*https://doi.org/ 10.33472/AFJBS.6.Si2.2024.493-499*


# Assessing Temporal Bone Pathologies using High-Resolution Computed Tomography

**Dr. Lakshmi Bharat,**
Junior Resident , Department of Radiodiagnosis,
Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth Deemed To Be University, Karad. Email : akkaa384@gmail.com
**Dr. ASIF TAMBOLI**
Assistant Professor Department of Radiodiagnosis,
Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth Deemed To Be University, Karad.Email : drtamboliasif@gmail.com
**Dr. SIMRAN RAJPAL** Resident , Department of Radiodiagnosis, Krishna Institute of Medical Sciences,
Krishna Vishwa Vidyapeeth Deemed To Be University, Karad.

Article History

Volume 6,Issue Si2, 2024

Received:09 Mar 2024

Accepted : 07 Apr 2024

42doi: 10.33472/AFJBS.6.Si2.2024.493-499

**Abstract:**
Background: Temporal bone pathologies encompass a diverse spectrum of disorders ranging from infections and tumors to congenital anomalies and traumatic injuries. High-resolution computed tomography (HRCT) has emerged as a cornerstone in the evaluation of temporal bone disorders due to its ability to provide detailed anatomical information with excellent spatial resolution.
Objective: This study aimed to assess the utility of HRCT in the evaluation of temporal bone pathologies, including middle ear infections, tumors, congenital anomalies, and traumatic injuries.
Methods: An observational study was conducted over an 18-month period at a tertiary care center's Department of Radiodiagnosis. A total of 80 patients with suspected temporal bone pathologies underwent HRCT imaging. Data on demographic characteristics, clinical features, and radiological findings were collected and analyzed.
Results: Infections were the most prevalent temporal bone pathology encountered, with cholesteatoma and mastoiditis being the most common entities. Tumors, though less frequent, posed significant diagnostic challenges, with acoustic neuroma being the predominant tumor type identified. Congenital anomalies, particularly external ear anomalies, were also observed. Traumatic injuries, including fractures and dislocations, were frequently encountered, highlighting the importance of HRCT in their evaluation.
Conclusion: HRCT is an invaluable tool in the assessment of temporal bone pathologies, offering detailed anatomical visualization and aiding in accurate diagnosis and management planning. Despite its limitations, HRCT remains a cornerstone in the imaging armamentarium for temporal bone disorders, contributing to improved patient outcomes and quality of care.
Keywords: temporal bone, high-resolution computed tomography, otosclerosis, cholesteatoma, temporal bone fractures

## Introduction

The temporal bone, a complex and intricate structure located at the base of the skull, plays a pivotal role in housing and protecting critical sensory organs and neural structures associated with hearing and balance. Comprised of several distinct anatomical regions including the petrous, squamous, mastoid, and tympanic portions, the temporal bone serves as a conduit for sound transmission, houses the delicate structures of the inner ear, and provides stability and protection to vital neurovascular elements [1-3].

Pathologies affecting the temporal bone can have profound implications for patient health and quality of life. These conditions encompass a broad spectrum of disorders ranging from congenital abnormalities to acquired diseases and traumatic injuries. Common temporal bone pathologies include otosclerosis, cholesteatoma, congenital anomalies such as Mondini dysplasia, and traumatic injuries such as temporal bone fractures [4-6].

Otosclerosis, characterized by abnormal bone remodeling of the otic capsule, represents a common cause of conductive hearing loss in adults. This condition typically manifests as the abnormal deposition of bone around the stapes footplate, resulting in fixation of the ossicular chain and impairment of sound transmission to the inner ear. Cholesteatoma, a non-neoplastic keratinizing epithelial lesion, is characterized by the presence of a cystic or pearly white mass within the middle ear space. Cholesteatomas can erode adjacent structures, leading to complications such as conductive or sensorineural hearing loss, vestibular dysfunction, and intracranial complications if left untreated [5-8].

Congenital anomalies of the temporal bone, such as Mondini dysplasia, are characterized by malformations of the inner ear structures, including cochlear hypoplasia and incomplete partitioning of the cochlea. These anomalies often present with sensorineural hearing loss and are associated with an increased risk of recurrent meningitis due to the communication between the inner ear and the subarachnoid space [3-6].

Traumatic injuries to the temporal bone, commonly resulting from motor vehicle accidents, falls, or physical assaults, can lead to a spectrum of injuries ranging from simple temporal bone fractures to complex injuries involving intracranial and extracranial structures. Temporal bone fractures may disrupt the integrity of the ossicular chain, cause labyrinthine concussion or fistula, or result in facial nerve injury, posing significant diagnostic and therapeutic challenges [7-10].

Given the complex anatomy and diverse pathologies associated with the temporal bone, accurate diagnosis and timely intervention are essential for optimizing patient outcomes. High-resolution computed tomography (HRCT) has emerged as an invaluable imaging modality for evaluating temporal bone disorders due to its ability to provide detailed anatomical information with excellent spatial resolution. By delineating bony structures and detecting soft tissue abnormalities, HRCT facilitates the diagnosis, treatment planning, and monitoring of temporal bone pathologies. This paper aims to explore the role of HRCT in the assessment of temporal bone disorders, focusing on its utility in diagnosing otosclerosis, cholesteatoma, and temporal bone fractures, while also discussing the limitations and future directions of imaging in this field.

## Methodology:

This observational study spanned a total duration of 18 months and was conducted at a tertiary care center's Department of Radiodiagnosis. The study focused on patients with suspected temporal bone pathologies, with a sample size calculated using the formula n = 4pq/L^2, where p=60%, q=40%, and L=11%, resulting in a minimum sample size of 80.

Participants meeting the inclusion criteria, which included clinical suspicion of temporal bone-related symptoms such as ear discharge, head trauma, facial palsy, tinnitus, vertigo, hearing loss, and increased intracranial tension, were referred for high-resolution computed tomography (HRCT) of the temporal bone. Post-operative cases were excluded from the study.

Prior to commencement, ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was obtained from eligible patients.

Data collection involved obtaining demographic information such as age and sex using a pre-designed proforma. Patients were briefed on the CT procedure, including the duration of the scan and the need for a steady position to optimize image acquisition.

The HRCT protocol involved using a Siemens SOMATOM EMOTION 6 Multidetector CT scanner in helical mode to minimize motion artifacts. Scanning parameters included 130 kV, 150 mAs, 1-2 mm section thickness, and 0.5 mm collimation. Axial projections were taken with the patient supine, ensuring the line connecting the external auditory meatus and infraorbital rim was perpendicular to the table. Reconstruction of images was performed using a bone algorithm.

Following HRCT, images were analyzed for specific features relevant to temporal bone pathologies, including type, location, and size of injury, erosion of middle ear walls by bones, integrity of the ossicular chain, facial nerve canal, and labyrinth, and mastoid air cell framework. Intravenous contrast studies were conducted for suspected malignancies.

Data obtained were entered into Microsoft Excel for analysis. Descriptive statistics such as rates, ratios, percentages, and proportions were calculated, with continuous data presented as mean ± standard deviation. Statistical significance was determined using a p-value $\leq 0.05$.

**Results:**

Table 1 provides an overview of the distribution of diseases among the study population. The majority of cases were attributed to infections, accounting for 53.75% of the total patients, followed by trauma (30%), tumors (11.25%), and congenital anomalies (5%). This highlights the prevalence of infectious etiologies as the primary temporal bone pathology in this cohort.

Table 2 presents the sex distribution among the study population. Of the total patients, 65% were male and 35% were female. However, statistical analysis indicated that the difference in sex distribution was not statistically significant ($p=0.34$), suggesting an equal likelihood of temporal bone pathologies between genders within this cohort.

Table 3 further explores the distribution of gender according to age groups in the study population. Across different age brackets, males were more prevalent than females. The age group of 21-40 years had the highest representation, with 40% of the total patients falling into this category. Conversely, the age group of >60 years had the lowest representation, with males comprising a larger proportion across all age groups. These findings underscore the demographic characteristics of the study population, with a higher incidence of temporal bone pathologies observed in younger individuals, particularly males.

Table 4 illustrates the age distribution among the study population. The majority of patients (40%) fell within the age range of 21-40 years, followed by 26.25% in the 0-20 age group. The mean age of the total study population was 28.15 years, with a standard deviation of 11.2. This indicates a relatively young population presenting with temporal bone pathologies.

Table 5 outlines the clinical features observed among the study population. Ear discharge was the most common symptom, reported by 65% of patients, followed by hearing loss (33.75%) and headache (30%). Other symptoms included vertigo (18.75%), fever (30%), and facial nerve weakness (7.5%). These findings highlight the diverse clinical presentations associated with temporal bone pathologies.

Table 6 delves into the distribution of infections among the study population. Cholesteatoma was the most prevalent infection, affecting 48.83% of patients, followed by mastoiditis (32.55%) and suppurative otitis media (11.62%). External malignant otitis was relatively less common, observed in 6.97% of cases. This underscores the significant burden of cholesteatoma and mastoiditis as leading infectious etiologies of temporal bone pathologies in this cohort.

**Discussion:**

High-resolution computed tomography (HRCT) has revolutionized the assessment of temporal bone pathologies, offering unparalleled detail and precision in diagnosis. The findings of our study underscore the utility of HRCT in evaluating a diverse range of temporal bone conditions, including infections, tumors, congenital anomalies, and traumatic injuries. This discussion will delve into the key findings of our study and their clinical implications, while also addressing the limitations and future directions of HRCT imaging in this context.

Our study revealed that infections, particularly cholesteatoma and mastoiditis, were the most prevalent temporal bone pathologies encountered. Cholesteatoma, characterized by the presence of a cystic or pearly white mass within the middle ear, poses significant diagnostic and management challenges due to its potential for erosion of adjacent structures and risk of complications such as meningitis and intracranial abscess. HRCT plays a crucial role in delineating the extent of bony erosion, identifying complications, and guiding surgical planning for cholesteatoma cases [11]. Similarly, mastoiditis, an inflammatory condition affecting the mastoid air cells, can lead to significant morbidity if not promptly diagnosed and managed. HRCT facilitates the identification of mastoid air cell opacification and bony erosions, aiding in the assessment of disease severity and guiding appropriate interventions [12].

Tumors of the temporal bone, though less common, represent a diagnostic and therapeutic challenge due to their varied histopathology and potential for local invasion and metastasis. Our study identified acoustic neuroma as the most prevalent tumor, followed by glomus tumors and metastatic lesions. HRCT is invaluable in characterizing tumor morphology, assessing the involvement of adjacent structures, and guiding surgical planning [13]. Additionally, HRCT findings can aid in staging tumors and determining the extent of surgical resection required for optimal oncological outcomes.

Congenital anomalies of the temporal bone, while relatively rare, can have significant implications for hearing and balance. Our study identified external ear anomalies as the most common congenital anomaly encountered, followed by middle ear anomalies. HRCT plays a crucial role in delineating the anatomical abnormalities associated with congenital anomalies, facilitating preoperative planning and counseling for patients [14].

Traumatic injuries to the temporal bone, including fractures and dislocations, are often encountered in clinical practice, particularly in cases of head trauma. HRCT serves as the imaging modality of choice for evaluating temporal bone trauma, allowing for accurate identification of fracture patterns, assessment of involvement of vital structures such as the ossicular chain and facial nerve canal, and detection of complications such as intracranial hemorrhage or pneumocephalus [15]. Early and accurate diagnosis of temporal bone fractures is essential for guiding appropriate management strategies and minimizing long-term sequelae.

While HRCT offers numerous advantages in the evaluation of temporal bone pathologies, it is not without limitations. The radiation exposure associated with CT imaging raises concerns, particularly in pediatric and pregnant populations. Additionally, HRCT may have limited sensitivity for detecting soft tissue abnormalities, necessitating adjunctive imaging

modalities such as magnetic resonance imaging (MRI) in certain cases. Furthermore, interpretation of HRCT findings requires expertise and familiarity with temporal bone anatomy, highlighting the importance of radiologist training and ongoing education in this specialized area [6-10].

Looking ahead, advancements in imaging technology, such as cone-beam CT and dual-energy CT, hold promise for further improving the diagnostic accuracy and clinical utility of HRCT in temporal bone imaging. Additionally, the integration of artificial intelligence and machine learning algorithms into image interpretation workflows may enhance efficiency and accuracy in detecting and characterizing temporal bone pathologies [7-9]. Further research is needed to validate these emerging technologies and optimize their clinical implementation in the evaluation of temporal bone disorders.

**Conclusion**

In conclusion, our study highlights the pivotal role of HRCT in the assessment of temporal bone pathologies, ranging from infections and tumors to congenital anomalies and traumatic injuries. HRCT offers detailed anatomical information, facilitates accurate diagnosis and staging, and guides therapeutic decision-making in clinical practice. Despite its limitations, HRCT remains an indispensable tool in the armamentarium of clinicians managing patients with temporal bone disorders, contributing to improved patient outcomes and quality of care.

**References:**

1. Khan, M. I., Patel, S., & Dasgupta, K. (2019). Is HRCT Temporal Bone Necessary in All Cases of Active Squamous Chronic Otitis Media? Indian Journal of Otolaryngology and Head & Neck Surgery, 71(Suppl 2), 1212–1216. https://doi.org/10.1007/s12070-018-1272-0
2. Singh, R., Rai, R., Singh, P., Sethi, S., Ahluwalia, A. P. S., & Choudhary, G. (2020). High-resolution computed tomography (HRCT) in pediatric and adult patients with unsafe chronic suppurative otitis media (CSOM) and its surgical correlation. Journal of Family Medicine and Primary Care, 9(8), 4067–4073. https://doi.org/10.4103/jfmpc.jfmpc_455_20
3. Manik, S., Dabholkar, Y., Bhalekar, S., Velankar, H., Chordia, N., & Saberwal, A. (2021). Sensitivity and specificity of high-resolution computed tomography (HRCT) of temporal bone in diagnosing cholesteatoma and its correlation with intraoperative findings. Indian Journal of Otolaryngology and Head & Neck Surgery, 73(1), 25–29. https://doi.org/10.1007/s12070-020-01892-z
4. Shah, C. K., Gupta, S., Gupta, D. P., Prajapati, B. J., & Prajapati, V. (2022). Role of High-Resolution Computed Tomography of Temporal Bone in Patients with Cholesteatoma, in a Tertiary Care Health Center. Indian Journal of Otolaryngology and Head & Neck Surgery, 74(Suppl 1), 681–685. https://doi.org/10.1007/s12070-021-02377-3
5. Agarwal, R., Pradhananga, R., Das Dutta, H., & Poudel, S. (2022). Correlation of Pre-operative Temporal Bone CT Scan Findings with Intraoperative Findings in Chronic Otitis Media: Squamous Type. Indian Journal of Otolaryngology and Head & Neck Surgery, 74(Suppl 1), 33–42. https://doi.org/10.1007/s12070-020-01805-0
6. Beig, S., Sharma, S. C., & Khalid, M. (2019). Revisiting Correlation Between Preoperative High-Resolution Computed Tomography and Operative Findings in Attico Antral Disease. Indian Journal of Otolaryngology and Head & Neck Surgery, 71(Suppl 2), 1351–1356. https://doi.org/10.1007/s12070-018-1419-z
7. Kataria, T., Sehra, R., Grover, M., Sharma, S., Verma, N., & Sharma, M. P. (2022). Correlation of Preoperative High-resolution Computed Tomography Temporal Bone

Findings with Intra-operative Findings in Various Ear Pathologies. Indian Journal of Otolaryngology and Head & Neck Surgery, 74(Suppl 1), 190–199. https://doi.org/10.1007/s12070-020-01950-6
8. Uz Zaman, S., Rangankar, V., Muralinath, K., Shah, V., K G., & Pawar, R. (2022). Temporal Bone Cholesteatoma: Typical Findings and Evaluation of Diagnostic Utility on High Resolution Computed Tomography. Cureus, 14(3), e22730. https://doi.org/10.7759/cureus.22730
9. Mandal, S., Muneer, K., & Roy, M. (2019). High Resolution Computed Tomography of Temporal Bone: The Predictive Value in Atticoantral Disease. Indian Journal of Otolaryngology and Head & Neck Surgery, 71(Suppl 2), 1391–1395. https://doi.org/10.1007/s12070-018-1465-6
10. Aljehani, M., & Alhussini, R. (2019). The Correlation Between Preoperative Findings of High-Resolution Computed Tomography (HRCT) and Intraoperative Findings of Chronic Otitis Media (COM). Clinical Medicine Insights. Ear, Nose and Throat, 12, 1179550619870471. https://doi.org/10.1177/1179550619870471
11. Jadia, S., Qureshi, S., Sharma, S., & Mishra, K. (2021). Correlation of Preoperative 'HRCT Temporal Bone' Findings with 'Surgical Findings' in Unsafe CSOM. Indian Journal of Otolaryngology and Head & Neck Surgery, 73(1), 33–40. https://doi.org/10.1007/s12070-020-01932-8
12. Singh, J., & Bhardwaj, B. (2019). How Efficacious is HRCT Temporal Bone in Determining the Ossicular Erosion in Cases of Safe and Limited Squamous Type CSOM? Indian Journal of Otolaryngology and Head & Neck Surgery, 71(Suppl 2), 1179–1182. https://doi.org/10.1007/s12070-018-1250-6
13. Husain, M., Khanduri, S., Faiz, S. M., Abbas, S. Z., Yadav, P., Khan, A. U., Singh, A., & Khan, M. (2020). Role of HRCT Temporal Bone in Pre-operative Assessment of Tegmen Height in Chronic Otitis Media Patients. Journal of Clinical Imaging Science, 10, 79. https://doi.org/10.25259/JCIS_131_2020
14. Baklacı, D., Kuzucu, İ., Guler, İ., Kum, R. O., & Özcan, M. (2020). Cautionary High-resolution Computed Tomography Findings for the Presence of Facial Canal Dehiscence in Patients with Cholesteatoma. Cureus, 12(1), e6717. https://doi.org/10.7759/cureus.6717
15. Khoo, H. W., Choong, C. C., Yeo, S. B., Goh, J. P., & Tan, T. Y. (2020). High Resolution Computed Tomography (HRCT) Imaging Findings of Oval Window Atresia with Surgical Correlation. Annals of the Academy of Medicine, Singapore, 49(6), 346–353. PMID: 32712631

**Tables**

Table 1: Showing Distribution of Disease in Study Population

| **Diseases** | **No. of Patients (n)** | **Percentage (%)** |
|---|---|---|
| Infections | 43 | 53.75% |
| Trauma | 24 | 30% |
| Tumors | 9 | 11.25% |
| Congenital | 4 | 5% |

Table 2: Showing Sex Distribution Among Study Population

| **Sex** | **No of Patients (n)** | **Percentage (%)** | **P value** |
|---|---|---|---|
| Male | 52 | 65% | 0.34 |
| Female | 28 | 35% | |

Table 3: Distribution of Gender According to Age Groups in the Study Population

| **Age** | **Male** | **Female** |
|---|---|---|
| 0-20 | 15 | 7 |
| 21-40 | 21 | 15 |
| 41-60 | 9 | 5 |
| >60 | 7 | 1 |
| Total | 52 | 28 |

Table 4: Showing Age Distribution Among Study Population

| **Age (in years)** | **Patients (n)** | **Percentage (%)** |
|---|---|---|
| 0-20 | 21 | 26.25% |
| 21-40 | 32 | 40% |
| 41-60 | 18 | 22.5% |
| >60 | 9 | 11.25% |
| Total | 80 | 100% |

Table 5: Clinical Features Among Study Population

| **Clinical Features** | **No. of Patients (n)** | **Percentage (%)** |
|---|---|---|
| Hearing loss | 27 | 33.75% |
| Ear discharge | 52 | 65% |
| Facial nerve Weakness | 6 | 7.5% |
| Headache | 24 | 30% |
| Otalgia | 12 | 15% |
| Tinnitus | 7 | 8.75% |
| Vomiting | 19 | 23.75% |
| Diplopia | 4 | 5% |
| Altered sensorium | 4 | 5% |
| Fever | 24 | 30% |
| Vertigo | 15 | 18.75% |
| Swelling | 10 | 12.5% |
| Post traumatic pain | 8 | 10% |

Table 6: Showing Distribution of Infections Among Study Population

| **Distribution of Infections** | **No. of Patients (n)** | **Percentage (%)** |
|---|---|---|
| External malignant otitis | 3 | 6.97% |
| Cholesteatoma | 21 | 48.83% |
| Mastoiditis | 14 | 32.55% |
| Suppurative Otitis media | 5 | 11.62% |