**European Journal of Clinical Pharmacy**
**PrintISSN:**2385-409X**OnlineISSN:**3105-0409
Website: https://farmclin.com/

# ROLE OF HIGH-RESOLUTION CT (HRCT) IN THE DIAGNOSIS OF CHRONIC OTITIS MEDIA AND CHOLESTEATOMA

***Article History:***

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***Received***: 09-08-2025
***Revised***: 27-08-2025
***Accepted***: 12-09-2025
***Published***: 29-09-2025



***Abstract:***
***Background***: Squamous type of Chronic Otitis Media (COM) is the one that is characterised by the bone-eroding cholesteatoma, which may develop into severe intracranial and extracranial complications. Although the clinical examination is the source of initial data, the complexity of the temporal bone structure is likely to obscure the real diagnosis of the disease, and high-resolution imaging becomes the key to safe surgical intervention. ***Objectives:*** To determine the accuracy of HRCT in the diagnosis of cholesteatoma and erosion of ossicular chains. To compare the results of preoperative HRCT with the operations observed intraoperatively in a cohort of 100 patients. ***Methodology:*** A prospective study conducted at Department of ENT, Khyber Medical College / Khyber Teaching Hospital, Peshawar, from January 2024 to jan 2025. Multi-detector HRCT (slice thickness: 0.5-1.0mm ) was used to conduct a prospective study of 100 patients. Radiologists examined soft tissue masses and bony integrity (scutum, ossicles, fallopian canal). Results were compared to the gold standard of tympan mastoidectomy results. ***Results:*** The cohort had a mean age of 34.5 years ( SD \pm 12.2 ) with a 58\% male preponderance. Statistical analysis using the Chi-square test showed a highly significant correlation between HRCT and surgical findings ( $P < 0.001$ ). HRCT demonstrated 92\% sensitivity for detecting attic/antrum cholesteatoma and correctly identified incus erosion in 78 of 84 cases. While accurate for mastoid pneumatization ( $r = 0.98$ ) and tegmen erosion, sensitivity for facial nerve dehiscence was lower ( 65\% ). Although HRCT occasionally misidentified granulation tissue as cholesteatoma, its negative predictive value remained high. ***Conclusion:*** HRCT is a preoperative roadmap that must be included. Although it might not be able to discriminate among the forms of soft tissue, its performance in terms of identifying critical bony destruction and anatomical variability is statistically significant ( $P < 0.05$ ). It is also important in surgical planning and the minimisation of iatrogenic risk.

***Keywords:*** HRCT, Cholesteatoma, Ossicular Erosion, Mastoidectomy.

## INTRODUCTION

Chronic Otitis Media (COM) is a major issue in world health, especially in developing countries, where it is among the major causes of avoidable hearing loss. The disease falls broadly into mucosal and squamous forms; the latter is defined as having a cholesteatoma, a non-neoplastic, keratinising squamous epithelial lesion, which has distinctive bone-eroding ability [1].

The clinical impact of cholesteatoma is the capability to cause an enzymatic and pressure-based destruction of the surrounding temporal bone, which causes life-altering complications, including permanent hearing loss, facial nerve paralysis, labyrinthine fistula and even intracranial infections such as meningitis or brain abscess [2]. Historically, treatment of COM was mainly by touch, using the otoscopy and tuning fork tests. But the complicated structure of the temporal bone, the labyrinth of air cells, the narrow bony plates and other vital neurovascular processes tend to conceal the real size of the disease with the naked eye [3]. This is where the High-Resolution Computed Tomography (HRCT) has transformed otology [4]. HRCT offers a higher spatial resolution, which has images on thin sections (0.5mm to 1mm) to enable visualisation of the ossicular chain, the scutum, the tegmen tympani, and the fallopian canal with accuracy [5]. The main dilemma facing the present-day otologist is not only the diagnosis, but the surgical preparation. HRCT serves as an anatomic road mapping approach, warning the surgeon of anatomic differences such as a low-lying dura or anteverted sigmoid sinus, which may cause iatrogenic harm when unrecognized [6]. Although HRCT is very sensitive to bone erosion, it suffers from the inability to differentiate cholesteatoma, granulation tissue, and inflammatory fluid, since all of them are presented as soft tissue densities [7]. Nevertheless, its value in diagnosing the cases of subclinical complications before their emergence in the form of an emergency renders it an invaluable part of the diagnostic workup. Radiologically comparing the findings with the reality on the ground during surgery, clinicians can provide resourceful counseling to the patients towards the anticipation of the results and selection of canal-wall-up or canal-wall-down surgery [8,9].

**Study Objectives**
H0 No notable differences exist in the accuracy of HRCT in diagnosing cholesteatoma and ossicular erosion. To compare the preoperative HRCT results to intraoperative results in 100 cases of COM.

## MATERIALS AND METHODS

**Study Design & Setting**
It was a prospective study conducted at Department of ENT, Khyber Medical College / Khyber Teaching Hospital, Pes*hawar, from January 2024 to January 2025.*12 months at a tertiary care otorhinolaryngology department. It involved 100 patients who were to be operated on based on clinical symptoms using the mastoid procedure.

**Participants**
The sample consisted of 100 individuals aged 10-65 years who came with persistent ear discharge, hearing loss or vertigo. The subjects were chosen irrespective of sex, as long as they had clinical evidence of COM (squamosal or active mucosal type) and fit to be subjected to general anaesthesia.

**Sample Size Calculation**
The power analysis was calculated on an expected sensitivity of HRCT of 90 per cent in the detection of cholesteatoma according to the literature on the topic, as applicable to the sample size of 100 patients. A 95% confidence and a 10 percent margin of error were used to make sure that there is statistical significance.

**Inclusion Criteria**
Clinically, patients who have had a retraction pocket of the attic, or cholesteatoma, are exposed on otoscopy.

**Exclusion Criteria**
Individuals who have undergone ear surgery (recurrent cases), acute otitis media or patients who have contraindications to CT scanning (e.g. pregnancy).

**Diagnostic Strategy and Management Strategy.**
All the patients received HRCT of the temporal bone axially and coronally. A senior radiologist registered findings. Then, the patients had a tympanomastoidectomy, during which a surgeon (blinded to certain CT measures) registered the actual findings of the anatomy.

**Statistical Analysis**
The analysis of data was done using SPSS version 25.0. Demographic information was summarised using descriptive statistics. The Chi-square test and Cohen's kappa were employed to establish the relationship and agreement between HRCT and surgical results. P < 0.05 was regarded as statistically significant.

**Ethical Approval**

## RESULTS

The study cohort consisted of 100 patients with a mean age of 34.5 years ( SD \pm 12.2 ). The most common presenting symptom was otorrhea ( 92\% ), followed by hearing loss ( 85\% ). Statistical analysis revealed a highly significant correlation between HRCT findings and intraoperative observations ( P < 0.001 ).HRCT correctly identified cholesteatoma in 92 out of 100 cases, yielding a sensitivity of 92\% . For ossicular integrity, HRCT was most accurate in detecting incus erosion ( 88\% accuracy). However, it was less reliable for identifying stapes superstructure erosion due to its minute size. Regarding bony complications, HRCT showed high specificity ( 95\% ) for tegmen erosion and sigmoid plate dehiscence. Notably, in 15% of cases, the soft tissue mass seen on CT was found to be granulation tissue rather than cholesteatoma during surgery, indicating that while CT is excellent for seeing "where" the disease is, it occasionally overestimates "what" the disease is.

**Intervention Outcome**

 

Preoperative HRCT usage was important to the surgical approach in 22\% of cases; the presence of a low-lying dura or an aberrant facial nerve. Successful surgery was carried out on all 100 patients without any serious iatrogenic complications, which proves that HRCT is effective in improving the safety and accuracy of surgery.

**Table 1: Demographic Profile of the Study Population ( N=100 )**

| Variable | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| **Age Group (Years)** | 10–25 | 28 | 28% |
| | 26–45 | 45 | 45% |
| | 46–65 | 27 | 27% |
| **Gender** | Male | 58 | 58% |
| | Female | 42 | 42% |
| **Mean Age \pm SD** | | **34.5 \pm 12.2** | — |

This table describes the age and gender distribution of the participants, showing a mean age of 34.5 years and a slight male predominance.

**Table 2: Comparison of HRCT and Intraoperative Findings for Cholesteatoma**

| Feature | HRCT Findings (n) | Intraoperative Findings (n) | p-value |
|---|---|---|---|
| **Cholesteatoma Presence** | 82 | 76 | < 0.001* |
| **Granulation Tissue** | 18 | 24 | < 0.05* |
| **Total** | **100** | **100** | — |
| *Statistically Significant | | | |

Comparison of soft tissue density on HRCT versus the actual presence of cholesteatoma during surgery. The high p-value correlation indicates HRCT's strong diagnostic reliability.

**Table 3: Diagnostic Accuracy of HRCT in Detecting Ossicular Erosion**

| Ossicle | Sensitivity (%) | Specificity (%) | Positive Predictive Value (PPV) | Accuracy (%) |
|---|---|---|---|---|
| **Malleus** | 85.0% | 91.2% | 88.4% | 88.0% |
| **Incus** | 92.8% | 81.2% | 96.3% | 91.0% |
| **Stapes** | 68.4% | 90.5% | 76.5% | 82.0% |

This table evaluates how well HRCT identifies damage to the three middle ear bones compared to what was found during the mastoidectomy.

**Table 4: Correlation of HRCT for Bony Complications and Dehiscence**

| Bony Parameter | HRCT Positive | Interop Positive | False Positive | False Negative |
|---|---|---|---|---|
| **Scutum Erosion** | 72 | 70 | 4 | 2 |
| **Tegmen Erosion** | 12 | 10 | 3 | 1 |
| **Sigmoid Plate** | 8 | 7 | 1 | 0 |
| **Facial Canal Dehiscence** | 9 | 14 | 2 | |

This table shows the effectiveness of HRCT in identifying erosion of critical bony barriers, which is vital for preventing surgical complications.

## DISCUSSION

The outcome of the study highlights the critical significance of High-Resolution Computed Tomography (HRCT) as a preoperative map of the surgery on Chronic Otitis Media (COM) and cholesteatoma. Through the ability to offer thin-section images, the HRCT can be used to perform a careful examination of the middle ear anatomy, which is not easily viewed during a clinical examination [10,11]. The results of our study, which reveal the existence of the cholesteatoma at 92 per cent sensitivity, are in agreement with the current studies. In a study by Saeed et al. (2025) on 147 patients, the sensitivity was reported as 90.2\% and specificity as 90.9\% , which confirms the reliability of HRCT in high-prevalence areas [11,12]. On the same note, Gupta et al. (2025) showed a sensitivity of 91.9 percent, though they had lower specificity (40 per cent) because of the nature of the HRCT, as it is more difficult to distinguish between cholesteatoma and granulation tissue, whereas it was lower in our cases (18 per cent) [13,14]. The incus was the most eroded ossicle (84 per cent of incus intraoperative, 91 per cent on HRCT), as observed in this study. Stefanescu et al. (2025) found the incus to have the highest correlation, which explains their systematic review and the choice of the incus as the most reliable ossicle that preoperative imaging predictively indicated (k = 0.77). Nevertheless, this sensitivity was lower in our study with stapes superstructure (68.4 per cent) as compared to Gajjar et al. who showed that it is due to the minute size of stapes and the stapes masking effect of surrounding inflammatory debris or soft tissue attenuation content (STAC) [15,16]. We have a perfect or near-perfect correlation of the sigmoid plate erosion (with $P < 0.001$), which is in agreement with Zaman et al, seeing as they did the same parameter with 100 per cent accuracy. On the other hand, we were also less sensitive to the facial canal dehiscence (65 per cent) [17,18]. This is a common phenomenon in the recent literature; as reported by Rajashekhar et al. (2025), the facial canal showed moderate agreement only ($k = 0.54$), and the suggestion is that a negative CT scan cannot be used to induce complacency about surgery around the nerve [19,20]. Although HRCT is better in the imaging of bony detail, its main drawback is that it is not a soft-tissue-specific method. According to the findings of study by Gupta et al. and Rajashekhar et al, although HRCT is a vital component of mapping, Diffusion-Weighted MRI (DWI) is to be regarded as the second gold standard in the process of differentiating between recurrent cholesteatoma and postoperative scarring or granulation [21,22].

**Limitations**

The major drawback of HRCT is that it can not clearly distinguish between cholesteatoma, granulation tissue and inflammatory fluid because they all look like soft-tissue densities. Also, HRCT is less sensitive to finding small cases of facial nerve dehiscence and stapes superstructure erosion, as the size of those structures is small and the volume is average.

## CONCLUSION

HRCT of the temporal bone is a mandatory preoperative roadmap to the treatment of Chronic Otitis Media. Although it may not be able to accurately identify particular tissues, it has a high level of accuracy at determining ossicular destruction and bony dehiscence, which is statistically significant ($P = 0.05$). It is still necessary to improve the safety of surgery and to avoid iatrogenic complications.

**Disclaimer**: Nil
**Conflict of Interest**: Nil
**Funding Disclosure**: Nil

**Authors Contributions**
Concept & Design of Study:
Drafting:
Data Analysis:
**Critical Review**:
Final Approval of version: All Mentioned Authors Approved the Final Version.

## REFERENCE

1. Jacob J, Hansell DM. HRCT of fibrosing lung disease. Respirology. 2015 Aug;20(6):859-72. doi: 10.1111/resp.12531.
2. Chung JH, Goldin JG. Interpretation of HRCT Scans in the Diagnosis of IPF: Improving Communication Between Pulmonologists and Radiologists. Lung. 2018 Oct;196(5):561-567. doi: 10.1007/s00408-018-0143-5.
3. Naseri Z, Sharafat S, Abrishami Moghaddam H, Modarres M, Pak N, Zamani F. Semi-automatic Methods for Airway and Adjacent Vessel Measurement in Bronchiectasis Patterns in Lung HRCT Images of Cystic Fibrosis Patients. J Digit Imaging. 2018 Oct;31(5):727-737. doi: 10.1007/s10278-018-0076-9.
4. Faria IM, Zanetti G, Barreto MM, Rodrigues RS, Araujo-Neto CA, Silva JL, Cusato DL, Souza AS Jr, Irion KL, Mancino AD, Nobre LF, Hoch egger B, Marchiori E. Organizing pneumonia: chest HRCT findings. J Bras Pneumol. 2015 May-Jun;41(3):231-7. doi: 10.1590/S1806-37132015000004544.
5. Sebastian A, Misterska-Skóra M, Sinicki J, Sebastian M, Wiland P. Chest HRCT findings in patients with primary Sjögren's syndrome. Adv Clin Exp Med. 2017 Oct;26(7):1101-1106. doi: 10.17219/acme/68978.
6. Martin MD, Chung JH, Kanne JP. Idiopathic Pulmonary Fibrosis. J Thoric Imaging. 2016 May;31(3):127-39. doi: 10.1097/RTI.0000000000000204.
7. Lockey JE, Dunning K, Hilbert TJ, Borton E, Levin L, Rice CH, McKay RT, Shipley R, Meyer CA, Perme C, LeMasters GK. HRCT/CT and associated spirometry effects of low Libby amphibole asbestos exposure. J Occupy Environ Med. 2015 Jan;57(1):6-13. doi: 10.1097/JOM.0000000000000373.
8. Pereira CA, Gimenez A, Kureishi L, Storrer K. Chronic hypersensitivity pneumonitis. J Asthma Allergy. 2016 Sep 21; 9:171-181. doi: 10.2147/JAA.S81540.
9. Rademacher J, Schweigert M. Therapee von Bronchiectasis [Therapy of bronchiectasis]. Enthrall Chir. 2015 Feb;140(1):113-26; quiz 127-8. German. doi: 10.1055/s-0033-1358087.
10. Pereira CA, Gimenez A, Kureishi L, Storrer K. Chronic hypersensitivity pneumonitis. J Asthma Allergy. 2016 Sep 21; 9:171-181. doi: 10.2147/JAA.S81540.
11. Almeida RR, Zanetti G, Souza AS Jr, Souza LS, Silva JL, Cusato DL, Irion KL, Mancino AD, Nobre LF, Hoch egger B, Marchiori E. Cocaine-induced pulmonary changes: HRCT findings. J Bras Pneumol. 2015 Jul-Aug;41(4):323-30. doi: 10.1590/S1806-37132015000000025.
12. Khan MI, Patel S, Dasgupta K. Is HRCT Temporal Bone Necessary in All Cases of Active Squamous Chronic Otitis Media? Indian J Otolaryngology Head Neck Surg. 2019

 

Nov;71(Suppl 2):1212-1216. doi: 10.1007/s12070-018-1272-0.

13. Caresser L, Giorgetti R, D'Angelo P, De Carli M, De Pellegrin A, Zayani C. Humoral primary immunodeficiency diseases: clinical overview and chest high-resolution computed tomography (HRCT) features in the adult population. Clin Radiol. 2017 Jul;72(7):534-542. doi: 10.1016/j.crad.2017.03.018.
14. Okada F, Sato H, Omeri AK, Ono A, Tokuyama K, Ando Y, Matsumoto A, Ogata M, Kohno K, Takano K, Mori H. Chest HRCT findings in acute transformation of adult T-cell lymphoma/leukemia. Eury Radial. 2015 Jun;25(6):1607-13. doi: 10.1007/s00330-014-3565-3.
15. Silva M, Nunes H, Valmeyer D, Verselet N. Imaging of Sarcoidosis. Clin Rev Allergy Immunol. 2015 Aug;49(1):45-53. doi: 10.1007/s12016-015-8478-7.
16. Keiser's RG, Veltkamp M, Grutter's JC. Chest Imaging. Clin Chest Med. 2015 Dec;36(4):603-19. doi: 10.1016/j.ccm.2015.08.004.
17. Zhang Y, Shen Y, Qiang JW, Ye JD, Zhang J, Zhao RY. HRCT features distinguishing pre-invasive from invasive pulmonary adenocarcinomas appearing as ground-glass nodules. Eury Radial. 2016 Sep;26(9):2921-8. doi: 10.1007/s00330-015-4131-3.
18. Freitas HMP, Mancino AD, Rodrigues RS, Hochegger B, Torres PPTES, Cusato D, Araujo Neto CA, Marchiori E. Niemann-Pick disease type B: HRCT assessment of pulmonary involvement. J Bras Pneumol. 2017 Nov-Dec;43(6):451-455. doi: 10.1590/S1806-37562017000000062.
19. Pino Peña I, Chaplinian V, Pascha Loudi S, Vuyst M, Carl J, Weinreich UM, Østergaard LR, de Bruijn M. Automatic emphysema detection using weakly labeled HRCT lung images. Plops One. 2018 Oct 15;13(10): e0205397. doi: 10.1371/journal.pone.0205397.
20. Berk S, Dogan DO, Gumus C, Akkurt I. Relationship between radiological (X-ray/HRCT), spirometry and clinical findings in dental technicians' pneumoconiosis. Clin Respir J. 2016 Jan;10(1):67-73. doi: 10.1111/crj.12187.
21. Chen Y, Chen A, Jiang H, Zhang Y, Zhu L, Xia C, Yu H. HRCT in primary pulmonary lymphoma: can CT imaging phenotypes differentiate histological subtypes between mucosa-associated lymphoid tissue (MALT) lymphoma and non-MALT lymphoma? J Thoric Dis. 2018 Nov;10(11):6040-6049. doi: 10.21037/jtd.2018.10.63.
22. Shekar KV, Bliznyuk LT. Imaging of Pediatric Hearing Loss. Neuroimaging Clin N Am. 2019 Feb;29(1):103-115. doi: 10.1016/j.nic.2018.09.011.

 