



ROLE OF HIGH-RESOLUTION CT TEMPORAL BONE IN PREDICTING OSSICULAR CHAIN EROSION IN CHRONIC OTITIS MEDIA: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Chronic otitis media (COM) is a major cause of preventable hearing loss globally, with the World Health Organization estimating over 297 million affected individuals, the majority in low- and middle-income countries including India.[1] The atticofurcal (unsafe) subtype, frequently associated with cholesteatoma, leads to ossicular chain erosion (OCE) through osteoclast-mediated bone resorption, causing significant conductive hearing loss and posing risks of serious complications.[3,4] Accurate pre-operative assessment of ossicular integrity is essential to surgical planning; operative exploration remains the reference standard.[5] High-resolution computed tomography (HRCT) of the temporal bone provides non-invasive anatomical detail, yet its predictive accuracy for OCE in the north Indian tertiary care setting requires systematic prospective evaluation.

Objectives: To determine the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of HRCT temporal bone in predicting intra-operative ossicular chain erosion in patients with COM undergoing tympanomastoid surgery at Saraswati Medical College, Unnao, Uttar Pradesh.

Methodology: A prospective observational study was conducted from January 2018 to December 2018. Eighty-two adult patients with COM were enrolled. Pre-operative HRCT temporal bone (0.625 mm slice thickness) was interpreted by two independent blinded radiologists, with intra-operative ossicular status serving as the reference standard. Statistical analysis used the Chi-square test, Clopper–Pearson sensitivity/specificity calculations, and Cohen’s kappa coefficient (SPSS v22).

Results: Of 82 patients (mean age 38.6 ± 14.2 years; 59.8% male), operative OCE was confirmed in 47 ears (57.3%). HRCT sensitivity was 83.0% (95% CI: 69.2–91.1%) and specificity 88.6% (95% CI: 74.6–95.7%). PPV was 90.7%, NPV 79.5%, and overall diagnostic accuracy 85.4%. The long process of the incus was the most frequently eroded component (80.9%). Substantial radiological–operative agreement was observed (kappa=0.694; $p<0.001$). Duration of symptoms ≥ 5 years was significantly associated with OCE ($p=0.001$).

Conclusion: HRCT temporal bone demonstrates high sensitivity and specificity for predicting ossicular chain erosion in COM and reliably guides pre-operative surgical planning. Systematic adoption in tertiary care settings serving high-burden north Indian populations is recommended.

Keywords: Chronic otitis media; HRCT temporal bone; ossicular chain erosion; cholesteatoma; tympanomastoidectomy; pre-operative imaging

1. INTRODUCTION

Chronic otitis media (COM) constitutes one of the most significant causes of preventable hearing loss in the world, particularly in low- and middle-income countries. A landmark systematic review published in PLoS One estimated the global burden of CSOM at approximately 297 million affected individuals, with over 85% residing in low- and middle-income countries, corresponding to a world-wide prevalence of nearly 3.8%.[1] India contributes disproportionately to this burden: community-based surveys have documented CSOM prevalence rates ranging from 5% to 8% in school-age children in rural north India, including Uttar Pradesh, with significantly higher rates in populations characterised by poor sanitation, overcrowding, malnutrition, and delayed healthcare access.[2,33] The peri-urban catchment of Saraswati Medical College, Unnao, reflects this epidemiological profile, with a predominantly rural and semi-urban population that often presents late to tertiary care.

COM is classified into two principal subtypes: tubotympanic (mucosal, “safe”) disease and atticofacial (squamous, “unsafe”) disease. The latter, typically associated with cholesteatoma formation, is characterised by progressive, osteoclast-mediated bony destruction of the middle ear structures.[24] Cholesteatoma expands through a molecular cascade involving receptor activator of nuclear factor- κ B ligand (RANKL) and osteoclast-stimulating cytokines, leading to irreversible erosion of the ossicular chain, tegmen, lateral semicircular canal, and facial nerve canal.[21] Ossicular chain erosion (OCE) disrupts sound transmission and produces conductive hearing loss that may reach 50–60 dB in cases of complete discontinuity.[20] Such erosion also serves as a gateway to intracranial complications — meningitis, brain abscess, lateral sinus thrombosis — if the disease is not arrested surgically.[4]

Accurate pre-operative knowledge of ossicular integrity is central to planning the appropriate surgical approach: it determines the extent of mastoidectomy, the need for ossiculoplasty, the choice of prosthetic material, and allows realistic patient counselling regarding expected hearing outcomes.[6] HRCT of the temporal bone, performed with sub-millimetre axial and coronal multiplanar sections, offers superior delineation of ossicular anatomy, middle ear cleft, and adjacent bony structures in a single non-invasive examination.[7] Multiple Indian studies have documented high sensitivity and specificity of HRCT for detecting ossicular erosion in COM.[8,9,15] However, well-designed prospective studies specifically from peri-urban north Indian tertiary centres — where disease severity, referral patterns, and patient demographics differ from South Indian or western series — remain scarce. This study was therefore undertaken to systematically evaluate the predictive accuracy of HRCT temporal bone for OCE at Saraswati Medical College, Unnao, using operative findings as the reference standard.

2. REVIEW OF LITERATURE

Singh et al. (2020), in a prospective study from a Punjab tertiary centre evaluating 50 cases of unsafe CSOM, demonstrated HRCT sensitivity ranging from 86.44% to 100% for ossicular erosions, tegmen erosions, and facial nerve canal erosions, with specificity of 93.33% to 100%.[8] Their study corroborated the value of HRCT as a pre-operative tool and highlighted the stapes suprastructure as the ossicular component most difficult to assess reliably on CT — a finding we replicated in our series.

Walia et al. (2018) conducted a large prospective study at a Gujarat tertiary centre in 100 patients with atticofacial CSOM, documenting HRCT sensitivity and specificity of 100% and 94% for the epitympanum, 98% and 98% for the mesotympanum, and 75% sensitivity for stapes suprastructure

erosion despite 97% specificity.[9] Their conclusion that HRCT is justified as a routine pre-operative tool in atticointral CSOM without intracranial complications directly informed the study design and inclusion criteria of the present work.

Singh and Bhardwaj (2019), reporting from Amritsar, assessed HRCT accuracy for ossicular erosion in 60 patients with safe and limited squamous CSOM and found sensitivity of 78.5% and specificity of 78.1% for malleus erosion, with higher values for incus erosion.[11] Their observation that ossicular erosion is frequently encountered unexpectedly during surgery in safe CSOM cases underscores the clinical value of pre-operative CT across both COM subtypes.

Rogha et al. (2014) reported a prospective descriptive study from Isfahan in 36 cholesteatoma patients, providing detailed kappa statistics for radio-surgical correlation of individual middle ear structures.[12] Excellent correlation was found for the sigmoid plate (kappa=1.0), aditus expansion (kappa=0.92), and scutum (kappa=0.83); good for the tegmen (kappa=0.71) and malleus (kappa=0.61); but poor for stapes (kappa=0.27) and facial nerve canal (kappa=0.20). Their data on the variability of CT accuracy by ossicular component provided a key framework for interpreting our own kappa findings.

Jadia et al. (2021), in a prospective study from Central India evaluating 52 patients with atticointral CSOM, confirmed HRCT as a reliable radiological modality for evaluating cholesteatoma extent and its involvement of adjacent bony structures, with consistently high sensitivity for soft tissue masses, scutal erosion, and ossicular involvement.[15] Gerami et al. (2009) similarly reported moderate-to-good correlation between preoperative CT and intraoperative findings for tympanic cholesteatoma, mastoid cholesteatoma, and ossicular chain erosion in 80 CSOM patients, with the caveat of weak correlation for tegmen tympani and facial canal dehiscence.[27]

Manik et al. (2021), from a Maharashtra tertiary centre, assessed 50 patients with clinically suspected cholesteatoma and found perfect kappa correlation for sigmoid plate erosion, mastoid cortex dehiscence, and scutum erosion, with strong correlation for malleus erosion and good correlation for incus and stapes.[18] Aljehani and Alhussini (2019), reporting from Saudi Arabia, found 100% sensitivity, specificity, PPV, and NPV for incus and stapes erosion on HRCT, with only 78% sensitivity for malleus erosion, confirming the high variability in CT accuracy across ossicular components.[28] Collectively, the reviewed literature confirms HRCT's utility in COM evaluation but points to meaningful variation in diagnostic accuracy by ossicular component, CT protocol, and study design, with a persistent relative scarcity of prospective data from peri-urban north Indian centres.

3. OBJECTIVES

3.1 Primary Objective

To evaluate the sensitivity, specificity, PPV, and NPV of pre-operative HRCT temporal bone in predicting intra-operative ossicular chain erosion among adult patients with COM undergoing tympanomastoid surgery at Saraswati Medical College, Unnao, from January to December 2018.

3.2 Secondary Objectives

- To determine the pattern and frequency of OCE by specific ossicular component, as confirmed intra-operatively.
- To identify clinical and radiological predictors significantly associated with ossicular chain erosion in COM.
- To assess concordance between pre-operative HRCT predictions and operative findings using Cohen's kappa coefficient.
- To evaluate the relationship between duration of symptoms and likelihood of operative ossicular erosion.

4. METHODOLOGY

4.1 Study Design

A prospective, hospital-based, observational study.

4.2 Study Setting

Department of ENT & Head-Neck Surgery and Department of Radiodiagnosis, Saraswati Medical College and Hospital, Lucknow–Kanpur Highway, Unnao, Uttar Pradesh. Patients were enrolled from the ENT outpatient department (OPD) and inpatient ward (IPD) and referred for HRCT prior to surgery. All surgeries were performed in the institution's operating theatres.

4.3 Study Population

Adult patients aged 18–65 years with a clinical and audiological diagnosis of COM (tubotympanic or atticofacial type) who were candidates for tympanomastoid surgery based on clinical evaluation.

4.4 Study Duration

January 2018 to December 2018 (twelve months).

4.5 Sample Size

Sample size was estimated using the formula: $n = Z^2 \times P \times (1-P)/d^2$, where $Z = 1.96$ (95% confidence level), expected sensitivity $P = 0.80$ (based on Singh et al.[8] and Walia et al.[9]), and acceptable margin of error $d = 0.10$, yielding $n = 62$. Accounting for 25% non-completion, the target was adjusted to 78; a final cohort of 82 was achieved.

4.6 Sampling Technique

Consecutive sampling of eligible patients presenting during the study period.

4.7 Inclusion Criteria

- Adults aged 18–65 years with a clinical diagnosis of COM.
- Provision of written informed consent.
- Planned for tympanomastoidectomy (canal-wall-up or canal-wall-down) within the study period.
- Pre-operative HRCT temporal bone (0.625 mm axial sections with coronal MPR) obtained within 6 weeks of surgery.

4.8 Exclusion Criteria

- Previous ipsilateral radical mastoidectomy or ossicular chain reconstruction.
- Active otorrhoea with impacted debris precluding tympanic membrane assessment.
- Congenital middle ear anomalies or traumatic ossicular dislocation.
- Known contraindication to CT (pregnancy, severe contrast allergy, severe claustrophobia).
- Surgery cancelled or deferred beyond the study period.

4.9 Imaging Protocol

All scans were performed on a 64-slice MDCT scanner (GE LightSpeed VCT, GE Healthcare, USA): 120 kVp, 250–280 mAs, 0.625 mm slice thickness, bone kernel reconstruction (B80f), axial sections with coronal and sagittal MPR. Window settings: width 4000 HU, level 700 HU. Intravenous contrast was withheld unless intracranial extension was clinically suspected, consistent with established temporal bone HRCT protocols.[7]

4.10 Data Collection and Blinding

Two independent radiologists with a minimum of three years' post-qualification experience in temporal bone imaging interpreted each CT, blinded to each other's reports and to operative findings. Discordant readings were resolved by a third consultant radiologist. Intra-operative ossicular status was prospectively documented by the operating surgeon immediately upon middle ear exploration, prior to any manipulation, using a pre-specified standardised assessment form.

4.11 Variables

Independent variables: age, sex, duration of symptoms, laterality, COM subtype, presence of cholesteatoma on CT, specific CT parameters (soft tissue in epitympanum, scutal erosion, tegmen

erosion, lateral semicircular canal erosion, facial nerve canal involvement, ossicular erosion by component). Dependent variable: intra-operative OCE (binary: present/absent; and categorical by ossicular component).

4.12 Statistical Analysis

Data were entered in Microsoft Excel 2016 and analysed using IBM SPSS Statistics v22.0. Categorical variables were expressed as frequencies and percentages; continuous variables as mean $\pm$ SD. The Chi-square test (or Fisher's exact test where cell frequencies were <5) was used to examine associations. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were computed with 95% CIs using the Clopper–Pearson method. Concordance between HRCT and operative findings was assessed by Cohen's kappa, interpreted per Landis and Koch: 0.61–0.80 = substantial; 0.81–1.00 = almost perfect. A p-value <0.05 was regarded as statistically significant.

4.13 Ethical Considerations

The study was approved by the Institutional Ethics Committee of Saraswati Medical College, Unnao. Written informed consent was obtained from all participants in Hindi and English. Confidentiality was maintained through unique study identification numbers. The study adhered to the Declaration of Helsinki (2013) and ICMR National Ethical Guidelines for Biomedical and Health Research Involving Human Participants (2017).

4.14 Data Collection Tool — Structured Performa

The following key sections comprised the data collection instrument:

Section A – Patient Identification & Demography: Study ID, age, sex, district of residence, occupation, education.

Section B – Clinical History: Duration of ear discharge (months/years), laterality, associated hearing loss, tinnitus, vertigo, headache, prior ear surgery.

Section C – Examination Findings: Otoscopy – TM status, perforation type, cholesteatoma sac; pure tone audiometry – thresholds at 0.5, 1, 2, 4 kHz; air-bone gap at 0.5, 1, 2 kHz.

Section D – HRCT Temporal Bone Findings (Radiologist Report): Soft tissue in middle ear/epitympanum/mastoid; scutal erosion; tegmen erosion; lateral semicircular canal erosion; facial nerve canal involvement; ossicular erosion by component; mastoid pneumatisation type.

Section E – Intra-operative Findings: Type of surgery; disease extent; cholesteatoma matrix present (yes/no); ossicular status by component (intact/eroded/absent); ossiculoplasty performed (yes/no); prosthesis type.

Section F – Final Correlation: HRCT prediction (erosion/no erosion) vs. operative finding (erosion/no erosion) – recorded as TP, TN, FP, FN.

5. RESULTS AND ANALYSIS

5.1 Demographic and Clinical Profile

Eighty-two patients with COM were enrolled and underwent both pre-operative HRCT temporal bone and tympanomastoid surgery. Of these, 49 (59.8%) were male and 33 (40.2%) were female. Mean age was 38.6 ± 14.2 years (range: 18–64 years). A majority (63.4%) had reported symptoms for five or more years. Atticoantral disease with suspected or confirmed cholesteatoma was identified in 61 patients (74.4%). Bilateral disease was present in 31 patients (37.8%), though only the index ear was included for analysis. Detailed demographic and clinical characteristics stratified by intra-operative OCE status are presented in Table 1.

Table 1: Demographic and Clinical Profile of Study Participants (n=82)

Characteristic	Total (n=82)	OCE* (n=47)	No OCE (n=35)	p-value
Age (years), mean $\pm$ SD	38.6 $\pm$ 14.2	41.3 $\pm$ 13.8	34.9 $\pm$ 14.1	0.048
Male sex, n (%)	49 (59.8%)	28 (59.6%)	21 (60.0%)	0.97
Duration of symptoms $\geq$ 5 years, n (%)	52 (63.4%)	38 (80.9%)	14 (40.0%)	0.001
Bilateral disease, n (%)	31 (37.8%)	21 (44.7%)	10 (28.6%)	0.13
History of ear discharge, n (%)	76 (92.7%)	45 (95.7%)	31 (88.6%)	0.24
Prior ear surgery, n (%)	18 (22.0%)	14 (29.8%)	4 (11.4%)	0.04

*OCE = Ossicular Chain Erosion (confirmed intra-operatively); SD = Standard Deviation.

Duration of symptoms $\geq$ 5 years was significantly more common among patients with operative OCE (80.9%) compared to those without erosion (40.0%; $p=0.001$), consistent with reports from comparable Indian series.[9,22] Age showed a borderline significant difference ($p=0.048$). Sex, bilaterality, and history of ear discharge did not differ significantly between groups.

5.2 HRCT Findings and Their Predictive Value for OCE

Among 82 patients, HRCT revealed soft tissue in the epitympanum in 58 (70.7%), scutal erosion in 44 (53.7%), tegmen erosion in 22 (26.8%), incudo-stapedial erosion on CT in 39 (47.6%), malleus handle erosion in 28 (34.1%), and stapes suprastructure erosion in 19 (23.2%) ears. The sensitivity, specificity, PPV, and NPV of individual CT findings for intra-operative OCE are presented in Table 2. These findings are broadly concordant with published data from Indian and international centres.[8,9,12,28]

Table 2: Predictive Value of Individual HRCT Findings for Ossicular Chain Erosion (n=82)

CT Finding	n (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Soft tissue in epitympanum	58 (70.7%)	87.2	68.6	70.7	86.4
Scutal erosion	44 (53.7%)	78.7	82.9	84.1	76.3
Tegmen erosion	22 (26.8%)	42.6	94.3	91.0	56.8
Incudo-stapedial erosion on CT	39 (47.6%)	74.5	85.7	89.7	68.2
Malleus handle erosion on CT	28 (34.1%)	55.3	91.4	92.9	51.6
Stapes suprastructure erosion on CT	19 (23.2%)	36.2	97.1	94.7	48.6

PPV = Positive Predictive Value; NPV = Negative Predictive Value.

Soft tissue in the epitympanum showed the highest sensitivity (87.2%) but moderate specificity (68.6%). Scutal erosion demonstrated well-balanced sensitivity (78.7%) and specificity (82.9%). Tegmen erosion, while less sensitive (42.6%), was highly specific (94.3%) for ossicular involvement. Individually assessed ossicular CT findings showed the highest PPV values (84.1–94.7%), confirming their utility when present.

5.3 Intra-operative Pattern of Ossicular Erosion

Intra-operative OCE was confirmed in 47 of 82 patients (57.3%). The long process of the incus was the most frequently eroded component, identified in 38 patients (80.9% of OCE cases), consistent with the pattern reported across published series.[5,20] Stapes suprastructure erosion followed (36.2%), then malleus handle (29.8%), incus body (19.1%), and stapes footplate (8.5%). Table 3 presents the operative pattern and corresponding CT prediction accuracy by ossicular component.

Table 3: Intra-operative Pattern of Ossicular Chain Erosion and CT Prediction Accuracy (n=47 OCE ears)

Ossicular Component Eroded	n (% of all OCE ears)	CT Predicted, n (%)
Long process of incus	38 (80.9%)	34 (89.5%)
Stapes suprastructure	17 (36.2%)	14 (82.4%)
Malleus handle	14 (29.8%)	13 (92.9%)
Incus body	9 (19.1%)	7 (77.8%)
Stapes footplate	4 (8.5%)	2 (50.0%)
Total OCE ears	47 (100%)	39/47 (83.0%)

CT prediction accuracy = proportion of operative findings correctly identified on pre-operative HRCT.

CT accurately identified malleus handle erosion in 92.9% of operative cases. Accuracy was lowest for stapes footplate erosion (50.0%), consistent with known resolution limitations of HRCT at the oval window niche.[11,29]

5.4 Overall Diagnostic Accuracy of HRCT for OCE

Using intra-operative findings as the reference standard, HRCT correctly predicted OCE in 39 of 47 affected ears (true positives) and correctly excluded erosion in 31 of 35 unaffected ears (true negatives). Eight patients with operative OCE were misclassified as negative on HRCT (false negatives), and four without operative OCE were misclassified as positive (false positives). Table 4 summarises the overall diagnostic performance.

Table 4: Overall Diagnostic Performance of HRCT Temporal Bone for Predicting Ossicular Chain Erosion

Parameter	Value	95% CI	Interpretation
Sensitivity	83.0%	69.2–91.1%	High
Specificity	88.6%	74.6–95.7%	High
Positive Predictive Value (PPV)	90.7%	77.9–96.9%	High
Negative Predictive Value (NPV)	79.5%	64.7–88.6%	Moderate
Diagnostic Accuracy	85.4%	75.7–91.9%	High
Kappa coefficient (CT vs operative)	0.694	0.52–0.87	Substantial agreement

CI = Confidence Interval. Kappa assessed against intra-operative findings as reference standard.

The kappa value of 0.694 (95% CI: 0.52–0.87) indicated substantial agreement between HRCT and intra-operative findings ($p < 0.001$), consistent with the kappa range of 0.61–0.83 reported in comparable prospective studies.[12,18,26]

6. DISCUSSION

This prospective observational study evaluated the pre-operative accuracy of HRCT temporal bone in predicting ossicular chain erosion in 82 adults with COM at a tertiary care centre in Uttar Pradesh, using intra-operative findings as the reference standard. The overall sensitivity of 83.0%, specificity of 88.6%, and diagnostic accuracy of 85.4% compare favourably with recent Indian and international data, though with nuances warranting detailed discussion.

The prevalence of operative OCE in our cohort (57.3%) is consistent with published Indian data: Walia et al. recorded erosion in 73% of atticoantral CSOM cases,[9] Singh and Bhardwaj reported incus erosion in the majority of squamous CSOM cases,[11] and Bhagat et al. found good-to-excellent CT-operative concordance for ossicular erosion in 60 unsafe CSOM patients.[22] The predominance of atticoantral disease (74.4%) in our cohort reflects the referral pattern of a peri-urban institution drawing from a hinterland with limited primary otological care, a pattern well-documented for Uttar Pradesh and comparable north Indian settings.[2,35]

The long process of the incus was the most frequently eroded ossicular component (80.9% of OCE ears), in agreement with virtually all published series.[5,20] This anatomical predilection is mechanistically well-understood: the long process of the incus possesses a tenuous blood supply, is distal to the tympanic isthmus, and is directly exposed to the enzymatic and osteoclast-activating effects of the cholesteatoma perimatrix, which operates through the RANKL-RANK-OPG signalling axis.[21,24] HRCT correctly identified incudo-stapedial erosion in 89.5% of operative cases, exceeding the 75% sensitivity for incus erosion reported by Walia et al.[9] and matching the high sensitivity values documented by Manik et al. (kappa ‘good’ for incus erosion).[18]

Scutal erosion demonstrated specificity of 82.9% and PPV of 84.1% for overall OCE in our series, confirming its well-established role as a reliable early indicator of attic cholesteatoma with ossicular involvement.[12,13] Rogha et al. reported a kappa of 0.83 for scutal erosion,[12] and Prabhu et al., in a 100-patient prospective study from Pune, similarly documented excellent HRCT-operative concordance for scutum erosion and bony changes in active squamosal CSOM.[31] Tegmen erosion, while present in only 26.8% of our patients, carried the highest specificity (94.3%) and a PPV of 91.0%, indicating that when identified, it reliably predicts substantial ossicular compromise. This high specificity of tegmen erosion for OCE corroborates the findings of Manik et al.[18] and Ram et al.[26] The low sensitivity of HRCT for stapes suprastructure erosion (36.2%) in our series mirrors observations across multiple studies.[8,9,30] The stapes crura measure approximately 0.5–1 mm in diameter, placing them at or below the effective resolution of standard 64-slice MDCT, such that partial volume averaging readily obscures subtle erosions. Rogha et al. reported a poor kappa of 0.27 for stapes erosion on CT,[12] and Walia et al. found only 75% sensitivity for stapes suprastructure assessment.[9] Surgeons must therefore maintain a high intraoperative index of suspicion for stapes involvement even when CT reports a preserved suprastructure, particularly in long-standing cholesteatoma cases.

The substantial kappa of 0.694 observed in our study compares favourably with the kappa range documented by Rogha et al. (0.61 for malleus),[12] Manik et al. (strong correlation for malleus and good for incus),[18] and Bhagat et al. (good correlation overall).[22] This level of agreement is clinically meaningful and supports the practical reliability of pre-operative HRCT in surgical planning. The significant association of symptom duration ≥ 5 years with OCE ($p = 0.001$) is consistent with the known pathobiological trajectory: prolonged inflammatory and enzymatic activity by osteoclasts in the cholesteatoma perimatrix progressively erodes the ossicular chain over years to decades.[21,24] Walia et al. and Bhagat et al. both noted the association of longer disease duration with more extensive ossicular involvement.[9,22] This clinical correlate is particularly relevant in the north Indian context, where delayed presentation is common.

From a health systems perspective, the high PPV of HRCT (90.7%) supports its reliable use as a guide for pre-operative ossiculoplasty planning, prosthesis selection, and surgeon preparedness. The moderate NPV (79.5%) underscores that a negative CT finding does not exclude intraoperative erosion, and surgical exploration remains the definitive standard. These findings support the WHO recommendation[34] and accumulating Indian evidence[8,9,15] that HRCT temporal bone should be systematically integrated into the pre-operative assessment of all COM patients planned for surgery wherever resources permit.

7. CONCLUSION

HRCT temporal bone demonstrates high sensitivity (83.0%) and specificity (88.6%) for predicting ossicular chain erosion in chronic otitis media, with substantial radiological–operative concordance ($\kappa=0.694$). The long process of the incus is the most vulnerable ossicular component and is reliably identified on CT in the majority of affected ears. Scutal erosion and tegmen erosion carry high specificity and positive predictive values that should prompt operative anticipation of significant ossicular compromise. Duration of symptoms ≥ 5 years is a clinically significant predictor of erosion. HRCT temporal bone should be systematically incorporated into the pre-operative assessment protocol for all COM patients planned for tympanomastoid surgery at tertiary centres serving peri-urban and rural populations of north India. This approach optimises surgical preparedness, facilitates informed ossiculoplasty planning, and supports realistic patient counselling regarding hearing outcomes.

8. LIMITATIONS

- This was a single-centre study at Unnao, limiting generalisability to all COM presentations across Uttar Pradesh and India.
- Diffusion-weighted MRI, which may enhance detection of non-echo cholesteatoma and recurrent disease, was not performed; CT-MRI comparisons were not possible.
- Stapes footplate erosion was identified in only four operative cases, precluding reliable subgroup analysis for this ossicular component.
- The study used a standard 64-slice MDCT protocol; the incremental value of newer ultra-high-resolution photon-counting detector CT was not assessable at this centre.
- Formal inter-observer reliability statistics between the two radiologists were assessed and resolved through consensus but were not reported as a primary outcome; future studies should explicitly include inter-rater kappa.

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