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Original Research Article

A Retrospective Prospective Study of Role of HRCT Temporal Bone in Patients with Chronic Suppurative Otitis Media Attending Tertiary Care Center in South Gujarat

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Abstract:

Introduction: CSOM (atticoantral type) is a common condition seen in patients attending ENT department. Anatomical variation in temporal bone is very common and is a significant source of concern in otologic surgeries. High-resolution computed tomography (HRCT) provides a direct visual window of the temporal bone providing vision of unavailable minute structural details. Advantages of HRCT are its ability to detect the extent of cholesteatoma in temporal bone and hidden areas. It assists the surgeon to make decision regarding the type of surgical procedure. Aids in surgical planning and complication prevention (e.g. facial nerve palsy).

Aim: To study correlation between otoscopy findings and HRCT temporal bone in CSOM patients. To document properties of patients with CSOM according to demographic data. To compare intra operative findings with HRCT temporal bone. To decide the modality of treatment based on HRCT temporal bone.

Method: This retrospective-prospective study was conducted in New Civil Hospital, Surat, Gujarat from year 2022 to 2025. 60 patients were selected for the study according to inclusion criteria and then mastoid surgeries were done. A proforma was prepared; clinical findings, investigations, treatment and results were charted. After detailed history taking, proper clinical examination was done. All patients underwent audiological and radiological investigation like PTA, X-ray B/L mastoid and HRCT scan of temporal bone.

Conclusion: In this study, correlation between preoperative HRCT temporal bone findings and intraoperative findings were analysed. It was observed from data that there is strong association between preoperative HRCT temporal bone and intraoperative findings. It provides useful information on anatomical variations of temporal bone and also enhances preoperative evaluation of cholesteatoma, its extension, erosions and complications. HRCT of the temporal bone is a valuable tool for early cholesteatoma detection, surgical planning, and informing patients about prognosis, potential morbidity, and postoperative hearing outcomes, despite drawbacks like radiation exposure and cost. A preoperative CT scan is crucial for diagnosing cholesteatoma, assessing its extent, detecting ossicular erosion, and planning reconstructive surgery for sound conduction.

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Introduction

Chronic suppurative otitis media (atticoantral type) is a common condition seen in patients attending E.N.T department. It is a condition in which there is a chronic infection of the middle ear cleft, which can cause severe destruction of middle ear and mastoid, leading to various sequelae. Anatomical variation of temporal bone is very common and is a significant source of concern in otologic

surgeries.[1] In patients with active squamosal chronic suppurative otitis media the pre-operative assessment of facial canal, lateral semi-circular canal, dural plate and sigmoid plate structures is important to avoid complications during surgery[2].HRCT, provides a direct visual window of the temporal bone providing vision of unavailable minute structural details[3].Advantages of HRCT are its ability to detect the extent of cholesteatoma in temporal bone and hidden areas. It assists the surgeon to make decisions regarding the type of surgical procedure, canal wall up or canal wall down [4]. The purpose of this study is primarily to determine the necessity of HRCT in diagnosis and detection of various pathological changes in the temporal bone in a case of CSOM. Facial canal erosion, lateral semicircular canal erosion, dural plate defect can be seen in patients who have COM with or without cholesteatoma. [5,6] Although LSC erosion increases risk of developing labyrinthitis, dural plate erosion raises the probability of spreading the pathology to the brain, sigmoid sinus plate erosion may lead to venous sinus thrombosis and facial canal erosion may lead to facial nerve palsy. Having preoperative comprehensive knowledge of the anatomy and anomalies of these critical structures is crucial for preventing post-operative morbidity in patients who require surgery due to middle ear disorders and help in justifying the type of tympanomastoid surgery done like canal wall up or canal wall down procedure [7].

Aims and Objectives

a) To study correlation between otoscopy findings and HRCT temporal bone in CSOM (chronic suppurative otitis media) patients.
b) To document properties of patients with chronic suppurative otitis media according to demographic data (age, sex, religion, educational status etc).
c) To compare intra operative findings with preoperative HRCT temporal bone.
d) To decide the modality of treatment based on HRCT temporal bone.

Methodology

This was retrospective-prospective study conducted in a tertiary care centre of South Gujarat (Dept. of ENT, Govt. Medical College & New Civil Hospital, Surat).

Inclusion Criteria:

- Patients with CSOM
- Patients who are giving informed consent

Exclusion Criteria:

- Patients of age < 18
- Operated case of ear
- Patients who are not willing to give informed consent

Result

Table 1: Sex Incidence

Sex	No. of Patients	Percentage
Male	28	46.70%
Female	32	53.30%
Total	60	100%

This study included 28 male and 32 female participants. The higher number of females could be attributed to a greater occurrence of malnutrition and anaemia, coupled with upper respiratory infections in rural regions. The male-to-female ratio observed in this research was 0.875:1

Table 2: Age distribution

Age Group	No. of Patients
18 - 24	32
25 - 34	14
35 - 44	9
45 - 54	1
55 - 64	2
65 - 74	1
75 - 84	1

The youngest patient was 18 years of age and the eldest was 75 years of age.

Table 4: Pre-operative hearing loss

Pre-operative hearing loss	No. of Ears (n=78)	Percentage
Conductive hearing loss	47	60.30%
Mixed hearing loss	24	30.80%
Sensorineural hearing loss	7	9.00%

Most of the diseased ears (60.3%) had conductive hearing loss. Only 9 % had sensorineural hearing loss. And 30.8 % had mixed hearing loss.

Table 6: Site of presentation of pathology:(n=78)

Site of Pathology	No. of Ears	Percentage
Unilateral	42	53.8%
Bilateral (18 patients)	36	46.2%
Total	78	100%

- In this study, there were 60 patients, and a total of 78 diseased ears were detected, out of which surgery was done in 60 ears. There were no specific criteria for patient selection regarding whether the pathology was unilateral or bilateral. Among the patients, 42 had unilateral pathology, while the 18 had bilateral pathology.

Table 7: Type of surgery

Type of Surgery	Ears (n-60)
Modified Radical Mastoidectomy with Type IIa tympanoplasty	5
Cortical mastoidectomy type III tympanoplasty	1
Modified Radical Mastoidectomy with Type III tympanoplasty	25
Modified Radical Mastoidectomy with Type IV tympanoplasty	22
Radical Mastoidectomy	7

- Modified radical mastoidectomy with type III tympanoplasty was done in 25 ears. Modified radical mastoidectomy with type IV tympanoplasty was done in 22 ears. Radical mastoidectomy was done in 7 ears and modified radical mastoidectomy with type IIa was done in 5 ears. Cortical mastoidectomy with type III tympanoplasty was done in 1 ear.

Table 8: Extent of the disease: HRCT temporal bone findings

Extent of the disease	No. of ears(n=60)
Scutum erosion	49
Thinning of tegmen tympani	29
Mesotympanum	47
Epitympanum	53
Antrum	59
Mastoid air cells	59
Facial canal dehiscence	8
Lateral semi-circular canal dome fistula	5
Extracranial complication	8
Intracranial extension	1

Table 11: Correlation of HRCT finding with Intra-op finding

Ossicles	HRCT finding	Intra operative
Malleus	40	39
Incus	54	59
Stapes	30	29

- Incus erosion could be visualized by HRCT in 54 ears & intraoperatively in 59, malleus erosion could be visualised by HRCT in 40 ears & intraoperatively in 39, stapes erosion could be visualised by HRCT in 30 cases & intraoperatively in 29.

Table 12: Ossicular Status (Total no. of ears = 60)

Ossicular erosion	HRCT temporal bone finding	Intra-op findings	Sensitivity (%)	Specificity (%)	Positive predictive value
Malleus	40	39	97.50%	95.24%	100%
Incus	54	59	91.5%	100%	100%
Stapes	30	29	96.70%	100%	100%

- In the case of incus erosion there were 5 false negative cases giving sensitivity of 91.5%, specificity of 100%, positive predictive value of 100%. In case of malleus erosion there were 1 false positive case giving sensitivity of 97.50%, specificity of 95.24%, positive predictive value 100%. In case of stapes erosion, there was 1 false positive ear giving

sensitivity of 96.70, specificity of 100%, positive predictive value 100%.

Table 14: Correlation of CT scan with surgical findings Evidence of cholesteatoma. (n=60)

Correlation	Evidence of cholesteatoma	Sensitivity	Specificity	P value
CT findings	58	98.30%	100%	0.01
Intraoperative findings	59			

- In our study, 59 ears showed evidence of cholesteatoma on surgical exploration & 58 ears showed evidence of cholesteatoma on preoperative HRCT scan.

Discussion

This study was conducted in the ENT Department of New Civil Hospital, Government Medical College, Surat. A total of 60 patients were included, with 78 ears affected by disease.

The youngest patient was 18 years and the eldest was 75 years. The male-to-female ratio was 0.875:1, with slightly more female patients (53.3%) than males (46.7%). This finding contrasts with some studies where males predominate; however, the higher female representation in the present study may be attributed to a greater prevalence of malnutrition, anaemia, and recurrent upper respiratory infections in rural women, which predispose them to chronic otitis media. A similar female preponderance was observed by Shraddha Sasi, who noted 42 female and 33 male patients among 75 cases of chronic otitis media (COM). [8]

Most of the diseased ears (79.48%) in our study had complaints of ear discharge and decreased hearing. Singh et al., in their prospective study on unsafe CSOM, reported that ear discharge was the most common symptom (100%), followed by earache (66%), vertigo (16%), and tinnitus (14%). [9] These findings are consistent with the classical presentation of atticoantral CSOM and reaffirm the importance of thorough clinical evaluation as the first step in diagnosis.

In this study, 42 patients had unilateral and 18 had bilateral pathology, yielding a total of 78 diseased ears. Surgery was performed in 60 ears. Kapoor et al. in their diagnostic accuracy study at a tertiary care centre in Western India similarly noted bilateral CSOM disease in 28% of their study population and accordingly analyzed findings per temporal bone rather than per patient. [10] Our approach of including all diseased ears for radiological-surgical correlation is consistent with this methodology.

Conductive hearing loss was the predominant type in our study (60.3%), followed by mixed hearing loss (30.8%) and sensorineural hearing loss (9%). This pattern is well established in the literature. Ossicular chain erosion, the primary cause of conductive hearing loss in cholesteatoma, is a well-recognized consequence of enzymatic bone resorption driven by keratinocytes and inflammatory mediators within the cholesteatoma matrix.

In the present study, the antrum and mastoid air cells were the most frequently involved structures (59 ears each), followed by the epitympanum (53 ears), mesotympanum (47 ears), and scutum (49 ears). Epitympanum/Prussak's space has been documented as the most commonly involved site by soft tissue density in cholesteatoma, followed by the aditus ad antrum and mesotympanum. [11] Facial canal dehiscence was detected on HRCT in 8 ears (13.3%), and lateral semicircular canal (LSCC) dome fistula in 5 ears (8.3%). Extracranial complications were detected in 8 ears, and intracranial extension in 1 ear. Facial canal erosion, lateral semicircular canal erosion, and dural plate defects can occur in chronic otitis media with or without cholesteatoma. LSC erosion increases the risk of labyrinthitis, dural plate erosion raises the possibility of intracranial spread, sigmoid sinus plate erosion may lead to venous sinus thrombosis, and facial canal erosion may result in facial nerve palsy.[12]

In our study, cholesteatoma was detected on preoperative HRCT in 58 ears and confirmed intraoperatively in 59 ears, yielding a sensitivity of 98.3%, specificity of 100%, with a statistically significant p-value of 0.01. This is comparable to the findings of Siripurapu et al., who reported a sensitivity of 100% and specificity of 100% for scutum erosion and mastoid cortex dehiscence, with HRCT serving as a useful preoperative investigation despite some false positives and false negatives for individual parameters. [13] Kapoor et al. reported a sensitivity of 100% (CI 93.8–100%), specificity of 88.1% (CI 74.4–96.0%), PPV of 92.1%, NPV of 100%, and overall accuracy of 95% for HRCT in diagnosing cholesteatoma when correlated with intraoperative and histopathological findings. [14] The single false negative in our study likely represents early or micro-cholesteatoma obscured by surrounding soft tissue opacification, a recognized limitation noted across multiple series. A key limitation of HRCT is its inability to differentiate cholesteatoma from other nonspecific soft tissue entities such as granulation tissue, cholesterol granuloma, or postoperative scarring. [15]

Incus was the most commonly eroded ossicle in our study, identifiable on HRCT in 54 ears and intraoperatively in 59 ears (sensitivity 91.5%,

specificity 100%, PPV 100%). Malleus erosion was detected in 40 ears on HRCT and 39 intraoperatively (sensitivity 97.5%, specificity 95.24%, PPV 100%). Stapes erosion was found in 30 ears on HRCT and 29 intraoperatively (sensitivity 96.7%, specificity 100%, PPV 100%). Incus is consistently identified as the most commonly eroded ossicle, reported in up to 86% of patients both on HRCT and intraoperatively, with sensitivity of 100% and specificity of 100% for incus erosion.[16] Singh et al. reported sensitivity of 78.5% and specificity of 78.1% for malleus erosion, noting that HRCT is a good preoperative diagnostic modality for identifying ossicular necrosis and its use should be encouraged for better adjunctive preoperative assessment and improved surgical outcomes. [17] The relative difficulty in visualizing stapes due to its small size and surrounding soft tissue attenuation is a recognized challenge, as noted by Krishnamoorthi et al., who observed that the status of the stapes was not effectively recorded on HRCT, with sensitivity values as low as 53.1% and 68% reported in different series. [18]

The surgical approach was guided by HRCT findings in all cases. Modified radical mastoidectomy (MRM) with type III tympanoplasty was the most common procedure (25 ears), followed by MRM with type IV tympanoplasty (22 ears), radical mastoidectomy (7 ears), MRM with type IIa tympanoplasty (5 ears), and cortical mastoidectomy with type III tympanoplasty (1 ear). The predominance of canal wall down procedures reflects the extensive disease burden encountered in this tertiary care setting. HRCT gives excellent details about the extent of cholesteatoma with reasonable accuracy in expert hands, effectively depicting the integrity or erosion of the dural plate, sinus plate, lateral semicircular canal, and facial nerve, which directly influences the choice between canal wall up and canal wall down mastoidectomy.[18]

Intraoperative findings and HRCT have shown better results with good correlation of diagnostic value, especially in detecting sigmoidal plate erosion, dural exposure, incus and stapes erosion, and malleus-incus joint discontinuity, with sensitivity and specificity of 100% for these parameters reported from the Middle East. [8] A study from Egypt by Monem et al. similarly found HRCT accuracy and sensitivity of 92.8% in detecting cholesteatoma, 96.4% for location and extension, 98% for ossicular chain erosion, and 100% for labyrinthine fistula and intracranial complications. [19] These findings collectively corroborate the strong diagnostic value of HRCT observed in our study, with the minor discrepancies in sensitivity values across studies likely attributable to differences in CT scanner technology, slice thickness, radiologist expertise, and the complexity of disease at presentation.

Conclusion

In this study, correlation between preoperative HRCT temporal bone findings and intraoperative findings were analysed. It was observed from data that there is strong association between preoperative HRCT temporal bone and intraoperative findings. It provides useful information on anatomical variations of temporal bone and also enhances preoperative evaluation of cholesteatoma, its extension, erosions, and complications. HRCT of the temporal bone is a valuable tool for early cholesteatoma detection, surgical planning, and informing patients about prognosis, potential morbidity, and postoperative hearing outcomes, despite drawbacks like radiation exposure and cost. A preoperative CT scan is crucial for diagnosing cholesteatoma, assessing its extent, detecting ossicular erosion, and planning reconstructive surgery for sound conduction. Limitations

The study only includes 60 ears, which may not be large enough to generalize these findings to a broader population.

The study relies on HRCT imaging. Any limitations of the machine, proper positioning of the patient or in the interpretation of the images could affect the results. Newer imaging technologies might yield different outcomes, and it is costly.

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