) in our study raises a red flag for potential intracranial extension, mandating meticulous surgical technique and, in some cases, neurosurgical involvement.[26] Similarly, the finding of facial nerve canal erosion (15.6%) is an absolute indication for intraoperative facial nerve monitoring to prevent iatrogenic paralysis.[27] The identification of a lateral semicircular canal fistula (3.1%), though less common, is critical, as it warns the surgeon of an increased risk of sensorineural hearing loss or vertigo during cholesteatoma removal, often necessitating a "leave behind" matrix over the fistula site.[28] Without preoperative HRCT, these high-risk conditions would be unexpected intraoperative "surprises," potentially leading to serious, avoidable morbidity. While our study is limited by its single-center, cross-sectional design and lack of direct surgical correlation, its strength lies in demonstrating the clear clinical utility of HRCT findings. The findings strongly advocate for HRCT as an essential, non-negotiable tool in the preoperative workup of all squamosal COM patients.

CONCLUSION

This study confirms that High-Resolution Computed Tomography of the temporal bone provides a comprehensive and clinically-actionable roadmap in squamosal chronic otitis media. It accurately delineates the extension of cholesteatoma into critical middle ear and mastoid spaces and precisely identifies bony erosions of the ossicular chain, scutum, tegmen, facial canal, and labyrinth. These findings are not merely descriptive; they are directly translatable into a preoperative surgical plan, guiding the choice of approach (CWD vs. CWU), the need for mastoidectomy and ossiculoplasty, and the anticipation of complications requiring special monitoring or techniques.

Recommendations

1. HRCT temporal bone should be a mandatory component of the preoperative evaluation for all patients with suspected squamosal COM.
2. Future prospective studies with direct intraoperative correlation are recommended to validate the sensitivity and specificity of HRCT for specific findings, especially for facial canal dehiscence.
3. In complex or recurrent cases, diffusion-weighted MRI should be considered as an adjunct to HRCT to differentiate cholesteatoma from inflammatory soft tissue and to assess for intracranial complications.

REFERENCES

1. Suneha S, Kumar M, Bhavana K. Clinical and sociodemographic profiles of patients with chronic otitis media seeking health care at a tertiary care center of Bihar: a prescription-based analysis. Int J Otorhinolaryngol Clin 2022;14(1):7-11.
2. Browning GG, Merchant SN, Kelly G, et al. Chronic otitis media. In: Gleeson M, Browning GG, Burton MJ, et al., editors. Scott-Brown's Otorhinolaryngology, Head and Neck surgery. Vol. 3. Edward Arnold (Publishers) Ltd 2008:3395-445.
3. Glasscock ME, Dickins JR, Wiet R. Cholesteatoma in children. Laryngoscope 1981;91:1743-53.
4. Robinson JM. Cholesteatoma: skin in the wrong place. J R Soc Med 1997;90(2):93-96.
5. Isaacson G. Diagnosis of pediatric cholesteatoma. Pediatrics 2007;120(3):603-8.
6. Semaan MT, Megerian CA. The pathophysiology of cholesteatoma. Otolaryngol Clin North Am 2006;39(6):1143-59.
7. Kangsanarak J, Fooanant S, Ruckphaopunt K, et al. Extracranial and intracranial complications of suppurative otitis media. Report of 102 cases. J Laryngol Otol 1993;107(11):999-1004.

8. Osma U, Cureoglu S, Hosoglu S. The complications of chronic otitis media: report of 93 cases. J Laryngol Otol 2000;114(2):97-100.
9. Mohammadi G, Naderpour M, Mousaviagdas M. Ossicular erosion in patients requiring surgery for cholesteatoma. Iran J Otorhinolaryngol 2012;24(68):125-8.
10. Zeifer B. Radiology of the temporal bone. In: Thomas R, Staecker H, eds. Otolaryngology, basic science and clinical review. 1st edn. Thieme medical publishers 2006:431-42.
11. Gaurano JL, Joharjy IA. Middle ear cholesteatoma: characteristic CT findings in 64 patients. Ann Saudi Med 2004;24(6):442-7.
12. Yu Z, Han D, Gong S, et al. The value of scutum erosion in the diagnosis of temporal bone cholesteatoma. Acta Otolaryngol 2010;130(1):47-51.
13. Rogha M, Hashemi SM, Mokhtarinejad F, et al. Comparison of Preoperative Temporal Bone CT with Intraoperative Findings in Patients with Cholesteatoma. Iran J Otorhinolaryngol 2014;26(74):7-12.
14. Juliano AF, Ginat DT, Moonis G. Imaging review of the temporal bone: part I. anatomy and inflammatory and neoplastic processes. Radiology 2013;269(1):17-33.
15. de Avila FAS, Aburjeli B de OM, Moreira W, et al. Imaging evaluation of middle ear cholesteatoma: iconographic essay. Radiol Bras 2013;46(4):247-51.
16. Sharma VK, Prajapati N, Sharma R, et al. Radiological changes in anatomy of temporal bone in cases of unsafe chronic suppurative otitis media: a retrospective study. Indian J Otol 2017;23(3):176-9.
17. Agarwal R, Pradhananga R, Das Dutta H, et al. Correlation of pre-operative temporal bone CT scan findings with intraoperative findings in chronic otitis media: squamous type. Indian J Otolaryngol Head Neck Surg 2022;74(Suppl 1):33-42.
18. Uz Zaman S, Rangankar V, Muralinath K, et al. Temporal bone cholesteatoma: typical findings and evaluation of diagnostic utility on high resolution computed tomography. Cureus 2022;14(3):e22730.
19. Shelke A, Magar V, Tamne A, et al. Analytical cross-sectional study: the correlation of HRCT temporal bone findings and intraoperative findings in chronic otitis media of squamosal type. Int J Med Pharm Res 2025;6(5):30-6.
20. Verma RB, Kumar R, Kapadia PB, et al. Intra-operative ossicular chain status in patients with chronic otitis media. Indian J Otolaryngol Head Neck Surg 2024;76(2):1563-8.
21. Iqbal J, Ahmad MM, Naeem M. Incidence of the incus erosion in chronic suppurative otitis media with cholesteatoma. PJHMS 2017;11(2):718-20.
22. Dhulipalla S, Choudhary SM, Madala N. A study to evaluate the role of high resolution CT temporal bone in preoperative assessment of ossicular chain status in chronic suppurative otitis media patients. IOSR-JDMS. 2018;17(1):33-7.
23. Bovi C, Luchena A, Bivona R, et al. Recurrence in cholesteatoma surgery: what have we learnt and where are we going? A narrative review. Acta Otorhinolaryngol Ital 2023;43(Suppl 1):S48-55.
24. Negi S, Singh I, Meher R, et al. Surreptitious Area of Middle Ear - the Sinus Tympani. Indian J Otolaryngol Head Neck Surg 2024;76(4):3109-13.
25. Khan MI, Patel S, Dasgupta K. Is HRCT Temporal Bone Necessary in All Cases of Active Squamous Chronic Otitis Media? Indian J Otolaryngol Head Neck Surg 2019;71(Suppl 2):1212-6.
26. Swanson J, Oetojo W, Uram Z, et al. Treatment of tegmen dehiscence using a middle fossa approach and autologous temporalis fascia graft: Outcomes from a single center. Clin Neurol Neurosurg 2022;219:107331.
27. Rasool S, Garg R, Tandon A, et al. Cholesteatoma and facial canal dehiscence: a comparative prospective study. J Otolaryngol Head Neck Surg 2020;3(2):1086.
28. Gopal S, Sivaranjani M, Shalini R, et al. Comparison of Lateral Semicircular Canal Dysfunction in Chronic Otitis Media Patients using Air Caloric Test and Video Head Impulse Test. Indian J Otolaryngol Head Neck Surg 2025;77(2):832-6.