Original Article

Role of High-Resolution Computed Tomography of the Temporal Bone in Chronic Suppurative Otitis Media: A Prospective Comparison with Intraoperative Findings

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Abstract

Background: The aim is to evaluate the diagnostic accuracy of high-resolution computed tomography (HRCT) of the temporal bone in chronic suppurative otitis media (CSOM) by comparing it with intraoperative findings, and to examine factors associated with complications. **Material and Methods:** In this prospective observational cross-sectional study at a tertiary teaching hospital in Shivamogga, Karnataka, India (January to December 2025), 40 patients with CSOM underwent HRCT followed by cortical or modified radical mastoidectomy with tympanoplasty. Findings at 16 sites were recorded on a structured proforma, with surgery as the reference standard. Sensitivity, specificity, predictive values and accuracy were calculated with exact 95% confidence intervals. **Results:** Mean age was 31.6 ± 11.0 years and 29 patients (72.5%) were female. Tubotympanic disease was present in 31 patients (77.5%). HRCT agreed completely with surgery for the scutum, all three middle ear compartments, dural plate, sigmoid sinus plate, tegmen mastoidea and mastoid pneumatization. For the ossicular chain, sensitivity was 80.0% and specificity 100%. Cholesteatoma was detected with 75.0% sensitivity and 100% specificity, whereas granulation tissue was identified with 66.7% sensitivity, and all six mastoid granulation foci were missed. Thirty-seven patients (92.5%) showed complete concordance across all assessed sites. Complications were more frequent in atticoantral disease (44.4% vs 12.9%; odds ratio 5.40; Fisher's exact p = 0.059). **Conclusion:** HRCT maps bony anatomy and middle ear disease accurately and identifies the hazards that alter operative planning, but it cannot reliably separate cholesteatoma from granulation tissue on density alone.

Keywords: Otitis Media, Suppurative, Cholesteatoma, Middle Ear, Tomography, X-Ray Computed, Temporal Bone, Sensitivity and Specificity.

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Introduction

Chronic suppurative otitis media (CSOM) is a persistent inflammation of the middle ear cleft that presents with recurrent discharge through a perforated tympanic membrane. A systematic review prepared for the Global Burden of Disease study estimated about 31 million new cases each year, an incidence of 4.76 per thousand, and attributed around 21,000 deaths annually to complications of otitis media.[1] The disease is multifactorial. Eustachian tube dysfunction, host immunity and biofilm-forming organisms such as Pseudomonas aeruginosa and Staphylococcus aureus all contribute.[2,3] Tubotympanic disease is largely confined to the mucosa, whereas atticoantral disease is often associated with cholesteatoma, an expanding keratinizing epithelial lesion that erodes the ossicles, scutum, tegmen, sigmoid sinus plate, facial canal and labyrinth.[4,5] In a review of 2,890 patients with chronic otitis media, complications developed in 3.22%, and mortality among those with intracranial complications was 26.3%.[6]

Mastoid surgery is the definitive treatment for persistent disease. Its extent depends on mastoid pneumatization, the distribution of disease, the state of the ossicles and the integrity of the tegmen, dural plate, sigmoid sinus plate and facial canal. Otoscopy and otoendoscopy cannot show the antrum, mastoid or tegmen, so imaging is the only preoperative view of these regions.

Computed tomography has been used for this purpose for four decades. Jackler and colleagues found that soft tissue with bone erosion on CT was strongly associated with cholesteatoma, but half of their 42 patients had soft tissue without erosion, in whom CT could neither confirm nor exclude it; volume averaging also gave false impressions of tegmen erosion and canal fistula.[7] Modern HRCT has excellent spatial resolution and high sensitivity for small soft tissue lesions, but poor specificity, because cholesteatoma, granulation tissue, oedematous mucosa and fluid have similar attenuation.[8]

Correlation studies have reached mixed conclusions. Chee and Tan reported excellent radiosurgical agreement for the malleus, stapes and semicircular canals (kappa 0.83 to 0.94), good

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agreement for the incus and tegmen, and poor agreement for the facial canal (kappa 0.30).[9] Yates and colleagues argued that imaging guides the surgical approach and forewarns of complications.[10] In contrast, Walshe and colleagues.[11] and Alzoubi and colleagues.[12] found that CT could not distinguish cholesteatoma from mucosal disease and contributed little to management, while Banerjee and colleagues reported that it influenced the choice of approach more than the decision to operate.[13] Gaurano and Joharjy found 97% correlation between CT and surgery in 64 patients with cholesteatoma.[14] In 60 Indian adults, Payal and colleagues found that soft tissue distribution was predicted confidently, but the long process of the incus, stapes, facial canal and tegmen tympani were assessed less reliably.[15]

Most of these series concentrated on cholesteatoma or atticoantral disease. Fewer have examined an unselected surgical population in which mucosal disease predominates, as it does in most Indian teaching hospitals, and fewer still have reported site-by-site accuracy with confidence intervals together with a separate analysis of tissue characterization. This study therefore aimed to evaluate the role of HRCT of the temporal bone in diagnosing CSOM and its complications. The objectives were to compare preoperative HRCT findings with intraoperative findings at defined anatomical sites; to estimate the sensitivity, specificity, predictive values and accuracy of HRCT for ossicular erosion, middle ear disease, cholesteatoma, granulation tissue and complications; and to examine the association of age, sex and type of CSOM with complications.

Materials and Methods

Study design, setting and participants: This hospital-based, prospective, observational cross-sectional study was conducted in the Department of Otorhinolaryngology, Shivamogga Institute of Medical Sciences and the attached McGann Teaching Hospital, Shivamogga, Karnataka, India, from January to December 2025. Patients of all ages with a clinical diagnosis of CSOM scheduled for mastoid surgery were enrolled consecutively. Patients with malignant ear pathology, granulomatous lesions of the ear, or those undergoing tympanoplasty without mastoidectomy were excluded. The Institutional Ethics Committee approved the study, and written informed consent was obtained from all participants or their guardians.

Sample size: Sample size was estimated in Epi Info for a single proportion, assuming an expected HRCT sensitivity of 90% for cholesteatoma, 5% absolute precision and 95% confidence. A finite population correction for about 40 eligible patients during the study period and an anticipated response rate of 90% gave a minimum of 35 patients, which was rounded up to 40.

Clinical and radiological evaluation: Each patient underwent a detailed history, otoscopy and otoendoscopy, and a provisional diagnosis of tubotympanic or atticoantral CSOM was recorded. Non-contrast HRCT of both temporal bones was performed before surgery with axial sections of 1 mm or less, coronal reconstructions and a bone window. Sixteen sites were assessed: external auditory canal, mastoid pneumatization, mastoid cortex and antrum, scutum, ossicular chain, epitympanum, mesotympanum, hypotympanum, tegmen tympani, tegmen mastoidea, dural plate, sigmoid sinus plate, lateral semicircular canal, facial nerve canal, internal auditory meatus and petrous apex. Each site was classified as normal or abnormal, and the abnormality was described. Scans were read jointly by a radiologist and an otorhinolaryngologist, and findings were entered in a predesigned proforma before surgery.

Surgical assessment and reference standard: Patients underwent cortical mastoidectomy with tympanoplasty or modified radical mastoidectomy with tympanoplasty under general anaesthesia. The surgeon recorded the status of each site on the same proforma, together with the presence and location of cholesteatoma, granulation tissue and oedematous mucosa. The internal auditory meatus and petrous apex were not exposed at surgery and could not be verified. Intraoperative findings were the reference standard. Because HRCT was used for planning, the operating team was not blinded to it.

Definitions: True positive, false positive, false negative and true negative results were defined for each site against surgery. HRCT was considered positive for cholesteatoma when soft tissue with bone erosion or expansion was reported, and positive for granulation tissue when non-dependent opacification without erosion was reported. A complication was defined as intraoperative tegmen erosion, sigmoid sinus plate abnormality, dural plate abnormality, scutum erosion or ossicular erosion. A patient was fully concordant when HRCT and surgery agreed at every site assessed by both.

Statistical analysis: Data were entered in Microsoft Excel and analysed with IBM SPSS Statistics version 23. Continuous data were summarized as mean ± standard deviation (SD) and median with interquartile range (IQR), and categorical data as frequency and percentage. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated from two-by-two tables, with exact (Clopper-Pearson) 95% confidence intervals (CI). Associations with complications were tested with the chi-square test, or Fisher's exact test when an expected count was below five, and odds ratios (OR) were reported with exact 95% CI. A two-tailed $p < 0.05$ was considered significant. A large language model was used to assist with drafting and language editing; the authors verified all data, analyses and references and take full responsibility for the content.

Results

Patient characteristics: Forty patients were included, with a mean age of 31.6 ± 11.0 years (range 9 to 48). Twenty-nine (72.5%) were female, a male to female ratio of 1:2.64. Ear discharge was the presenting complaint in 37 patients (92.5%), hearing loss in 11 (27.5%) and ear pain in 8 (20.0%). Tubotympanic CSOM was diagnosed in 31 patients (77.5%) and atticoantral CSOM in 9 (22.5%), and disease was unilateral in 35 (87.5%) [Table 1].

Table 1: Demographic and clinical profile of the study participants (n = 40)

Variable	Category	n (%)
Age (years)	Mean ± SD	31.6 ± 11.0
	Median (IQR)	33.0 (21.8-40.2)
	Range	9-48
Age group	Below 20 years	10 (25.0)
	20-30 years	6 (15.0)
	31-40 years	14 (35.0)
	Above 40 years	10 (25.0)
Sex	Female	29 (72.5)
	Male	11 (27.5)
Presenting complainta	Ear discharge	37 (92.5)
	Hearing loss	11 (27.5)
	Ear pain	8 (20.0)
Provisional diagnosis	Right CSOM, tubotympanic	13 (32.5)
	Left CSOM, tubotympanic	13 (32.5)
	Bilateral CSOM, tubotympanic	5 (12.5)
	Right CSOM, atticoantral	4 (10.0)
	Left CSOM, atticoantral	5 (12.5)
Type of CSOM	Tubotympanic	31 (77.5)
	Atticoantral	9 (22.5)

SD standard deviation, IQR interquartile range, CSOM chronic suppurative otitis media
aPatients could report more than one complaint

HRCT and intraoperative findings: The commonest HRCT abnormalities were opacification of the mastoid cortex and antrum (95.0%) and a sclerotic mastoid (72.5%). At surgery, mastoid disease was present in 37 patients (92.5%), most often oedematous mucosa (40.0%), granulation tissue was the predominant middle ear pathology, and cholesteatoma was found in 4 patients (10.0%). No labyrinthine fistula or facial nerve dehiscence was found by either method [Table 2].

Table 2: Abnormal findings on HRCT and at surgery by anatomical site (n = 40)

Anatomical site	HRCT abnormal, n (%)	Intraoperative abnormal, n (%)	Predominant abnormality at surgery
External auditory canal	0 (0.0)	1 (2.5)	Wall thickening
Mastoid pneumatization	29 (72.5)	29 (72.5)	Sclerotic mastoid
Mastoid cortex and antrum	38 (95.0)	37 (92.5)	Oedematous mucosa, soft tissue
Scutum	1 (2.5)	1 (2.5)	Erosion
Ossicular chain	4 (10.0)	5 (12.5)	Erosion, engulfed in granulation
Epitympanum	5 (12.5)	5 (12.5)	Cholesteatoma, granulation
Mesotympanum	8 (20.0)	8 (20.0)	Granulation tissue
Hypotympanum	2 (5.0)	2 (5.0)	Granulation, cholesteatoma
Tegmen tympani	5 (12.5)	4 (10.0)	Thinned out
Tegmen mastoidea	1 (2.5)	1 (2.5)	Thinned out
Dural plate	5 (12.5)	5 (12.5)	Thinned out, low lying
Sigmoid sinus plate	2 (5.0)	2 (5.0)	Anteriorly placed
Lateral semicircular canal	0 (0.0)	0 (0.0)	None
Facial nerve canal	0 (0.0)	0 (0.0)	None
Internal auditory meatus	0 (0.0)	Not assessed	Not exposed at surgery
Petrous apex	1 (2.5)a	Not assessed	Not exposed at surgery

HRCT high-resolution computed tomography
aPneumatized petrous apex (anatomical variant)

Diagnostic accuracy by site: HRCT agreed with surgery in all 40 patients at 10 of the 14 sites assessed by both methods (Table 3). For the ossicular chain, sensitivity was 80.0% (95% CI 28.4 to 99.5), specificity 100% (95% CI 90.0 to 100) and NPV 97.2%. The tegmen tympani had one false positive (specificity 97.2%, PPV 80.0%), and when both parts of the tegmen were combined, sensitivity was 100% (95% CI 47.8 to 100). Specificity for the mastoid cortex was 66.7% (95% CI 9.4 to 99.2), based on only three normal mastoids. The one abnormal external auditory canal was missed. Accuracy ranged from 97.5% to 100% at all 14 sites.

Table 3: Diagnostic performance of HRCT against intraoperative findings by anatomical site (n = 40)

Anatomical site	TP	FP	FN	TN	Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	Accuracy % (95% CI)
External auditory canal	0	0	1	39	0.0 (0.0-97.5)	100 (91.0-100)	NA	97.5 (86.8-99.9)	97.5 (86.8-99.9)
Mastoid pneumatization	29	0	0	11	100 (88.1-100)	100 (71.5-100)	100 (88.1-100)	100 (71.5-100)	100 (91.2-100)
Mastoid cortex and antrum	37	1	0	2	100 (90.5-100)	66.7 (9.4-99.2)	97.4 (86.2-99.9)	100 (15.8-100)	97.5 (86.8-99.9)

Scutum	1	0	0	39	100 (2.5-100)	100 (91.0-100)	100 (2.5-100)	100 (91.0-100)	100 (91.2-100)
Ossicular chain	4	0	1	35	80.0 (28.4-99.5)	100 (90.0-100)	100 (39.8-100)	97.2 (85.5-99.9)	97.5 (86.8-99.9)
Epitympanum	5	0	0	35	100 (47.8-100)	100 (90.0-100)	100 (47.8-100)	100 (90.0-100)	100 (91.2-100)
Mesotympanum	8	0	0	32	100 (63.1-100)	100 (89.1-100)	100 (63.1-100)	100 (89.1-100)	100 (91.2-100)
Hypotympanum	2	0	0	38	100 (15.8-100)	100 (90.7-100)	100 (15.8-100)	100 (90.7-100)	100 (91.2-100)
Tegmen tympani	4	1	0	35	100 (39.8-100)	97.2 (85.5-99.9)	80.0 (28.4-99.5)	100 (90.0-100)	97.5 (86.8-99.9)
Tegmen mastoidea	1	0	0	39	100 (2.5-100)	100 (91.0-100)	100 (2.5-100)	100 (91.0-100)	100 (91.2-100)
Tegmen (either site)a	5	1	0	34	100 (47.8-100)	97.1 (85.1-99.9)	83.3 (35.9-99.6)	100 (89.7-100)	97.5 (86.8-99.9)
Dural plate	5	0	0	35	100 (47.8-100)	100 (90.0-100)	100 (47.8-100)	100 (90.0-100)	100 (91.2-100)
Sigmoid sinus plate	2	0	0	38	100 (15.8-100)	100 (90.7-100)	100 (15.8-100)	100 (90.7-100)	100 (91.2-100)
Lateral semicircular canal	0	0	0	40	NA	100 (91.2-100)	NA	100 (91.2-100)	100 (91.2-100)
Facial nerve canal	0	0	0	40	NA	100 (91.2-100)	NA	100 (91.2-100)	100 (91.2-100)

TP true positive, FP false positive, FN false negative, TN true negative, PPV positive predictive value, NPV negative predictive value, CI exact (Clopper-Pearson) confidence interval, NA not applicable. The internal auditory meatus and petrous apex were not assessed at surgery and are excluded

aCombines tegmen tympani and tegmen mastoidea; not counted as a separate site

Cholesteatoma and granulation tissue: HRCT identified 3 of 4 cholesteatomas with no false positives (sensitivity 75.0%, 95% CI 19.4 to 99.4; specificity 100%, 95% CI 90.3 to 100). All middle ear cholesteatomas were detected, and the missed lesion was a small sac in the mastoid and antrum. For granulation tissue, sensitivity was 66.7% (95% CI 29.9 to 92.5) and specificity 93.5% (95% CI 78.6 to 99.2). Every middle ear focus was detected, but all six mastoid foci were missed, and three mesotympanic opacities attributed to granulation proved to be other soft tissue (PPV 57.1%) [Table 4].

Table 4: Detection of cholesteatoma and granulation tissue by HRCT, by location (n = 40)

Pathology and location	HRCT positive, n	Intraoperative positive, n	TP	FP	FN	TN	Sensitivity % (95% CI)	Specificity % (95% CI)	Accuracy % (95% CI)
Cholesteatoma: epitympanum	2	2	2	0	0	38	100 (15.8-100)	100 (90.7-100)	100 (91.2-100)
Cholesteatoma: mesotympanum	1	1	1	0	0	39	100 (2.5-100)	100 (91.0-100)	100 (91.2-100)
Cholesteatoma: hypotympanum	1	1	1	0	0	39	100 (2.5-100)	100 (91.0-100)	100 (91.2-100)
Cholesteatoma: mastoid and antrum	1	2	1	0	1	38	50.0 (1.3-98.7)	100 (90.7-100)	97.5 (86.8-99.9)
Cholesteatoma: any locationa	3	4	3	0	1	36	75.0 (19.4-99.4)	100 (90.3-100)	97.5 (86.8-99.9)
Granulation: epitympanum	3	2	2	1	0	37	100 (15.8-100)	97.4 (86.2-99.9)	97.5 (86.8-99.9)
Granulation: mesotympanum	7	4	4	3	0	33	100 (39.8-100)	91.7 (77.5-98.2)	92.5 (79.6-98.4)
Granulation: hypotympanum	1	1	1	0	0	39	100 (2.5-100)	100 (91.0-100)	100 (91.2-100)
Granulation: mastoid	0	6	0	0	6	34	0.0 (0.0-45.9)	100 (89.7-100)	85.0 (70.2-94.3)
Granulation: any locationa	8	9	6	2	3	29	66.7 (29.9-92.5)	93.5 (78.6-99.2)	87.5 (73.2-95.8)

TP true positive, FP false positive, FN false negative, TN true negative, CI exact 95% confidence interval

aEach patient counted once; a patient could have disease at more than one location

Concordance: HRCT and surgery agreed at every assessed site in 37 patients (92.5%). The remaining three patients accounted for four discordant observations: two false negatives (subtle external canal wall thickening, and ossicles engulfed by granulation) and two false positives (minimal tegmen tympani thinning reported as abnormal, and mastoid opacification corresponding to minimal disease) [Table 5].

Table 5: Discordant observations between HRCT and intraoperative findings

Anatomical site	Concordant, n (%)	False positive, n	False negative, n	Probable reason for discordance
External auditory canal	39 (97.5)	0	1	Subtle wall thickening below the resolution of HRCT
Ossicular chain	39 (97.5)	0	1	Ossicles engulfed by granulation tissue, erosion not visible
Tegmen tympani	39 (97.5)	1	0	Minimal thinning reported as abnormal
Mastoid cortex and antrum	39 (97.5)	1	0	Opacification corresponded to minimal disease
Other 10 sites	40 (100.0) each	0	0	None
Patient level (all sites)	37 (92.5)	2	2	Four discordant observations in three patients

HRCT high-resolution computed tomography. Percentages are of 40 patients

Factors associated with complications: Eight patients (20.0%) had at least one complication. Complication rates did not differ across age groups (p = 0.996) or between men and women (27.3% vs 17.2%; p = 0.660). Complications were more frequent in atticoantral than tubotympanic disease (44.4% vs 12.9%; OR 5.40, 95% CI 0.71 to 39.09), but the difference was not statistically significant (Fisher's exact p = 0.059) [Table 6].

Table 6: Association of age, sex and type of CSOM with complications (n = 40)

Variable	Category	Complications present, n (%)	No complications, n (%)	Total, n	Test statistic	p-value
Age group	Below 20 years	2 (20.0)	8 (80.0)	10	Chi-square = 0.06 (df 3)	0.996
	20-30 years	1 (16.7)	5 (83.3)	6		
	31-40 years	3 (21.4)	11 (78.6)	14		
	Above 40 years	2 (20.0)	8 (80.0)	10		
Sex	Male	3 (27.3)	8 (72.7)	11	OR 1.80 (0.22-11.78)	0.660a
	Female	5 (17.2)	24 (82.8)	29		
Type of CSOM	Atticoantral	4 (44.4)	5 (55.6)	9	OR 5.40 (0.71-39.09)	0.059a
	Tubotympanic	4 (12.9)	27 (87.1)	31		
Total		8 (20.0)	32 (80.0)	40		

Complication: intraoperative tegmen erosion, sigmoid sinus plate abnormality, dural plate abnormality, scutum erosion or ossicular erosion. OR odds ratio with exact 95% confidence interval (reference: female; tubotympanic)
aFisher's exact test, two-tailed.

Discussion

In this cohort of 40 patients, most with tubotympanic disease, HRCT agreed with surgery at 10 of 14 sites in every patient, and 37 patients (92.5%) showed no discordance at any site. Its errors were few and predictable: one of five eroded ossicular chains, one of four cholesteatomas and every mastoid focus of granulation tissue were missed, and the tegmen tympani and mastoid were overcalled once each. In practical terms, HRCT showed where disease lay and which bony barriers were compromised, but it was much less reliable in identifying what the disease was.

Our patients were mostly young adults, similar to the median ages of 26 years reported by Kumari and colleagues in Jharkhand.[16] and 22 years by Gaurano and Joharjy.[14] The female predominance (72.5%) contrasts with the male to female ratio of 1.63:1 in the Jharkhand series.[16] and with 35 men and 29 women in the Saudi series.[14] and probably reflects local referral patterns. Tubotympanic disease made up 77.5% of our cohort, the reverse of most correlation studies, which concentrated on squamosal disease.[14,17-20] Our results therefore describe the routine surgical caseload of an Indian teaching hospital, and accuracy figures should be compared with that difference in mind.

Agreement for mastoid pneumatization and the middle ear compartments was perfect. This matches the finding by Payal and colleagues that soft tissue distribution in the middle ear cleft and mastoid can be predicted confidently.[15] and the 98.8% correlation for mastoid involvement reported by Singh and colleagues.[20] Baráth and colleagues attribute this sensitivity to the spatial resolution of modern scanners.[8] The same property explains our false positive at the mastoid cortex, where thin oedematous mucosa appeared as opacification.

For the ossicular chain, sensitivity was 80.0% and specificity 100%. Published figures vary by ossicle. Altaf and colleagues reported sensitivities of 92.5% for the malleus, 93.5% for the incus and 76% for the stapes, with specificities of 94.7% to 100%.[18] Agarwal and colleagues found lower sensitivities of 81.3%, 70.2% and 68.3% for the malleus, incus and stapes in 156 patients with squamosal disease.[19] and Rogha and colleagues found poor correlation for incus and stapes erosion.[17] Varshney and colleagues found that ossicular erosion was more common in unsafe CSOM and that the incus was the most susceptible ossicle.[21] In our missed case, the ossicles were surrounded by granulation tissue of similar density, the same mechanism that limits visualization of the incudostapedial region in other series.[15, 19] We recorded the chain as a single unit and cannot report ossicle-specific accuracy.

The structures most relevant to surgical safety were assessed well. Every abnormality of the dural plate, sigmoid sinus plate and tegmen was detected, with one false positive at the tegmen tympani. Rogha and colleagues reported excellent correlation for sigmoid plate erosion and good correlation for the tegmen.[17] Agarwal and colleagues found 100% sensitivity and specificity for the sinus plate.[19] and Singh and colleagues reported perfect agreement for intracranial complications (kappa 1.0).[20] By contrast, dural plate sensitivity was only 38.9% in the Agarwal series.[19] Our tegmen false positive resembles the volume averaging error described by Jackler and colleagues.[7] At a barrier to the middle cranial fossa, a false positive is the safer error because it leads to more careful dissection, and forewarning of such hazards is one of the main arguments for scanning before mastoidectomy.[9,10]

We found no facial canal dehiscence or labyrinthine fistula, unlike cholesteatoma series in which Selesnick and Lynn-Macrae found facial nerve dehiscence in 33% of procedures.[22] and Gaurano and Joharjy reported facial canal erosion in 86%.[14] This reflects our case mix, and with no positive cases our data say nothing about sensitivity at these sites. Others have found the facial canal the least reliable structure on CT, with a kappa of 0.30.[9] and a sensitivity of 45.8%.[19] so a normal canal on HRCT should not reduce caution near the tympanic segment. HRCT detected cholesteatoma with 75.0% sensitivity and 100% specificity. Mansour and colleagues reported a similar

sensitivity of 75.5% in 230 patients with histopathological confirmation, but a lower specificity of 70.2%.[23] Our stricter criterion, requiring bone erosion or expansion, probably favoured specificity, consistent with the observation of Jackler and colleagues that soft tissue without erosion is indeterminate.[7] Granulation tissue was much harder to identify, and all mastoid foci were missed. Walshe and colleagues.[11] and Alzoubi and colleagues.[12] likewise found that CT could not separate cholesteatoma from mucosal disease or fluid. HRCT detected soft tissue in the mastoid in 38 patients; it failed only in labelling it. When tissue type will change management, diffusion-weighted MRI is the appropriate complement. Non-echo-planar sequences gave a sensitivity of 82.6% and specificity of 87.2% for primary cholesteatoma.[24] and pooled values of 89.8% and 94.6%.[25] and 91% and 96%.[26] for residual or recurrent disease. Combining clinical assessment, diffusion-weighted MRI and HRCT raised sensitivity to 95.5% in the Mansour series.[23]

Our concordance figures are at the upper end of published reports, which include 97% correlation in cholesteatoma.[14] 97.6% to 100% for cholesteatoma, mastoid and ossicular involvement.[20] and a strong relationship in 112 patients with squamosal disease.[27] Shah and colleagues found HRCT highly sensitive for soft tissue extension, ossicular erosion and tegmen and sigmoid erosion.[28] whereas Sirigiri and Dwaraknath reported false positive and false negative rates in attico-antral disease high enough to prevent full reliance on HRCT.[29] Case mix explains part of this variation. Many of our sites had few true positives, so high accuracy there largely reflects correct identification of normal anatomy, and the specificity and NPV estimates are more precise than the sensitivity estimates. The apparent disagreement about routine scanning also reflects different questions. Studies asking whether CT changed the decision to operate found little benefit,[11,12] whereas those asking whether it changed how the operation was done found that it often did.[10, 13] Our findings support the second view.

Complications were more frequent in atticoantral disease, a pattern consistent with the greater bone erosion of squamosal disease.[4,6] although the difference did not reach significance with only nine atticoantral cases.

This study has limitations. The sample was small, several sites had one or two positive cases, and confidence intervals for sensitivity are wide. The predominance of tubotympanic disease limited the number of cholesteatomas and bony complications. The surgical team was not blinded to HRCT, interobserver agreement was not measured, histopathology was not used as a separate reference for tissue type, the ossicular chain was assessed as a whole, and the internal auditory meatus and petrous apex could not be verified at surgery.

Conclusion

HRCT of the temporal bone agreed with intraoperative findings at every assessed site in 92.5% of patients with CSOM, with accuracy of 97.5% to 100% across 14 sites. It was fully concordant for mastoid pneumatization, the scutum, the middle ear compartments, the dural plate, the sigmoid sinus plate and the tegmen mastoidea, and it detected every tegmen abnormality. Its limitations lay in ossicular assessment when granulation surrounds the chain (sensitivity 80.0%) and in tissue characterization, where cholesteatoma was detected with 75.0% sensitivity and granulation tissue with 66.7%, with every mastoid focus missed. We recommend HRCT before mastoid surgery for CSOM to define mastoid anatomy and the tegmen, dural plate and sigmoid sinus, interpreted together with clinical findings, and the addition of diffusion-weighted MRI when the nature of soft tissue will change management. Larger studies with more atticoantral disease, blinded readers and histopathological confirmation are needed.

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Conflicts of interest

There are no conflicts of interest.

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