

To Evaluate the Diagnostic Performance and Clinical Utility of Preoperative High-Resolution Computed Tomography (HRCT) of the Temporal Bone in Patients with Squamous Type Chronic Otitis Media (Com) and to Compare Radiological Findings with Intraoperative Findings

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Received: 20-11-2025 / Revised: 08-12-2025 / Accepted: 05-01-2026

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Conflict of interest: Nil

Abstract

Aim: To evaluate diagnostic performance and clinical utility of preoperative high-resolution computed tomography (HRCT) temporal bone in squamous type chronic otitis media (COM) patients and to compare intraoperative findings with radiological.

Materials and Methods: A prospective observational study was conducted on 100 clinically diagnosed adult patients with squamous type COM in Krishna Mohan Medical College and Hospital. All the patients were subjected to complete ENT examination, tuning fork tests, pure tone audiometry, and preoperative HRCT temporal bone imaging.

Intraoperative findings were recorded systematically using the same checklist as HRCT parameters and were considered the reference standard for comparison with preoperative HRCT.

Results: The most common symptom was ear discharge (97%), followed by hearing loss (84%). On HRCT, middle ear soft tissue was seen in 94% and mastoid soft tissue/opacification in 91% of patients. Scutum erosion was detected in 69%, with ossicular erosion involving the incus (61%), malleus (46%), and stapes (30%). Tegmen erosion and LSCC erosion/fistula were seen in 16% and 10% of cases, respectively. Intraoperatively, middle ear soft tissue and mastoid disease were confirmed in 97% and 94%, scutum erosion in 67%, malleus erosion in 40%, incus erosion in 55%, and stapes necrosis in 45%, indicating that some findings, especially stapes pathology and facial canal dehiscence, were more frequently detected intraoperatively than on HRCT.

Conclusion: HRCT temporal bone is an invaluable preoperative imaging modality in squamous COM, with greater precision in the identification of important anatomical variations and in surgical access planning. It significantly improves surgical preparedness and patient counselling. Restrictions remain in the identification of facial nerve dehiscence and stapes pathology. HRCT in difficult cases can be selectively applied for improved surgical success.

Keywords: Squamous chronic otitis media; Cholesteatoma; HRCT temporal bone; Ossicular erosion; Facial canal dehiscence; Mastoidectomy.

DOI: 10.25258/ijcpr.18.1.174

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Introduction

Chronic otitis media (COM) remains a major cause of preventable hearing loss in developing countries. The squamous type (often referred to as unsafe COM) is particularly aggressive, commonly leading to bony erosion, ossicular damage, and serious intracranial or extracranial complications if left untreated [1]. The global burden of COM is significant, with an estimated prevalence of over 65

to 330 million people suffering from disabling chronic middle ear infections worldwide [2]. Given its destructive nature, squamous type COM demands accurate preoperative assessment to plan the extent of surgery and minimize complications.

Otoscopy and pure tone audiometry, while essential, do not offer insight into deeper middle

ear or mastoid involvement. This is where high-resolution computed tomography (HRCT) of the temporal bone has become indispensable. HRCT offers excellent spatial resolution for bony

structures and can visualize subtle erosions, ossicular chain disruptions, and complications such as lateral semicircular canal fistula, facial canal dehiscence, and sinus plate erosion [3].

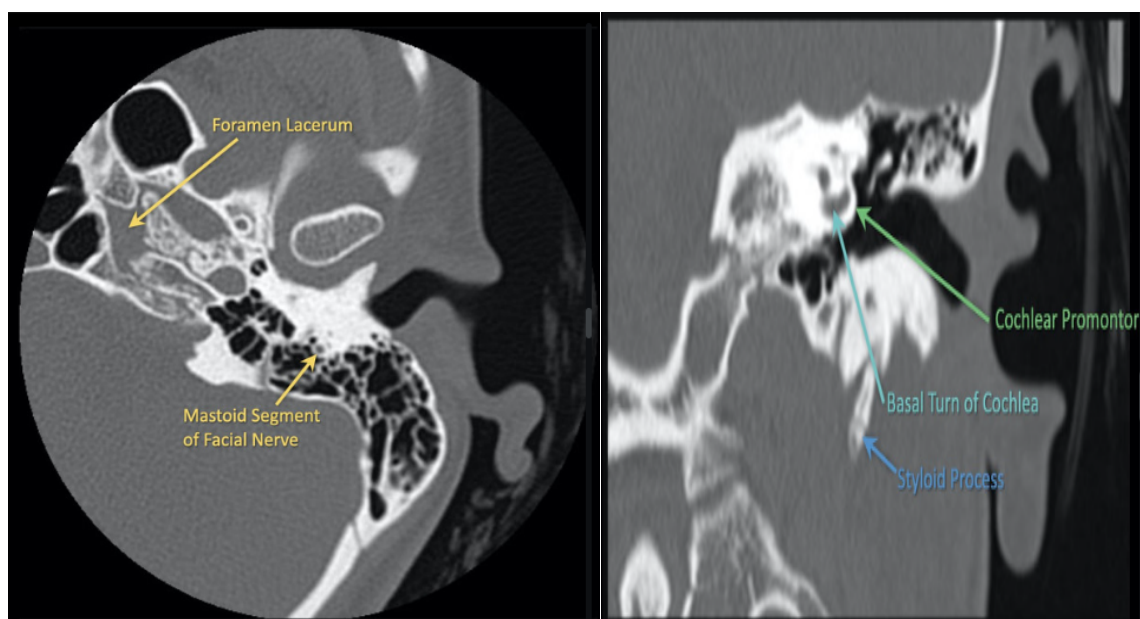


Figure 1: HRCT showing Normal temporal bone

Numerous studies have emphasized the role of HRCT in cholesteatoma surgery. For example, Zaman et al. demonstrated that HRCT shows high sensitivity and specificity in detecting soft tissue pathology, scutum erosion, and ossicular damage, especially malleus and incus [4]. Gulati et al. provided a comprehensive radiological atlas that supports HRCT as a strong preoperative tool, though limitations remain in detecting fine structures like stapes and identifying early dehiscence of the facial nerve canal [5].

Despite its diagnostic value, HRCT interpretation can vary among radiologists and may miss subtle erosions, particularly in the stapes or facial canal.

Therefore, correlating HRCT findings with actual intraoperative observations remains crucial for validating its utility as a pre-surgical planning tool.

Our study was undertaken to evaluate the diagnostic performance of preoperative HRCT temporal bone in patients with squamous type COM, by comparing radiological features with intraoperative findings, and to assess how imaging influences surgical decision-making.

Materials and Methods

Study Design and Setting: Our study is a prospective observational study conducted in the Department of Otorhinolaryngology, Krishna Mohan Medical College & Hospital, Mathura, over a period of 18 months (November 2023 to May 2025).

Study Population and Sample Size:

The study included 100 adult patients aged between 18 to 70 years, presenting with signs and symptoms suggestive of squamous type chronic otitis media (COM). The sample size was calculated using the standard formula for estimating proportions in cross-sectional studies, assuming a 50% prevalence, 95% confidence level ($Z = 1.96$), and 10% margin of error ($d = 0.10$). This yielded a minimum sample size of 96, which was rounded off to 100 to ensure statistical power.

Inclusion Criteria

- Age 18 to 70 years
- Clinical diagnosis of squamous type COM (e.g., attic perforation, cholesteatoma, marginal perforation, polyp)
- Scheduled for mastoid exploration surgery
- Willing to undergo HRCT and surgery with informed consent

Exclusion Criteria

- Mucosal (safe) type COM
- History of temporal bone trauma or previous mastoidectomy
- Unfit or unwilling for imaging or surgery

Study Procedure: Each patient underwent a detailed ENT history and examination, including otoscopy, microscopy, and tuning fork tests (Rinne's, Weber's, and ABC). Hearing assessment was done using Pure Tone Audiometry (PTA).

All patients underwent High-Resolution Computed Tomography (HRCT) of the temporal bone, using a Siemens Somatom Emotion 6-slice scanner, with axial and coronal images at 0.69 mm slice thickness. Radiological assessment focused on several key parameters to evaluate the middle ear and mastoid. The presence of soft tissue was first noted, followed by a detailed examination for erosion in the scutum, malleus, incus, and stapes. The assessment also included a check for dehiscence of the facial nerve canal, and the presence of a lateral semicircular canal (LSCC) fistula. Finally, the integrity of the surrounding bony structures was evaluated by looking for erosion of the tegmen and sinus plate.

Subsequently, all patients underwent mastoidectomy (canal wall up or canal wall down) based on disease extent. Intraoperative findings were documented using the same checklist as the HRCT parameters and were considered the reference standard for comparison with preoperative HRCT.

Data Collection and Analysis: All data were compiled in Microsoft Excel and analyzed using SPSS software. Radiological findings were

compared with intraoperative findings (reference standard) for key anatomical parameters, and the strength of association was assessed using appropriate tests for categorical variables. Categorical variables were summarised as frequencies and percentages. Comparisons between HRCT and intraoperative findings were presented descriptively for each parameter, and statistical significance was considered at $p < 0.05$.

Ethical Considerations:

Our study adhered to the guidelines of the Indian Council of Medical Research (ICMR) for human research and the principles of the Declaration of Helsinki. Patient confidentiality and the right to withdraw from the study were ensured at all stages.

Results

A total of 100 patients diagnosed with squamous type chronic otitis media (COM) were included in our study. The majority of patients were in the age group of 31–40 years (36%), followed by 21–30 years (23%), indicating a predominance in young to middle-aged adults. Male patients constituted 62%, and females 38%, showing a male preponderance.

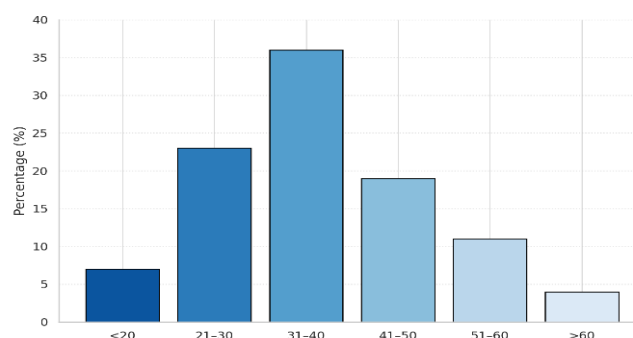


Figure 2: Age distribution.

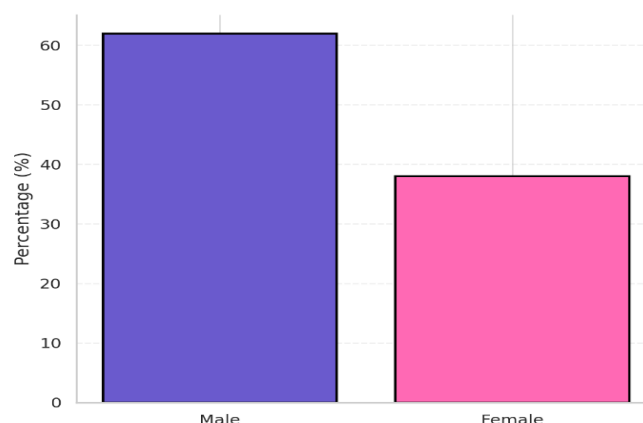


Figure 3: Gender distribution

Clinical Presentation: The most common presenting complaint was ear discharge, reported by 97% of the patients, followed by hearing loss (84%), and ear pain (17%). Less frequent symptoms included vertigo (6%),

tinnitus (3%), and facial weakness (2%). These findings highlight the chronic and symptomatic nature of squamous COM.

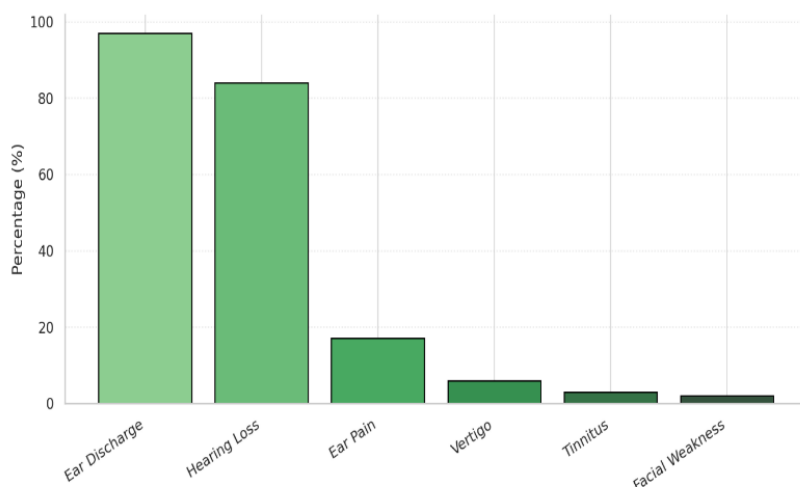


Figure 4: Clinical presentations

Pure Tone Audiometry (PTA): Audiometric evaluation revealed that 88% of patients had conductive hearing loss, 10% had mixed hearing loss, and 2% had sensorineural hearing loss. This pattern reflects the primary involvement of middle ear structures in squamous COM.

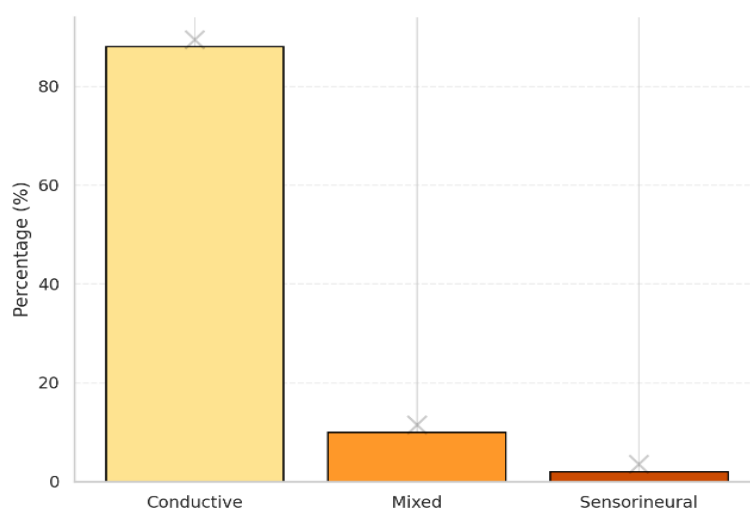


Figure 5: Types of Hearing Loss

HRCT Findings: On preoperative HRCT temporal bone imaging, middle ear soft tissue shadow was seen in 94 patients (94%), and mastoid soft tissue opacification in 91 patients (91%). Scutum erosion was the most frequent finding, detected in 69% of cases. The ossicles also showed high rates of

erosion, with the incus affected in 61%, the malleus in 46%, and the stapes in 30% of cases. Beyond ossicular damage, other critical findings included facial canal dehiscence in 6% of cases (6 patients), tegmen erosion in 16%, and lateral semicircular canal (LSCC) erosion/fistula in 10%.

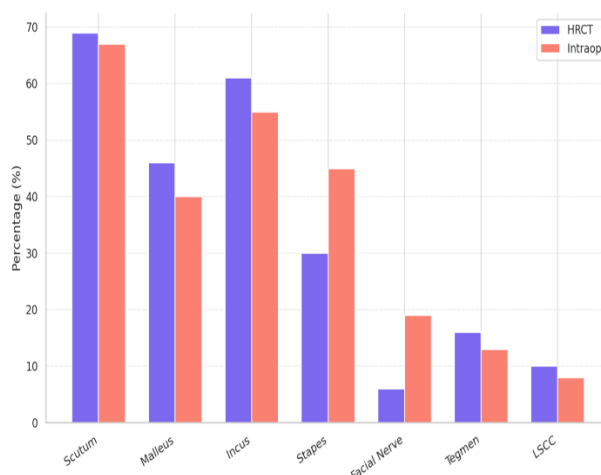


Figure 6: HRCT vs Intraoperative Findings

Intraoperative Correlation: Intraoperatively, middle ear soft tissue was confirmed in 97%, and mastoid opacification in 94%, closely correlating with HRCT findings. During surgery, the rate of scutum erosion was confirmed in 67% of cases, closely matching the 69% detection rate seen on high-resolution computed tomography (HRCT). Surgical findings for ossicular chain erosion also provided key insights. The malleus and incus showed erosion in 40% and 55% of cases,

respectively. Facial canal dehiscence, tegmen erosion, and LSCC erosion/fistula were confirmed intraoperatively in 19%, 13%, and 8% of cases, respectively. Notably, stapes necrosis was identified in 45% of patients; this was more frequently detected intraoperatively than on HRCT. Comparison of HRCT and intraoperative findings (n = 100): Key HRCT findings were compared with intraoperative findings for major anatomical parameters.

Table 1:

Finding	HRCT detected (n, %)	Intraoperative confirmed (n, %)
Middle ear soft tissue	94 (94%)	97 (97%)
Mastoid soft tissue / opacification	91 (91%)	94 (94%)
Scutum erosion	69 (69%)	67 (67%)
Malleus erosion/necrosis	46 (46%)	40 (40%)
Incus erosion/necrosis	61 (61%)	55 (55%)
Stapes erosion/necrosis	30 (30%)	45 (45%)
Facial canal dehiscence	6 (6%)	19 (19%)
Tegmen erosion	16 (16%)	13 (13%)
LSCC erosion / fistula	10 (10%)	8 (8%)

Overall, HRCT findings correlated well with intraoperative findings for middle ear/mastoid soft tissue, scutum erosion, and malleus/incus erosion; however, stapes involvement and facial canal dehiscence were more frequently detected intraoperatively. However, HRCT was less sensitive in detecting stapes necrosis and facial nerve dehiscence, which were more reliably diagnosed intraoperatively.

Discussion

Our study underscores the vital role of preoperative HRCT of the temporal bone in the evaluation and surgical planning of squamous type chronic otitis media (COM). With its high-resolution capability, HRCT offers critical insights into bony erosion and soft tissue pathology that are often difficult to appreciate through clinical examination alone [1-3].

We observed excellent specificity for detecting middle ear and mastoid soft tissue shadows, matching closely with intraoperative findings. These results align with those of Zaman et al., who reported similar high sensitivity and specificity for soft tissue detection using HRCT [4].

Ossicular erosion, especially of the malleus and incus, was also reliably identified. Our findings reflect those of Gulati et al., who emphasized the accuracy of HRCT in delineating the ossicular chain, particularly the malleus and body of the incus [5]. Similarly, Manik et al. reported high HRCT accuracy for ossicular necrosis in squamous COM, with sensitivity over 85% and specificity nearing 90% [6].

Stapes pathology was more frequently identified intraoperatively (45%) than on HRCT (30%),

suggesting that small stapes erosions may be missed on imaging. This underperformance mirrors findings in multiple studies [5-7], which have noted that stapes, due to its minute size and complex orientation, often evades detection on routine HRCT protocols.

The facial nerve canal is another structure that remains challenging to evaluate. Facial canal dehiscence was detected in 6% on HRCT, whereas intraoperative assessment identified it in 19%, indicating under-detection of subtle dehiscence on imaging and this is consistent with data from Aljehani et al. and others, who noted similarly poor correlation for this parameter [8].

We also noted tegmen erosion and LSCC fistula in a small subset of cases. HRCT correctly predicted most of these findings, with sensitivity ranging from 61–80% and specificity nearing 99%.

This supports previous literature that recognizes HRCT as a useful preoperative tool in identifying such critical anatomical risk zones [7,8].

In practice, HRCT not only guides the extent of mastoidectomy (canal wall up vs down), but also alerts the surgeon to anatomical hazards such as facial nerve dehiscence or LSCC fistula, potentially averting devastating complications. It provides a preoperative map, helping balance surgical radicality with functional preservation [3,9].

While HRCT demonstrates strong utility in the preoperative setting, our study supports a balanced view, leveraging imaging strengths while recognizing its blind spots. Intraoperative findings still serve as the gold standard, particularly for fine structures like the stapes and facial canal [5-8].

Conclusion

Our study confirms that high-resolution computed tomography (HRCT) of the temporal bone is a highly specific and clinically valuable imaging modality in the preoperative assessment of squamous type chronic otitis media (COM). HRCT demonstrated excellent accuracy in detecting soft tissue involvement, scutum erosion, and ossicular necrosis, particularly of the malleus and incus. It also provided reliable insights into potentially hazardous areas such as tegmen erosion and lateral semicircular canal fistula.

However, its diagnostic sensitivity was comparatively lower for stapes necrosis and facial nerve canal dehiscence, underscoring the continued importance of intraoperative evaluation as the definitive standard. Thus, while HRCT serves as an essential guide for otologic surgeons, its findings must be interpreted in conjunction with clinical

judgment and operative findings to optimize surgical outcomes and minimize complications.

Future improvements in imaging protocols, including thinner slice acquisition and 3D reconstruction, may enhance HRCT's sensitivity in evaluating finer middle ear structures, offering even greater preoperative precision.

Limitations

Despite the robust sample size and comprehensive analysis, our study had a few limitations. HRCT sensitivity was limited for evaluating minute middle ear structures such as the stapes and facial nerve canal, which may be influenced by slice thickness and interpreter experience. Additionally, as this was a single-centre study, generalizability may be limited across broader populations or radiological setups. Inter-observer variability in HRCT interpretation was not assessed and could impact diagnostic consistency.

Ethical Approval

Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of Krishna Mohan Medical College and Hospital, Mathura, prior to the initiation of the study. Informed consent was obtained from all participants. The study adhered to the ethical principles outlined in the Declaration of Helsinki [10].

Acknowledgements

The authors wish to express their sincere gratitude to the Department of ENT and Radiology, Krishna Mohan Medical College and Hospital, Mathura, for their support and collaboration during the course of the study. Special thanks to all patients who consented to be part of this research.

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