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RADIOLOGIC-SURGICALCORRELATION OF HIGH-RESOLUTION COMPUTED TOMOGRAPHY TEMPORAL BONE IN CHRONIC OTITIS MEDIA SQUAMOUS

ABSTRACT

Aims and Objectives: High-resolution computed tomography (HRCT) temporal bone is widely used for preoperative assessment in chronic otitis media (COM) squamous. Though it identifies the extent of disease, its diagnostic reliability can be challenged by the presence of inflammation and soft tissue artefacts. This study evaluates the accuracy of HRCT by correlating radiologic predictions with definitive intraoperative findings to optimize surgical planning.

Methods: A hospital-based cross-sectional study was conducted at Bir Hospital, Kathmandu, from August 2024 to August 2025. Forty-six patients with clinically diagnosed COM squamous undergoing mastoid surgery were included. Preoperative HRCT findings were compared with intraoperative findings. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Cohen's kappa were calculated.

Results: The majority of patients were aged 21–40 years (45.65%) with slight male predominance (52.17%). Mastoid sclerosis (86.95%) and scutum erosion (100%) showed complete radiologic–surgical concordance. Facial canal erosion (21.7% vs 13.0%; $p < 0.001$) and stapes erosion (67.39% vs 45.65%; $p = 0.015$) were significantly overestimated on HRCT. HRCT demonstrated high sensitivity for ossicular erosion (malleus 90.3%, incus 95.3%, stapes 85.7%) but variable specificity. For bony erosions, sensitivity ranged from 42% (tegmen) to 83% (facial canal), with fair to moderate agreement ($\kappa = 0.21–0.55$). HRCT showed 100% sensitivity for disease extension to middle ear and mastoid subsites, with the highest agreement for mesotympanum ($\kappa = 0.802$) and sinus tympani ($\kappa = 0.809$).

Conclusion: HRCT is highly sensitive in detecting ossicular erosion and disease extent, but may exaggerate certain bony erosions. Careful radiologic–surgical correlation is essential.

Keywords: Chronic otitis media; Cholesteatoma; Computed Tomography; Ossicle

INTRODUCTION

Chronic otitis media (COM) is the inflammation of the middle ear with tympanic membrane perforation/retraction and chronic otorrhea for more than 12 weeks.[1] Cholesteatoma is a stratified squamous epithelium containing keratin debris in the tympanomastoid compartment with a propensity for surrounding bone erosion, leading to tegmen and sinus plate erosion, facial canal involvement, and lateral semicircular canal fistula and ossicular destruction.[2-4] Delay in intervention may lead to intracranial and intratemporal complications.[2]

Preoperative assessment with High-resolution computed tomography (HRCT) of the temporal bone is essential, as it provides excellent delineation of bony anatomical details and the extent of disease.[5,6] However, its diagnostic precision is frequently compromised by inflammatory granulation tissue and volume-averaging artefacts, which may obscure critical bony margins. Such radiologic-surgical discrepancies can lead to unexpected intraoperative challenges and increased surgical morbidity. This study rigorously evaluates the predictive value of HRCT by correlating preoperative imaging with definitive intraoperative findings to refine surgical navigation and prioritize patient safety.

METHODS

This cross-sectional study was conducted at the Department of ENT, National Academy of Medical Sciences, Bir Hospital, Kathmandu, from August 2024 to August 2025. Ethical

approval was obtained from the Institutional Review Committee. Written informed consent was obtained from all participants. Patients planned for mastoid surgeries for COM squamous type with HRCT of the temporal bone were included. We excluded patients who had prior surgery or known congenital ear anomalies. A consecutive sampling technique was used for the study. HRCT temporal bone axial and coronal view (0.6-1mm cut) was done with Philips 128 slice Computed Tomography. Reporting of the HRCT temporal bone was done by a single consultant radiologist from the Department of Radiology, Bir Hospital, NAMS. Recording was done on the proforma. Type of mastoid pneumatization, erosion of scutum, erosion of tegmen & sinus plate, facial canal, lateral semicircular canal, ossicular status and extent of disease were recorded. Intraoperative findings were also documented and compared with HRCT findings.

Data were entered and analyzed using SPSS. Chi-square test and McNemar test were applied. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and Cohen's kappa coefficient were calculated. A p-value <0.05 was considered statistically significant.

RESULTS

The study population included 46 patients with a slight male predominance (52.17%). The most represented age cohort was the third and fourth decades (21–40 years), accounting for 45.65% of the participants (Table 1).

Table 1. Distribution of Study Participants by Age and Sex (n = 46)

Characteristics		Frequency (n)	Percentage (%)
Gender	Male	24	52.17
	Female	22	47.83
Age Group (Years)	< 20	14	30.43
	21-40	21	45.65
	41-60	9	19.56
	61-80	2	4.34
Total		46	100

Scutum erosion and mastoid pneumatization was completely concordant. Tegmen erosion was detected in 21.7% on HRCT versus 15.2% intraoperatively (p = 0.14). Sigmoid plate erosion was seen in 8.6% radiologically and 4.3% during surgery (p = 0.30). Facial canal erosion was significantly overestimated on HRCT (21.7% vs 13.0%; p < 0.001). LSCC erosion showed no significant difference (13.0% vs 8.7%; p = 0.60) (Table 2).

Ossicular erosion was common in our study, particularly involving the incus (93.47%) and the malleus (91.30%). Stapes erosion was significantly exaggerated on HRCT (67.39% vs 45.65%; p = 0.015) (Table 2).

Table 2. Correlation of HRCT and Intraoperative Findings for Anatomic structure and Ossicular Status

Structure	HRCT n (%)	Intraoperative n (%)	P-value
Mastoid pneumatization (Sclerosed)	40 (86.95%)	40 (86.95%)	
Scutum erosion	46 (100%)	46 (100%)	
Tegmen erosion	10 (21.7%)	7 (15.2%)	0.14
Sigmoid plate erosion	4 (8.6%)	2 (4.3%)	0.3
Facial canal erosion	10 (21.7%)	6 (13.0%)	<0.001*
LSCC erosion	6 (13.0%)	4 (8.7%)	0.6
Malleus erosion	41 (89.13%)	42 (91.30%)	0.342
Incus erosion	42 (91.30%)	43 (93.47%)	0.31
Stapes erosion	31 (67.39%)	21 (45.65%)	0.015

**Statistically significant, HRCT: High Resolution computed tomography; LSCC: Lateral Semicircular Canal*

HRCT showed variable accuracy for bony erosions. Sensitivity and specificity were 42% and 82% for the tegmen tympani (κ = 0.212), and 50% and 93% for the sigmoid plate (κ = 0.292), indicating fair agreement. For facial canal and LSCC erosions, sensitivity was 83% and 75%, and specificity was 87% and 92%, respectively, with moderate agreement (κ = 0.552 and 0.553) (Table 3).

Table 3. Correlation in the Involvement of Anatomical Structures

Structure	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	κ value
Tegmen tympani	42	82	30	88.9	0.212
Sigmoid plate	50	93	25	97.6	0.292
Facial canal	83	87	50	97.2	0.552
LSCC	75	92	50	97.5	0.553
Malleus	90.3	25	90	20	0.139
Incus	95.3	66.7	97.6	50	0.537
Stapes	85.7	48	58.1	80	0.325

PPV: Positive Predictive Value; NPV: Negative Predictive Value; kappa: Cohen's kappa coefficient; LSCC: Lateral Semicircular Canal

HRCT demonstrated high sensitivity for ossicular erosion (malleus 90.3%, incus 95.3%, stapes 85.7%) but variable specificity, particularly low for malleus (25%) (Table 3).HRCT showed 100% sensitivity for disease extension to epitympanum, mesotympanum, hypotympanum, aditus,

antrum, and sinus tympani, with the highest agreement for mesotympanum (κ = 0.802) and sinus tympani (κ = 0.809) (Table 4).

Table 4. Correlation in Detecting Extension of Disease

Site	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	κ value
Epitympanum	100	0	95.6	-	*
Mesotympanum	100	73	92.1	100	0.802
Hypotympanum	100	64.5	57.7	100	0.542
Aditus	100	20	91.1	100	0.308
Antrum	100	50	93	100	0.635
Sinus tympani	100	95	71.4	100	0.809

** Kappa could not be calculated as epitympanic involvement was present in all cases*

This table summarizes the diagnostic accuracy metrics. PPV: Positive Predictive Value; NPV: Negative Predictive Value; kappa: Cohen's kappa coefficient Canal

DISCUSSION

Preoperative information regarding the extent of disease, ossicular status and involvement of structures like the facial canal, tegmen, sigmoid plate and jugular bulb are crucial in surgical planning, minimizing intraoperative complications, and complete disease clearance. HRCT of the temporal bone plays a valuable role in providing this preoperative information.

Chronic Otitis Media (COM) squamous type is frequently associated with sclerotic mastoid. In our study, HRCT demonstrated exceptional reliability in evaluating the architectural changes of the temporal bone. Specifically, mastoid sclerosis and scutum erosion showed absolute concordance between preoperative imaging and intraoperative findings. This perfect correlation suggests the utility of HRCT as a definitive tool for detecting gross bony changes of squamous disease. which is consistent with previous reports.[7-9]

In contrast, the assessment of the facial nerve canal revealed a significant radiologic-surgical discrepancy. Facial canal dehiscence detection in our study showed good sensitivity (83%) and specificity (87%) with moderate agreement (κ=0.552), comparable to findings of similar other studies, though higher than those reported by Jose et al and Sirigiri et al.[10-13] The statistically significant overestimation of facial canal warrants clinical caution. This 'false-positive' trend on HRCT is likely attributable to volume averaging effects or the presence of inflammatory granulation tissue and cholesteatoma matrix obscuring the delicate bony margins.[14,15]

While this leads to lower specificity, from a surgical standpoint, this high sensitivity serves a protective role—ensuring the surgeon approaches these critical landmarks with heightened vigilance.[16]

Our analysis revealed a disparity in the diagnostic performance of HRCT when evaluating the tegmen and sigmoid plates. While the high specificity (82%–93%) suggests that HRCT is a reliable tool for ruling out dural or venous exposure, the relatively low sensitivity (42%–50%) indicates a significant risk of underestimating these defects preoperatively where the thin, demineralized bony partitions of the tegmen are masked by adjacent hyperdense soft tissue masses, such as a cholesteatoma matrix or inflammatory granulation tissue. These findings align with the observations of Gerami et al. and Rai et al., who similarly reported that HRCT frequently fails to detect small tegmen dehisences that are only revealed during meticulous surgical clearance.[17,18]

Furthermore, the fair agreement (k=0.212) for tegmen erosion emphasizes that while HRCT is an indispensable tool, it cannot replace the surgeon's high index of suspicion. The lack of statistical significance in the discrepancy for the sigmoid plate—concordant with the results of Jose et al. suggests that while HRCT is statistically consistent, it lacks the resolution to serve as a definitive predictor for every minor plate thinning. Consequently, the surgeon must remain prepared for unexpected dural or sinus exposure, even when preoperative imaging suggests an intact bony partition.[11]

For lateral semicircular canal erosion, HRCT demonstrated good specificity (92%) but moderate sensitivity (75%), which is consistent with Jadia et al.[7] but contrasts with the very low sensitivity reported by Gerami et al.[17]

Regarding ossicular erosion, HRCT showed high sensitivity for malleus (90.3%) and incus (95.3%) but lower specificity, similar to findings by Jadia et al.[7] and Rogha et al.[19] Detection of stapes erosion was less reliable and statistically different from operative findings (p=0.015), consistent with previous literature likely due to its small size.[8,17]

Regarding disease extent, there is a tendency of HRCT to show more disease extension in mesotympanum, hypotympanum, aditus, antrum, and sinus tympani, similar to results by various studies.[7,9,11] This overestimation may be attributed to the inability of HRCT to differentiate cholesteatoma from granulation tissue, edema, or retained secretions.

Overall, the study finds HRCT of the temporal bone is an excellent preoperative tool for assessing disease extent and major bony erosions, but with some limitations in detecting subtle erosions and in differentiating soft tissue pathology. The major limitation of the study is the small sample size and surgery was performed by different surgeons.

CONCLUSION

HRCT temporal bone is a sensitive imaging modality for assessing disease extent, bone erosion and anatomic details in COM squamous. It shows fair to moderate agreement for most bony erosions, but may show increased facial canal and stapes involvement. Therefore, HRCT findings should be interpreted cautiously. Despite some limitations, HRCT of the temporal bone can be a valuable preoperative investigation in patients with COM squamous planned to undergo surgery.

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