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# Role of high resolution CT temporal bone in unsafe chronic suppurative otitis media

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## Abstract

**Introduction:** HRCT Temporal bone in unsafe CSOM can provide excellent details of temporal bone anatomy, its congenital variations, location and extent of disease, asymptomatic complications and degree of bone destruction. It confirms otoscopic findings to greater extent, clear many clinical doubts and helps in determining surgical efficacy when surgery will be necessary and also for planning the approach for surgery.
**Aim:** To assess the usefulness of HRCT imaging of temporal bone in cases of unsafe chronic suppurative otitis media and to describe the status of the disease in unsafe chronic suppurative otitis media.
**Material and Methods:** Total 40 patients with clinical diagnosis of unsafe CSOM were included in the study and underwent HRCT using Siemens Somatom Scope 16 slice CT machine as per standard protocol. Each HRCT was analysed for presence of soft tissue density in middle ear and mastoid cavity and status of ossicles, mastoid cavity, scutum, lateral semicircular canal, cochlea, facial nerve canal, external auditory canal, tegmen tymphani and sinus plate.
**Results:** Maximum numbers of patients were in age group of 21 to 30 (35%) with male to female ratio of 2.6:1. Most common chief complaint was otorrhoea (90%) and hearing loss (45%). Most common ossicle eroded was incus (65%) and scutum erosion noted in 55% cases.
**Conclusion:** HRCT is useful for diagnosis, surgical planning and management of temporal bone pathologies. Preoperative CT scan is beneficial and contributory in relation to diagnosis and decision-making in indicating operation to patients with CSOM and improves the success rate of cholesteatoma surgeries. It serves as road map to assist the surgeon during surgery.

**Keywords:** Cholesteatoma, atticoantral CSOM, Middle ear, mastoid antrum.

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## Introduction

Chronic suppurative otitis media (CSOM) is a pathology of the middle ear and often involves the mastoid, insidious in onset and is capable of causing severe destruction and irreversible sequelae [1]. CSOM is a very common disease, especially in South East Asia and western pacific nations, which contribute 85% of global burden of CSOM cases [2]. Occurrence of CSOM is highest in children and young adults of developing countries and it accounts for 91% of childhood hearing impairment among Indian population [2].

It is clinically categorized into two types: tubotympanic and atticoantral. Tubotympanic, also called safe or benign type, involves the anteroinferior part of middle ear cleft and is associated with central perforation. Atticoantral, also called unsafe or dangerous type, involves the posterosuperior part of middle ear cleft, namely, the attic, antrum, and mastoid, and is associated with an attic or marginal perforation. Compared to tubotympanic CSOM, atticoantral poses a higher risk of complications. Cholesteatoma, granulation tissue or osteitis are found to occur in the atticoantral type of CSOM [3-5].

The complicated anatomical spatial arrangement of middle ear structures and petrous bone makes it difficult to assess them radiologically. In conventional radiograhic procedures, there exist several special projections for optimal representation of particular structures, but they are often diagnostically insufficient and additional tomographs in one or more planes are necessary [6-9]. However, Computed tomography (CT) play a role in the evaluation of temporal bone disorders because with sufficiently high spatial resolution and thin collimation it demonstrates the cochlea, oval window, internal auditory canal, vestibule, superior semicircular canal, ossicles, descending facial nerve canal, drum spur, and external auditory canal [10,11].

HRCT can provide excellent details of temporal bone anatomy, its congenital variations, location and extent of disease, asymptomatic complications and degree of bone destruction [12]. It confirms otoscopic findings to greater extent, clear many clinical doubts, and helps in determining surgical efficacy when surgery will be necessary and also for planning the approach for surgery.

From the imaging perspective, attico- antral CSOM can be further classified into cholesteatomatous and non-cholesteatomatous types. In both these subtypes, granulation tissue is present; however, cholesteatoma characteristically leads to bone and ossicular erosion (in ~90% of the cases).

The classical HRCT findings in attico-antral CSOM with cholesteatoma include

1. Erosion and blunting of scutum (lateral attic wall).
2. Widening of the aditus and antrum.
3. Displacement of ossicular chain.
4. Destruction of ear ossicles [10].

Facial canal dehiscence (FCD), lateral semicircular canal (LSC) dehiscence, and dural plate defect can be seen in patients who have CSOM with or without cholesteatoma [13, 14].

CT imaging in all patients with CSOM would assist in patient counselling, surgical approach and preparing the surgeon for possible complications or difficulties [15-17]. The purpose of this study was to assess the role of HRCT in unsafe CSOM.

## Material and Methods

This hospital based prospective observational study was conducted in the Department of Radiodiagnosis & Imaging, Muzaffarnagar Medical College, Uttar Pradesh from July 2020 to June 2021, after approval from institutional ethical committee. Total 40 patients of varied age group were included in the study which were diagnosed clinically as unsafe CSOM and

referred for HRCT temporal bone. Patients were excluded if there is history of previous ear surgery, temporal bone fracture or temporal bone neoplasm.
High resolution Computed Tomography of temporal bone using CT Machine Siemens Somatom Scope 16 slice was performed. A detailed clinical history was recorded. The patient is placed supine in the gantry and positioned to place the lens of the eye as far as possible out of the path of X-Ray beam to minimize the exposure to the lens. Scans were acquired in the helical mode to reduce motion artifacts. With the patient in supine position, axial projections were obtained by serial 1 mm thin sections of the temporal bone with the line joining the infra-orbital rim and external auditory meatus perpendicular to the table. The images were reconstructed with a bone algorithm. Coronal and sagittal reformatting was done to a slice thickness of 0.69 mm.
Each HRCT image were analysed for specific features relevant to the evaluation of pathologies of temporal bone and interpreted in detail to define the type and extent of lesion. Presence of soft tissue density in middle ear and mastoid cavity noted with status of ossicles, mastoid cavity, scutum, lateral semicircular canal, cochlea, facial nerve canal, external auditory canal, tegmen tymphani and sinus plate.

**Statistical analysis:** Data was collected and subjected to statisical analysis using SPSS software version 24.

## Results

A total number of 40 patients were included in the study. All patients were diagnosed clinically as unsafe chronic suppurative otitis media. The age of patients ranged from 6 years to 67 years with mean age 28.5 years. Most common age group was 21-30 years (32.5%) in our study. Total male patients were 29 (72.5%) & female patients were 11 (27.5%) in our study. Male-to-female ratio was 2.6:1 [Table-1].
In the present study, right ear involvement was seen in 12 patients (30%), left ear was affected in 22 patients (55%), and bilateral ear involvement was present in 6 patients (15%). The major chief complaint of the patient was otorrhea (n=36, 90%), followed by complaint of hearing loss (n= 18, 45%), otalgia (n= 13, 32.5%), aural fullness (n=11, 27.5%), headache (n=8, 20%) and vertigo (n=4, 10%). There were 2 patients each with complain of tinnitus, facial palsy and fever (5% each). Complaint of nausea and vomiting was reported by 1 patient (2.5%) [Table-2].
The site and extension of unsafe CSOM was recorded, maximum involvement was of Epitympanum (n=26, 65%), followed by Mastoid antrum (n=23, 57.5%), Aditus ad antrum (n=21, 52.5%), Mesotympanum (n=18, 45%), and Hypotympanum (n=13, 32.5%). The least involvement was of Mastoid air cells (n=7, 17.5%) [Table-3]. Bony erosion was seen in 32 patients (80%). Incus was the most common ossicle to be necrosed (n=26, 65%), followed by malleus (n=17, 42.5%) and least was of stapes (n=8, 20%). Other than ossicles, scutum erosion noted in maximum cases (n=22, 55%), followed by Tegmen erosion (n=5, 12.5%), Sinus plate erosion (n=4, 10%). Lateral SCC erosion and Mastoid cortex erosion was present in two patients each (5% each). Least erosion was of Facial canal (n=1, 2.5%) [Table-4].

**Table 1:** Age and sex wise distribution of the patients

| Age Group (in years) | Male | Female | Total |
|---|---|---|---|
| 0-10 years | 2 | 1 | 3 |
| 11-20 years | 5 | 2 | 7 |
| 21-30 years | 9 | 4 | 13 |
| 31-40 years | 8 | 3 | 11 |
| 41-50 years | 1 | 0 | 1 |

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| | | | |
|---|---|---|---|
| 51-60 years | 2 | 0 | 2 |
| >60 years | 2 | 1 | 3 |
| Total | 29 | 11 | 40 |

**Table 2:** Symptoms among the study subjects

| Symptoms | Number(N) | Percentage (%) |
|---|---|---|
| Otorrhea | 36 | 90% |
| Hearing loss | 18 | 45% |
| Otalgia | 13 | 32.5% |
| Aural fullness | 11 | 27.5% |
| Tinnitus | 2 | 5% |
| Vertigo | 4 | 10% |
| Headache | 8 | 20% |
| Facial palsy | 2 | 5% |
| Nausea and vomiting | 1 | 2.5% |
| Fever | 2 | 5% |

**Table 3:** Site and extension of CSOM among the study subjects

| Site | Number (N) | Percentage (%) |
|---|---|---|
| Epitympanum | 26 | 65% |
| Mesotympanum | 18 | 45% |
| Hypotympanum | 13 | 32.5% |
| Aditus ad antrum | 21 | 52.5% |
| Mastoid antrum | 23 | 57.5% |
| Mastoid air cells | 7 | 17.5% |

**Table 4:** Status of middle ear cleft structures among the study subjects

| Erosion | Number(N) | Percentage (%) |
|---|---|---|
| Malleus | 17 | 42.5 |
| Incus | 26 | 65 |
| Stapes | 8 | 20 |
| Scutum erosion | 22 | 55 |
| Tegmen erosion | 5 | 12.5 |
| Sinus plate erosion | 4 | 10 |
| Lateral SCC erosion | 2 | 5 |
| Mastoid cortex erosion | 2 | 5 |
| Facial canal erosion | 1 | 2.5 |

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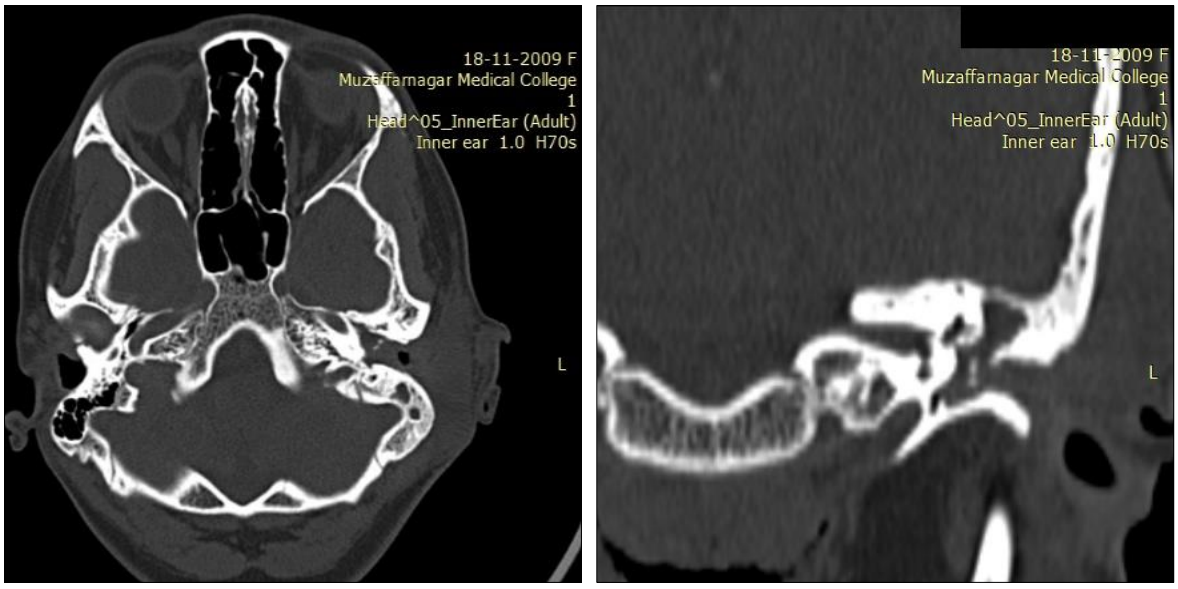
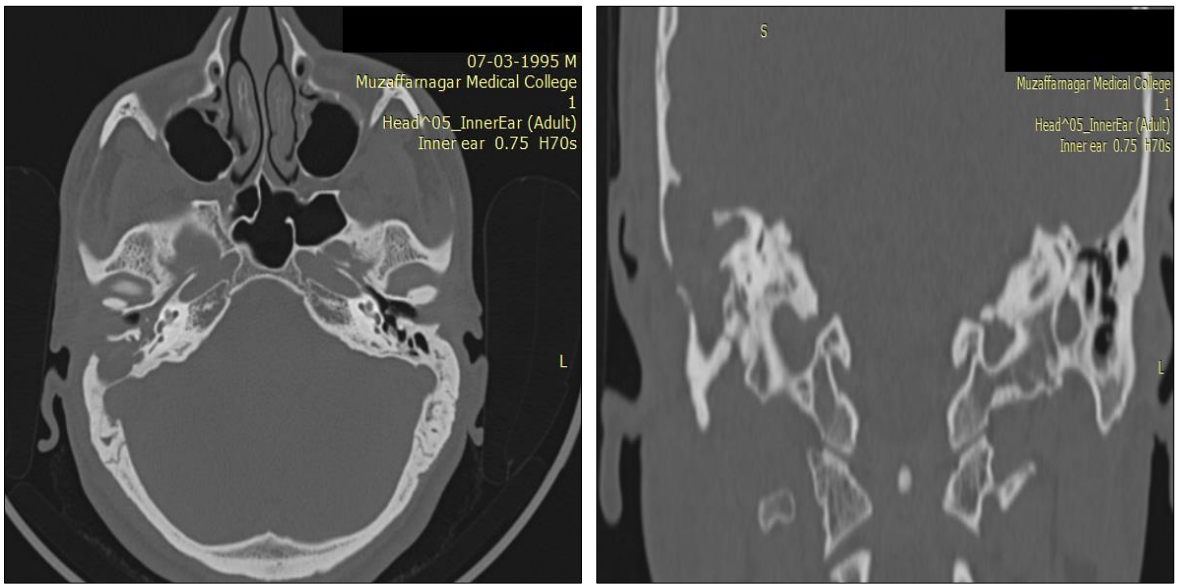



**(A)** **(B)**

**Fig 1:** HRCT temporal bone axial (A) and coronal (B) section shows soft tissue density contents in left external auditory canal and completely filling the middle ear cavity causing mild erosion of the ear ossicles with erosion and blunting of scutum.




**(A)** **(B)**

**Fig 2:** HRCT temporal bone axial (A) and coronal section (B) shows complete destruction of right mastoid air cells with soft tissue opacification and seen completely filing the epitympanum, mesotypanum & hypotympanum of right middle ear cavity with partially visualized middle ear ossicles and erosion of tegmen tympani on the right side.

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**(A)** **(B)**

**Fig 3:** HRCT temporal bone axial (A) and coronal (B) section shows erosion of left lateral semicircular canal.

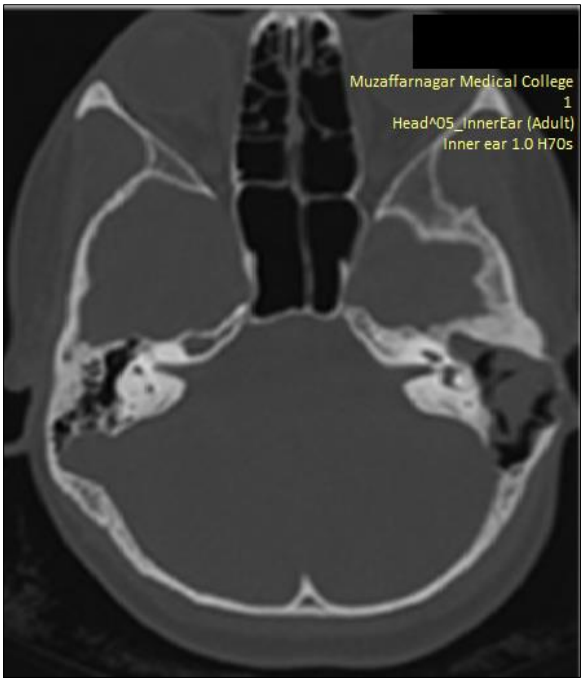


**Fig 4:** HRCT temporal bone axial section shows soft tissue density mass in the left middle ear cavity, aditus and antrum with the erosion of the sigmoid sinus plate and lateral cortical wall of the mastoid. Mastoid septae are eroded forming single cavity on left side.

## Discussion

High-resolution computed tomography (HRCT) of the temporal bone may demonstrate a soft-tissue mass with characteristic ossicular displacement and erosion of the bone. Cholesteatoma in hidden areas may be revealed by radiological examination even if it is not detected clinically [18]. HRCT of the temporal bone is considered the most crucial imaging technique for assessing the hypotympanum, facial recess, and labyrinthine canal, which cannot be evaluated by otomicroscopy [19, 20, 21]. HRCT provides a direct visual window into the

temporal bone providing visualization of unavailable minute structural details, surgical visualization of the anatomy and pathology of the temporal bone [22, 23, 24].

In the present study, it was observed that unsafe CSOM was most commonly diagnosed in age group of 21-30 years and least common in 41-50 years. It was in accordance with the study of Sharma VK *et al*. [25], Aljehani M, Alhussini R [26] and Lyngwa GY *et al*. [27], where maximum patients belong to age group 21-30 and least were in 41-50 age group.

In present study, out of the total 40 cases, CSOM was more common in males (72.5%). Male-to-female ratio in present study was 2.6:1. This was in accordance to study of Gerami *et al*. [16], Sharma N *et al*. [28], Thukral CL *et al*. [29], Sharma VK *et al*. [25] and Lyngwa GY *et al*. [27].

In our study, maximum involvement was of left ear (55%), followed by right ear (30%) and bilateral ear involvement (15%). The result was in accordance to study of Lyngwa GY *et al*. [27], where right ear was affected in 34% patients, left ear in 52% patients and bilateral ear involvement was present in 14% patients.

In the present study, the most common presenting symptom was otorrhea (90%), followed by complaint of hearing loss (45%), otalgia (32.5%), aural fullness (27.5%), headache (20%), vertigo (10%), tinnitus (5%), facial palsy (5%), fever (5%) and nausea and vomiting (2.5%). This probably indicates that the patients come to hospital relatively late and are reluctant for initial treatment. In study done by Rai T [24] the most common presenting symptom was otorrhea followed by hearing loss and otalgia and least was of nausea and vomiting.

In present study, Scutum erosion was most commonly seen (55%) [Fig-1], followed by Tegmen erosion (12.5%) [Fig-2], Sinus plate erosion (10%), Lateral SCC erosion [Fig-3] and Mastoid cortex erosion [Fig-4] (5% each) and Facial canal erosion (2.5%). The result was in accordance to study of Sharma VK *et al*. [25], Lyngwa GY *et al*. [27] and Singh R *et al*. [30] According to Sharma VK *et al*. [25] bony erosions in the form of scutum erosion were present in 84% of patients. According to study done by Singh R *et al*. [30], the erosion of scutum was seen in 36/60 (60%) ears on HRCT and confirmed intraoperatively.

In present study, incus was the most common ossicle to be necrosed (65%), followed by malleus (42.5%) and least was of stapes (20%). The result was in accordance to result of Sharma VK *et al*. [25]. According to study done by Sharma VK *et al*. [25], incus was most commonly involved ossicle and CT could identify the erosion of incus in 92% of cases. But according to Singh R *et al*. [30], preoperative complete malleus, incus and stapes erosions reported in 14/60 (23%), 25/60 (42%), and 36/60 (60%) ears on HRCT were confirmed intraoperatively. So according to this study erosion of stapes was most common. HRCT provides a good visualization which helps in detection of variances despite the presence of surrounding soft tissue.

In the present study, when the site and extension of cholesteatoma among the study subjects was recorded, maximum involvement was of Epitympanum (65%), followed by Mastoid antrum (57.5%), Aditus ad antrum (52.5%), Mesotympanum (45%), and Hypotympanum (32.5%). The least involvement was of Mastoid air cells (17.5%). This was in accordance to study of Lyngwa GY *et al*. [27], in which involvement was of Epitympanum was present in 35/50 patients.

HRCT scans of the temporal bone have significantly enhanced the preoperative evaluation of unsafe CSOM. This study has shown that CT imaging for CSOM accurately depicts soft-tissue mass. It also effectively depicts the integrity or erosion of dural plate, sinus plate, lateral semicircular canal, lateral cortical wall, etc. The ear ossicles malleus and incus are well depicted in the study.

Noteworthy, this study has some limitations, the main of which is the absence of correlation with postoperative finding and small sample size of study participants.

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## Conclusion

CT temporal bone is an efficacious modality for accurate delineation of the anatomy and pathological involvement of temporal bone. HRCT is useful for diagnosis, surgical planning and management of temporal bone pathologies. HRCT has revolutionized temporal bone imaging and has replaced the earlier modalities. The significant correspondence between HRCT and clinical findings may lead to a better diagnosis of probable problems before surgery and improves the success rate of cholesteatoma surgeries.
HRCT temporal bone despite its pitfalls such as more radiation exposure and higher cost delineates the location and extent of the disease and provides information on anatomical variations and complications.

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