

Comparing Findings of Preoperative Computerized Tomography of the Petromastoid Region with Intraoperative Finding in Cases with Chronic Suppurative Otitis Media (CSOM)

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ABSTRACT

Objective: To compare the preoperative computerized tomography of petromastoid region with intraoperative finding in cases with chronic suppurative otitis media (CSOM).

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Department of Otorhinolaryngology, Combined Military Hospital Gujranwala, Pakistan, from Jul to Dec 2024.

Results: High-Resolution Computed Tomography (HRCT) findings were compared with intraoperative results in 70 patients. Ossicular erosion was detected in 37 cases by HRCT, with 33 confirmed (sensitivity 64.7%, specificity 78.9%, $p=0.001$). Bone erosion was noted in 40 cases, with 28 true positives (sensitivity 84.8%, specificity 67.6%). Tegmen erosion had 100% sensitivity but 0% specificity. Detection accuracy for scutum, facial canal, and sinus plate erosion varied (sensitivity 44%–50%, specificity 42.9%–100%).

Conclusion: Retraction pockets seen on otoscopy are the most common sign of potentially dangerous CSOM (primary acquired cholesteatoma). HRCT has enhanced the preoperative detection of advanced disease and complications. However, it remains imperfect, with both false-positive and false-negative findings limiting its reliability.

Keywords: Cholesteatoma, Chronic Otitis Media, Mastoidectomy, Tomography, Temporal Bone, X-Ray Computed.

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INTRODUCTION

The most prevalent reason for tympanic membrane perforation is an infection in the middle ear. Traumatic causes include the passage of foreign bodies via the external auditory canal or the insertion of an iatrogenic tube after a tympanostomy.¹ Its importance stems from its correlation with high morbidity and occasionally death. Modern imaging methods including magnetic resonance imaging (MRI) and computed tomography (CT) can help enhance the clinical diagnosis by indicating the presence of cholesteatoma within the temporal bone.² With advances in antibiotics, microsurgical tools, and better imaging techniques, the treatment of atticotympanic chronic suppurative otitis media, with or without cholesteatoma, has become more manageable. Treating atticotympanic CSOM is still difficult even with these advances and calls careful attention to numerous elements.³

Advanced imaging, especially high-resolution computed tomography (HRCT) and MRI, enhances diagnostic accuracy by identifying complications such

as cholesteatoma within the temporal bone. Cholesteatomas, which may be congenital or acquired, frequently involve the attic and posterior mesotympanum but can affect any part of the temporal bone. In attic cholesteatoma, scutum erosion is an early sign, best visualized on coronal HRCT.⁴

Bony erosion commonly involves the long process and body of the incus, and the head of the malleus. In pars tensa cholesteatoma, the disease may extend to the stapes. An enlarged aditus ad antrum often indicates attic cholesteatoma.⁵ HRCT of the temporal bone is commonly used to diagnose and determine the extent of the disease. It helps the surgeon understand the severity and associated conditions. It is better than plain CT and can visualize areas that cannot be seen with an endoscope.⁶

This study was conducted to evaluate the clinical presentation and to find the correlation between pre-operative HRCT findings and intra-operative findings in patients with chronic suppurative otitis media.

METHODOLOGY

This comparative cross-sectional study was conducted at the Department of Otorhinolaryngology, Combined Military Hospital Gujranwala, Pakistan, from Jul to Dec 2024, after approval from the Hospital

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Ethical Review Committee (vide ERB No 4-2025) and was conducted in accordance with the ethical standards set forth in the Declaration of Helsinki.

Inclusion Criteria: Patients of either gender, belonging to any age group, who were undergoing surgery for chronic suppurative otitis media (CSOM), with clinical and otoscopic evidence of CSOM were included.

Exclusion Criteria: Patients with severe ischemic heart disease (IHD), lung diseases or renal disorders, those unable to comply with study procedures e.g., inability to undergo HRCT scans, those with previous ear surgeries that would influence the current study's findings were excluded.

Sample size was calculated using the WHO calculator, taking a previous prevalence of 4.78% of cholesteatoma, which came out to be 70 patients.⁷⁻⁹

Each case was assessed for following parameters- age, sex, socioeconomic strata, laterality of ear complaints, nature of ear discharge (profuse, scanty, foul smelling, blood stained), presence or absence of symptoms showing complications (otalgia, vertigo, headache, vomiting, post-aural swelling, facial weakness), otoscopic examination, hearing assessment by pure tone audiometry. Standard temporal bone CT involving 1.5 mm sequential cuts in both the axial and coronal projections was done. The axial images ranged from the arcuate eminence to the jugular fossa, while the coronal images spanned from the bony eustachian tube to the posterior semicircular canal. Noted parameters included presence or absence of bone erosion and ossicular erosion.

The gold standard in this study is the intra-operative surgical findings using the parameters of presence of cholesteatoma, scutum erosion, tegmen erosion, facial canal erosion, sinus plate erosion and mastoid sclerosis. All patients underwent mastoid exploration. The type of surgery was determined based on the intra operative findings. All patients were followed up regularly in otolaryngology outpatient clinic after four weeks and then every two months regularly for one year post operation.

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 25. The study variables included demographic factors (age, sex), clinical parameters (ear discharge, otoscopic findings, symptoms), and HRCT findings (ossicular erosion, bone erosion, anatomical landmarks). The association between preoperative HRCT findings and

intraoperative results was analyzed using Chi-square tests for categorical variables, and sensitivity, specificity, and accuracy were calculated. A p -value of ≤ 0.05 was considered statistically significant.

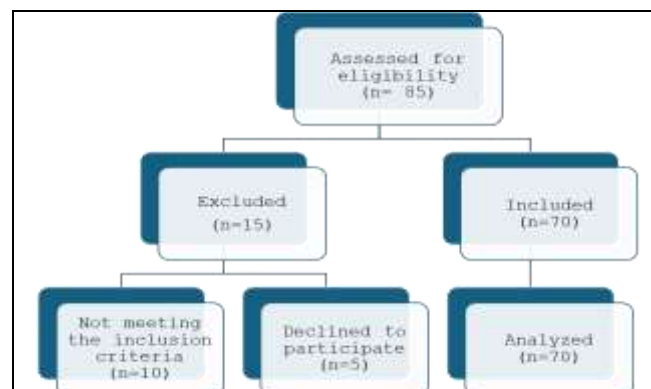


Figure-1: Flow Diagram of Patient Recruitment (n= 70)

RESULTS

The mean age of the patients was 32.6 ± 12.8 years, with the age range spanning from 1 to 50 years. A total of 70 patients with chronic suppurative otitis media (CSOM) were included in the study. Fifty-two (74.3%) were male and 18 (25.7%) were female.

The most common clinical finding was foul-smelling ear discharge, present in 58 patients (82.9%), while facial weakness was the least common symptom, occurring in 5 patients (7.1%). Audiometry findings indicated mild hearing loss in 46 patients (65.7%), while severe hearing loss was observed in 12 patients (17.1%).

When comparing the HRCT findings with the intraoperative results, ossicular erosion was detected in 37 cases (52.9%), of which 33 were confirmed during surgery, showing a strong positive correlation (sensitivity 64.7%, specificity 78.9%), as seen in Table-I. Bone erosion was detected in 40 cases (57.1%), with 28 true positives and 12 false positives. The sensitivity of HRCT for bone erosion was 84.8%, with a specificity of 67.6% (Table-II).

Table-I: Comparison of Ossicular Erosion Detection by HRCT and Intraoperative Findings in Patients with Chronic Suppurative Otitis Media (n=70)

	Ossicular Erosion (HRCT) (n=51) n(%)	Ossicular Erosion During Surgery (Operation) n= 48 n(%)	p-value
Yes	37(52.9%)	33 (47.1%)	0.001
No	18(25.7%)	15 (21.4%)	
Total	51(72.9%)	48 (68.6%)	

*HRCT (High-resolution computed tomography)

Table-II: Comparison of Bone Erosion Detection by HRCT and Intraoperative Findings in Patients with Chronic Suppurative Otitis Media (n=70)

Bone Erosion (HRCT)	Bone Erosion Intraoperative (Operation)		Total	p-value
	Yes n(%)	Non(%)		
Yes HRCT	28(40%)	12(17.1%)	40(57.1%)	<0.001*
No HRCT	5(7.1%)	25(35.7%)	30(42.8%)	
Total	33(47.1%)	37(52.9%)	70(100.0%)	

*HRCT (High-Resolution Computed Tomography)

The association between HRCT findings and surgical outcomes was statistically significant for ossicular and bone erosion ($p=0.001$). However, tegmen erosion showed 100% sensitivity, but 0% specificity, indicating overestimation by HRCT. Further, scutum erosion had a sensitivity of 44%, while facial canal and sinus plate erosion showed moderate sensitivity (50%) with higher specificity ranging from 66.7% to 100% (Table-III).

18 cases subsequently verified during surgery. While the specificity was 78.9%, demonstrating a modest capacity to rule out erosion when absent, the computed sensitivity of HRCT in identifying ossicular erosion was 64.7%, implying it properly identified almost two-thirds of the actual cases. Reinforcing its function as a valuable but not definitive diagnostic tool, the statistically significant chi-square test result ($p=0.001$) confirms the relationship between HRCT findings and surgical outcomes.^{10,11}

Bone erosion, a significant issue in chronic suppurative otitis media (CSOM), was detected by high-resolution computed tomography (HRCT) in 40 instances, with 28 cases confirmed during surgery. Nevertheless, 12 cases were identified as false positives, in which HRCT exaggerated the detection of erosion.¹² Furthermore, of the 30 instances in which HRCT failed to identify bone deterioration, five were false negatives. The sensitivity of HRCT in identifying

Table-III: Comparison of HRCT and Surgical Findings in Bony Anatomical Landmarks involved (n=70)

Bony Anatomical Landmarks Involved	HRCT n(%)	Surgery n(%)	Cases in Agreement (True Positive) n(%)	True Negative n(%)	False Positive n(%)	False Negative n(%)	Sensitivity (%)	Specificity (%)	Accuracy (%)
Evidence of Cholesteatoma	12(17.1%)	5(7.1%)	0 (0%)	4(5.7%)	5(7.1%)	0 (0%)	0.0%	0.0%	0.0%
Scutum Erosion	19(27.1%)	11(15.7%)	4(5.7%)	4(5.7%)	5(7.1%)	3(4.3%)	44.4%	42.9%	42.9%
Tegmen Erosion	11(15.7%)	16(22.9%)	0(0%)	2(2.9%)	0(0%)	0(0%)	100.0%	0.0%	18.2%
Facial Canal Erosion	8(11.4%)	15(21.4%)	1(1.4%)	2(2.9%)	1(1.4%)	1(1.4%)	50.0%	66.7%	62.5%
Sinus Plate Erosion	10(14.3%)	16(22.9%)	2(2.9%)	0(0%)	0(0%)	2(2.9%)	50.0%	100.0%	71.4%
Mastoid Sclerosis	10(14.3%)	7(10.0%)	0(0%)	0(0%)	3(4.3%)	0(0%)	0.0%	100.0%	70.0%

*HRCT (High-Resolution Computed Tomography)

DISCUSSION

The results of this study emphasize the advantages and constraints of preoperative High-Resolution Computed Tomography (HRCT) in forecasting surgical results in patients with chronic suppurative otitis media (CSOM). The accuracy of HRCT in identifying ossicular erosion, bone erosion, and bony anatomical involvement was evaluated by means of surgical observations in tandem with HRCT findings. Although HRCT has turned out to be a useful diagnostic tool, the existence of false positives and false negatives implies that it should not be dependent upon just for surgical planning.

Because ossicular erosion can cause appreciable conductive hearing loss, it is a major issue in CSOM. Out of the 37 instances HRCT found ossicular erosion in, 33 were confirmed intraoperatively, indicating a clear relationship between radiological and surgical results. Four cases, meantime, were false positive, that is, HRCT revealed erosion absent during operation. Furthermore, demonstrating a significant percentage of false negatives, HRCT missed ossicular erosion in

bone erosion was notably high at 84.8%, demonstrating its efficacy in recognizing the majority of instances with erosion. Nonetheless, its specificity was diminished at 67.6%, indicating that it occasionally erroneously indicated erosion in the absence of such a condition. These data indicate that although HRCT is typically dependable for identifying bone degradation, its propensity to overestimate necessitates cautious interpretation.¹³

The diagnostic accuracy of HRCT was shown to vary when examining particular bone anatomical features. All cases with genuine erosion were successfully identified since the detection of tegmen erosion displayed 100% sensitivity. On the other hand, it had zero specificity, which means it often gave false positive results since it overstated its presence. The reliability of scutum erosion detection was lower; the diagnostic performance was erratic, with a sensitivity and specificity of roughly 44%. With a moderate sensitivity of 50% and a higher specificity of 66.7%-100%, HRCT was better at ruling out than confirming erosions of the sinus plates and facial canals. These results show that HRCT is useful for

assessing skeletal structures, but that the predictive power of the scan differs across different body parts.¹⁴

This study's strengths reside in its systematic comparison of HRCT and intraoperative data, offering a comprehensive assessment of HRCT's diagnostic efficacy in CSOM. The results align with prior research, which has similarly indicated moderate to high sensitivity but inconsistent specificity of HRCT in identifying bone erosions. The inconsistencies between HRCT findings and intraoperative observations highlight the necessity for a multi-modal strategy in surgical decision-making, integrating clinical examination, audiometric evaluation, and intraoperative confirmation.¹⁵

Additionally, the role of HRCT in assessing disease extent in patients with CSOM highlights its value in detecting subtle anatomical variations that may influence surgical outcomes.^{16,17} The correlation of HRCT with intraoperative findings provides useful preoperative insights, enabling better preparation for cases requiring mastoidectomy or ossicular chain reconstruction.¹⁸ Given its accessibility and cost-effectiveness, HRCT remains a preferred imaging modality, despite its limitations.¹⁹ Further advancements, such as cone-beam computed tomography (CBCT), may enhance spatial resolution and diagnostic performance, providing a promising alternative for future studies.

Moreover, new technologies including artificial intelligence (AI)-assisted imaging have showed promise in enhancing diagnosis accuracy and lowering false positives and negatives. Reported to improve diagnosis accuracy, particularly in distinguishing cholesteatoma from inflammatory alterations, is AI-enhanced HRCT interpretation.^{20,21}

A further crucial factor is how HRCT results affect surgical planning clinically. When HRCT correctly detects ossicular or bone erosion, surgeons can forward suitable restorative operations and expect possible consequences. False positives, however, could cause cautious surgical interventions while false negatives could cause underestimating of illness severity. Thus, combining HRCT with intraoperative results guarantees more exact decision-making and better patient outcomes.¹⁷

Finally, HRCT is still a great instrument for preoperative evaluation in CSOM since it provides important information about ossicular and bone erosion. Its poor specificity, however, emphasizes the need to closely coordinate with intraoperative results.

Surgeons should be aware of the possibility for false positives and negatives and use HRCT results in combination with clinical judgement to maximize surgical planning and patient outcomes: Emerging technologies like artificial intelligence-assisted image processing have showed promise in raising diagnosis accuracy and might eventually help to hone HRCT interpretation. Improving imaging techniques and investigating multimodal ways to increase the dependability of HRCT in CSOM diagnosis and management should be the main priorities of next studies.

LIMITATIONS OF STUDY

There are certain drawbacks to this study, despite its positives. Although the sample size is sufficient, it might not be big enough to draw any firm conclusions about the population as a whole. Also, the results could be skewed because different observers have different ways of interpreting HRCT images.

CONCLUSION

Retraction pockets identified through otoscopy represent the most common clinical manifestation of a potentially hazardous chronic suppurative otitis media (CSOM), also referred to as primary acquired cholesteatoma. The advancement of HRCT has significantly improved the detection of severe CSOM and its associated complications prior to surgical intervention. Nonetheless, HRCT is not entirely dependable, as it continues to yield both false positive and false negative outcomes.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

S & ZAS: Conception, study design, drafting the manuscript, approval of the final version to be published.

HM & NJ: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

AK & YR: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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