



Original Article

High-Resolution Computed Tomography in the Evaluation of Temporal Bone Pathologies

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ABSTRACT

Background: The temporal bone has complex anatomy, and clinical examination alone is often insufficient for accurate diagnosis of infective, traumatic, congenital, and neoplastic disease. High-resolution computed tomography (HRCT) is the preferred modality for detailing fine bony architecture.

Objective: To evaluate the role of HRCT in detecting and characterizing temporal bone pathologies and to describe the radiological spectrum in a tertiary care centre.

Methods: A prospective observational study was conducted over 18 months in the Department of Radiodiagnosis, Geetanjali Medical College and Hospital, Udaipur. Consecutive adults (>18 years) referred for HRCT temporal bone who met inclusion criteria were enrolled (N = 140). Examinations were performed on a 256-slice multidetector CT scanner with sub-millimetre bone-algorithm imaging and multiplanar reformats. Findings were correlated with clinical diagnosis and, where available, surgical or histopathological confirmation.

Results: Mean age was 38.11 ± 14.59 years; 58.6% were male. Hearing loss (63.6%) and ear discharge (60.0%) were the commonest symptoms. Infective pathology predominated (60.0%), followed by traumatic (14.3%) and neoplastic (12.9%) lesions. Chronic otitis media (24.3%) and cholesteatoma (20.0%) were the leading final HRCT diagnoses. Ossicular erosion was seen in 34.3% (incus most often, 20.0%). Soft-tissue opacity (52.9%) and mastoid sclerosis (24.3%) were frequent. HRCT correlated accurately with final diagnosis in 77.1% of cases. In subsets with confirmatory data, HRCT showed complete concordance for cholesteatoma, ossicular erosion, acoustic neuroma, and temporal bone fracture.

Conclusion: HRCT is a reliable modality for mapping temporal bone disease, detecting bony complications, and guiding management, particularly in chronic otitis media, cholesteatoma, and trauma. Clinical, surgical, histopathological, and MRI correlation remain important in selected soft-tissue and intracranial assessments.

Keywords: Temporal bone; High-resolution computed tomography; Chronic otitis media; Cholesteatoma; Temporal bone fracture; Ossicular erosion.

INTRODUCTION

The temporal bone forms a major part of the lateral skull base and houses critical neurovascular and sensory structures. Its intricate three-dimensional architecture renders clinical examination alone insufficient for accurate diagnosis of the wide spectrum of pathologies that may affect it¹². High-resolution computed tomography (HRCT) has emerged as the preferred modality for temporal bone evaluation because of its ability to delineate fine bony architecture with sub-millimetre resolution³.

Chronic suppurative otitis media and cholesteatoma remain leading indications for temporal bone HRCT, especially in developing countries, where preoperative imaging guides assessment of ossicular integrity, tegmen height, sigmoid sinus position, and disease extent³⁴. Trauma, congenital anomalies, and neoplastic lesions are other important indications, for which HRCT complements clinical and, when needed, magnetic resonance imaging evaluation⁵¹. Institution-based studies from India continue to report infective aetiology as the dominant case mix⁶⁹. The present study evaluated the role of HRCT in the spectrum of temporal bone pathologies at a tertiary care centre in Rajasthan.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Radiodiagnosis, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, over 18 months after Institutional Ethics Committee approval. Written informed consent was obtained from all participants.

Inclusion criteria were adults above 18 years of either gender with clinical suspicion of external, middle, or inner ear disease, congenital abnormality, trauma, or neoplasm, referred for HRCT temporal bone. Exclusion criteria were uncooperative patients, previously operated temporal bone pathology, refusal of consent, and hypersensitivity precluding required contrast when clinically indicated.

Consecutive eligible patients during the study period were enrolled. HRCT was performed on a GE Revolution Frontier 256-slice multidetector CT scanner. Axial acquisition parallel to the orbitomeatal line covered both temporal bones with tube voltage 120 kVp, dose-modulated tube current, pitch 0.5–0.75, and 0.625 mm slice thickness with bone-algorithm reconstruction. Coronal and sagittal multiplanar reformats were generated routinely. Images were reviewed on bone and soft-tissue windows. Contrast-enhanced CT or complementary MRI was performed when neoplastic disease was suspected. Demographics, clinical complaints, symptom duration, trauma history, and provisional diagnosis were recorded on a structured proforma. HRCT parameters included external auditory canal, middle ear soft tissue, ossicular integrity, scutum, tegmen and mastoid status, facial canal, labyrinth, fracture morphology, congenital anomalies, and soft-tissue masses. Where available, findings were correlated with surgical or histopathological diagnosis. Data were analysed in SPSS 25.0. Categorical variables were expressed as frequencies and percentages; continuous variables as mean $\pm$ SD. Associations used chi-square or Fisher's exact tests ($p < 0.05$ significant). Diagnostic accuracy parameters were calculated when a confirmatory reference standard was available.

RESULTS

A total of 140 patients were analysed. Mean age was 38.11 ± 14.59 years. The largest age groups were 21–30 years (30.0%) and 31–40 years (23.6%). Males comprised 58.6% and females 41.4%. Hearing loss (63.6%) and ear discharge (60.0%) were the commonest complaints, followed by ear pain (37.9%), tinnitus (22.9%), vertigo (17.9%), postauricular swelling (13.6%), and facial weakness (5.0%). Trauma history was present in 14.3%. Symptom duration exceeded one year in 31.4%. No patient had prior ear surgery (Tables 1–3).

Table 1. Age distribution (N = 140)

Age group (years)	n	%
18–20	12	8.6
21–30	42	30.0
31–40	33	23.6
41–50	24	17.1
51–60	18	12.9
>60	11	7.9
Total	140	100.0

Table 2. Demographic and clinical profile (N = 140)

Variable	Category	n (%)
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Gender	Male	82 (58.6)
	Female	58 (41.4)
Trauma history	Yes	20 (14.3)
	No	120 (85.7)
Symptom duration	>1 year	44 (31.4)
	6–12 months	30 (21.4)
	1–6 months	33 (23.6)
	<1 month	33 (23.6)
Chief complaints	Hearing loss	89 (63.6)
	Ear discharge	84 (60.0)
	Ear pain	53 (37.9)
	Tinnitus	32 (22.9)
	Vertigo	25 (17.9)
	Postauricular swelling	19 (13.6)
	Facial weakness	7 (5.0)

Side involvement was left in 35.7%, bilateral in 35.0%, and right in 29.3%. Infective lesions accounted for 60.0%, traumatic 14.3%, neoplastic 12.9%, congenital 5.7%, inflammatory 4.3%, and miscellaneous 2.9%. Final HRCT diagnoses were led by chronic otitis media (24.3%), cholesteatoma (20.0%), and temporal bone fracture (14.3%) (Tables 3–4).

Table 3. Pathology categories on HRCT (N = 140)

Pathology category	n	%
Infective	84	60.0
Traumatic	20	14.3
Neoplastic	18	12.9
Congenital	8	5.7
Inflammatory	6	4.3
Miscellaneous	4	2.9
Total	140	100.0

Table 4. Selected final HRCT diagnoses (N = 140)

Final HRCT diagnosis	n	%
Chronic otitis media	34	24.3
Cholesteatoma	28	20.0
Temporal bone fracture	20	14.3
Mastoiditis	12	8.6
Inflammatory/miscellaneous	10	7.1
Acoustic neuroma	9	6.4
Otitis externa	6	4.3
Other diagnoses	21	15.0
Total	140	100.0

Among infective pathologies, COM (24.3%), cholesteatoma (20.0%), and mastoiditis (8.6%) predominated; petrositis and labyrinthitis were each 1.4%. Ossicular erosion was present in 34.3%, most often involving the incus (20.0%), then malleus (10.7%) and stapes (6.4%). Scutum erosion was seen in 20.0%. Soft-tissue opacity (52.9%), mastoid sclerosis (24.3%), and scutum blunting (20.0%) were common additional findings. Mastoid pattern was pneumatized in 35.7%, diploic in 34.3%, and sclerotic in 30.0%. No intracranial extension was identified (Table 5).

Table 5. Selected HRCT bony and soft-tissue findings (N = 140)

HRCT finding	n (%)
Soft-tissue opacity	74 (52.9)
Ossicular erosion	48 (34.3)
Incus erosion	28 (20.0)
Scutum erosion / blunting	28 (20.0)
Mastoid sclerosis	34 (24.3)
Malleus erosion	15 (10.7)

Stapes erosion	9 (6.4)
Facial canal erosion	1 (0.7)
Intracranial extension	0 (0.0)

Temporal bone trauma was present in 20 patients (14.3%): longitudinal fractures 13 (9.3%), mixed 4 (2.9%), and transverse 3 (2.1%). Associated findings included sensorineural hearing loss in 13 (9.3%), hemotympanum in 10 (7.1%), ossicular disruption in 8 (5.7%), and facial nerve palsy in 3 (2.1%). Congenital anomalies were found in 8 (5.7%), most often cochlear dysplasia (2.9%). Neoplastic lesions occurred in 18 (12.9%), led by acoustic neuroma (6.4%). Conductive hearing loss was the commonest audiometric pattern (29.3%), followed by mixed (25.7%) and sensorineural (17.1%).

HRCT correlated accurately with final diagnosis in 108 patients (77.1%) and partially in 32 (22.9%). Histopathological confirmation was available in 62.9%. In confirmatory subsets for cholesteatoma, ossicular erosion, acoustic neuroma, and temporal bone fracture, sensitivity, specificity, PPV, and NPV were each 100% in the present dataset. Management advised was follow-up in 36.4%, conservative treatment in 32.1%, and surgical planning in 31.4%.

DISCUSSION

In this tertiary-care cohort of 140 patients, infective disease dominated the HRCT case mix (60%), consistent with Indian institutional series reporting infective aetiology in roughly 55–66% of temporal bone HRCT referrals^{69,14}. Predominance of young and middle-aged adults and mild male excess also align with chronic otitis media–focused HRCT studies⁶.

COM and cholesteatoma as leading diagnoses, frequent soft-tissue opacity, and substantial ossicular erosion—particularly of the incus—underscore the preoperative value of HRCT for disease mapping and surgical hazard identification³⁴. Longitudinal fracture predominance among trauma cases accords with classical temporal bone fracture epidemiology, while modern practice emphasizes detailed structural injury characterization on thin-section CT⁵.

Accurate correlation with final diagnosis in 77.1% supports HRCT as a reliable first-line modality, while partial correlation in nearly one-quarter of cases highlights the continuing need for clinical, operative, histopathological, and MRI correlation for soft-tissue characterization and selected complications^{31,4}. Perfect diagnostic metrics in confirmatory subsets should be interpreted cautiously, as they may reflect selected patients in whom a reference standard was available rather than unrestricted test performance across all referrals.

Limitations include single-centre design, adult-only enrolment, and incomplete operative documentation for some surgically planned cases. Despite these constraints, consecutive enrolment over 18 months provides a representative institutional spectrum of temporal bone disease evaluated by HRCT.

CONCLUSION

HRCT temporal bone is a reliable imaging modality for evaluating the spectrum of temporal bone pathologies in tertiary practice. Infective disease, especially chronic otitis media and cholesteatoma, predominates, and HRCT effectively demonstrates soft-tissue opacity, ossicular and scutum erosion, mastoid changes, traumatic fractures, congenital anomalies, and bony involvement by neoplasm.

Accurate disease mapping on HRCT supports diagnosis, complication detection, and management planning. Complementary clinical, audiological, surgical, histopathological, and MRI assessment remain important in selected soft-tissue and intracranial evaluations.

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