



### Original Research Paper

## A Prospective Study of 42 Cases of Unsafe CSOM & Comparison of Operative Findings with Pre-Operative HRCT in a Tertiary Health Care Center in Central India

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### Abstract

**Aim:** To compare pre operative radiological findings (HRCT) with intra operative findings in unsafe CSOM patients.

**Materials and Method:** 42 cases of unsafe csom were examined clinically and then followed by surgery. HRCT of 0.5 mm sections in both axial and coronal planes was performed in all cases. Considering intra-operative findings as gold standard, a comparison and correlation was made with HRCT temporal bone.

**Results:** According to this study, HRCT temporal bone can identify structures such as facial nerve canal, dural plate, sinus plate, ossicles and soft tissue mass distribution easily. It is highly sensitive in identifying the condition of ear ossicles, soft tissue mass distribution in middle ear, mastoid pneumatisation, carotid canal and jugular canal with high specificity whereas less specific for facial nerve canal and sigmoid sinus plate erosion.

**Conclusion:** The present study states that HRCT temporal bone scan plays a very important role in diagnosing unsafe CSOM and its complications preoperative. Despite of a few pitfalls, it plays an excellent role in helping surgeons to plan the type of surgery for each and every case specifically.

**Keywords:** HRCT temporal bone, Unsafe CSOM, Intra-operative, Ossicles, Temporal bone.

### Introduction

Chronic suppurative otitis media (CSOM) refers to an inflammatory process involving the middle ear and mastoid spaces chronically over duration of longer than 3 months<sup>(1,2)</sup>. Since prehistoric times, its complications have been a challenge to both the otologist and the radiologist. The diagno-

sis of attico-antral disease or unsafe CSOM can be made quite effectively by clinical examination, but for the assessment of the extension of the disease, imaging has an important role to determine the early surgical approach to be followed to limit the disease. Schuller was the first to describe pathological lesion radio-graphically in temporal

bone. Many views were developed and improved to see the pathological changes such as ossicular erosion, labyrinthine involvement, cholesteotoma<sup>(4)</sup> and intracranial complications, but none of them gave sufficient information. Radiological evaluation of the temporal bone is difficult because of complicated anatomical structure of the middle ear and inner ear. Conventional radiography<sup>(19)</sup> is used only for screening temporal bone as it produces a composite single plane image of a tri-dimensional bone which results in superimposition where larger and denser structures obscure smaller and less dense ones. HRCT, a modification of routine CT gives a direct visual window into the temporal bone, thus helping in evaluation of unavailable minute structural details of bone and air space anatomy. Thin section HRCT imaging of temporal bone up to a spatial resolution of 0.45-0.65mm provides an excellent topographical visualization devoiding of any artifacts from superimposition of structures. It also helps the surgeon in deciding between a canal wall up Vs an open procedure<sup>(20)</sup> as HRCT has the ability to determine the extent of soft tissue involvement of the middle ear, antrum and the posterior tympanic spaces especially. The purpose of the study is primarily to understand the capability of HRCT in correct diagnosis and detection of pathological changes occurring in the temporal bone in case of attico-antral CSOM preoperatively.

### Aim and Objectives

1. To compare pre operative radiological findings (HRCT) with intra operative findings in unsafe CSOM patients
2. To find the role of HRCT for correct diagnosis of attico-antral or unsafe CSOM cases.

### Materials and Method

This prospective study was conducted in the department of otorhinolaryngology and radiodiagnosis at a tertiary care centre in central India. 42 patients were selected whose clinical diagnosis was attico-antral type CSOM.

Inclusion criteria for selection of cases:-

1. Unilateral / bilateral unsafe CSOM.

Exclusion criteria:

1. Safe CSOM clinically
2. Congenital ear disease
3. Unfit patients for surgery
4. Old operated CSOM cases
5. Malignant ear pathology
6. Cervical spine osteoarthritis
7. Patients < 10 years age

All the cases were examined clinically. Pure tone audiometry and all the routine investigations for surgery were done. HRCT of 1mm sections in both axial and coronal planes was performed in all cases. Findings were recorded and tabulated. All the patients underwent surgery and their intra operative findings were noted. A comparison was made between HRCT temporal bone and intra operative finding.

### Observations

A total of 42 cases of attico-antral type chronic suppurative otitis media were selected for the present study.

### Age Distribution

The patients were in the age group from second to sixth decade. Maximum number of patients belonged to the age group of 11- 20 years. Mean age of the patients included in the present study was 24.28 years.

**Table 1** Age distribution

| Age Grouping (In Years) | No. Of Cases | %Age    |
|-------------------------|--------------|---------|
| 11- 20                  | 23           | 54.7 %  |
| 21- 30                  | 12           | 28.57 % |
| 31- 40                  | 3            | 7.14 %  |
| 41- 50                  | 2            | 4.76 %  |
| 51- 60                  | 1            | 2.38 %  |
| Above 60                | 1            | 2.38 %  |

### Sex Distribution

Male to Female ratio in the present study was 1.33:1. Out of a total of 42 cases, 18(42.87 %) were found to be males and 24(57.14) were females.

**Symptoms**

All the 42 cases had ear discharge. 36 cases had decreased hearing as complaint. Other less frequent symptoms were vertigo, tinnitus, and facial nerve palsy.

**Table 2** No. of cases with symptoms:

| Symptoms           | Number Of Cases |
|--------------------|-----------------|
| Ear discharge      | 42              |
| Hearing loss       | 36              |
| Fever              | 8               |
| Pain               | 4               |
| Tinnitus           | 3               |
| Headache           | 4               |
| Vertigo            | 3               |
| Vomiting           | 3               |
| Facial nerve palsy | 3               |

**Comparison between HRCT temporal bone and intra-operative findings:**

[1] Soft tissue mass:

On comparing pre-operative HRCT temporal bone with intra-operative findings, soft tissue masses were found in all the 42 cases. Out of which,

11(26.19%) cases were found to have cholesteatoma, 13(30.95%) cases were associated with granulations and 18 (42.85 %) cases were found to have granulations and cholesteatoma both.

**Table 3** No. of cases with soft tissue mass

| Operative Findings | No. Of Cases | %Age    |
|--------------------|--------------|---------|
| Soft tissue mass   | 42           | 100 %   |
| Cholesteatoma      | 11           | 26.19 % |
| Granulation        | 13           | 30.95 % |
| Both               | 18           | 42.85 % |

[2] Distribution of soft tissue mass

On HRCT, the soft tissue in 36 (85.7 %) cases was seen in both middle ear and mastoid. In 3 (7.14 %) cases, it was confined to middle ear only. Intra operatively soft tissue was present in middle ear and mastoid in 37 (88.09 %) cases and confined to middle ear in 2 (4.76%) cases. Whereas, 3(7.14 %) cases showing soft tissue in external auditory canal (EAC), middle ear along with mastoid in HRCT was confirmed intra operatively also.

**Table 4** Soft tissue mass distribution

| Site Of Soft Tissue Mass   | CT Finding   |        | Operative Findings |        |
|----------------------------|--------------|--------|--------------------|--------|
|                            | No. Of Cases | %Age   | No. Of Cases       | %Age   |
| Middle ear and mastoid     | 36           | 85.7 % | 37                 | 88.09% |
| Middle ear only            | 3            | 7.14%  | 2                  | 4.76%  |
| Mastoid only               | 0            | 0%     | 0                  | 0%     |
| EAC + middle ear + mastoid | 3            | 7.14%  | 3                  | 7.14%  |

[3] Ossicular status:

Malleus appeared to be intact in 18 (42.85 %) cases on HRCT, but it appeared eroded in 24 (57.1%) cases per operatively. On HRCT, Incus appeared to be intact in 18 (42.85 %) cases, intra operatively it was found to be intact in 13(30.95 %) cases, and in the remaining 29 (69.04%) cases

it was partially necrosed. On HRCT, incus appeared to be eroded in 24 (57.1%) cases. On HRCT, Stapes appeared to be intact in 21(50 %) cases, eroded in other 21 (50 %) cases, intra operatively it was eroded in 25 cases (59.52 %) and found to be intact in 17(40.47 %) cases.

**Table 5** Ossicular chain status

| Ossicles       | CT Findings  |      | Operative Findings |      |        |
|----------------|--------------|------|--------------------|------|--------|
|                | No. Of Cases | %Age | No. Of Cases       | %Age |        |
| <b>Malleus</b> | - Intact     | 18   | 42.85%             | 14   | 33.33% |
|                | - Necrosed   | 24   | 57.1%              | 28   | 66.66% |
| <b>Incus</b>   | - Intact     | 18   | 42.85%             | 13   | 30.95% |
|                | - Necrosed   | 24   | 57.1%              | 29   | 69.04% |
| <b>Stapes</b>  | - Intact     | 21   | 50%                | 17   | 40.47% |
|                | - Necrosed   | 21   | 50%                | 25   | 59.52% |

[4] Semicircular Canal, Facial Canal, Dural Plate and Sinus Plate:

Lateral semicircular canal erosion was depicted in 2 (4.76 %) cases on CT and the same was confirmed intra operatively. Facial nerve canal appeared eroded in 1(2.3%) case in tympanic segment on HRCT but was confirmed in 2 (4.76 %) cases per operatively.

Dural plate erosion was seen in 2 (16%) cases on HRCT which was confirmed intra operatively. Intact Dural plate was seen in 40 (95.25%) cases on HRCT which was also confirmed intra operatively. Sinus plate erosion was seen in 3 (7.14%) cases and intact sinus plate was seen in 39 (%) cases in HRCT, whereas 38 (90.47%) intra operatively.

**Table 6** Status of Lateral Semicircular Canal, Facial Canal, Dural Plate and Sinus Plate

|                     | CT Findings  |        | Operative Findings |        |
|---------------------|--------------|--------|--------------------|--------|
|                     | No. Of Cases | %Age   | No. Of Cases       | %Age   |
| <b>LSCC</b>         |              |        |                    |        |
| -Intact             | 40           | 95.25% | 40                 | 95.23% |
| -Eroded             | 2            | 4.76%  | 2                  | 4.76%  |
| <b>Facial canal</b> |              |        |                    |        |
| -Intact             | 41           | 97.61% | 40                 | 95.23% |
| -Eroded             | 1            | 2.3%   | 2                  | 4.76%  |
| <b>Dural plate</b>  |              |        |                    |        |
| -Intact             | 40           | 95.23% | 40                 | 95.23% |
| -Eroded             | 2            | 4.76%  | 2                  | 4.76%  |
| <b>Sinus plate</b>  |              |        |                    |        |
| - Intact            | 39           | 92.85% | 38                 | 90.47% |
| - Eroded            | 3            | 7.14%  | 4                  | 9.52%  |

#Jugular canal wall and Carotid canal wall were found intact in all the 42 cases both preoperatively on HRCT temporal bone and intra operatively.

**Table 7** Statistical Analysis

|                            | Sensitivity | Specificity | Ppv %  | Npv %  |
|----------------------------|-------------|-------------|--------|--------|
| Dural plate erosion        | 100%        | 100%        | 100%   | 100%   |
| Sinus plate erosion        | 80%         | 97.44%      | 80%    | 97.44% |
| LSCC erosion               | 100%        | 100%        | 100%   | 100%   |
| Mallus erosion             | 73.68%      | 77.78%      | 87.50% | 58.33% |
| Incus erosion              | 85.29%      | 72.22%      | 85.29% | 72.22% |
| Stapes erosion             | 86.21%      | 84%         | 86.21% | 84%    |
| Facial canal erosion       | 66.67%      | 97.56%      | 66.67% | 97.56% |
| Jugular canal wall erosion | 100%        | 100%        | 100%   | 100%   |
| Carotid canal wall erosion | 100%        | 100%        | 100%   | 100%   |

**Discussion:**

The present study was conducted in the OPD, department of Otorhinolaryngology in a tertiary care centre in central India in the study period from March 2017- September 2018. A total of 42 cases of attico-antral type CSOM were studied clinically and radiologically and subsequently followed by surgery. The intra-operative findings were correlated with that of pre-operative HRCT findings.

Age: The cases included in the present study were in the age group varying from 2<sup>nd</sup> to 6<sup>th</sup> decade.

Maximum number of patients was in the age group of 11- 20 years. Mean age group of the patients was 24.28 years.

Sex: A female preponderance was seen in this study with 24 females and 18 males. Female to male ratio being 1.33:1. Similar female preponderance was also seen by other researchers in their respective studies<sup>(3, 9)</sup>.

Dural plate and Sinus Plate: Dural plate was depicted intact in 40 (95.93%) cases and eroded in 2(4.76%) cases on HRCT temporal bone with

100% sensitivity and specificity both. Similar results were obtained intra-operatively. Jackler et al<sup>(6)</sup> detected all their cases but also had eight false positive cases. Mafee<sup>(8)</sup> et al missed 3 out of 8 cases. O'Reilly<sup>(5)</sup> also said in his research that the demonstration of a dehiscence in the tegmen on axial scan alone cannot be done reliably but even after using coronal cuts, they found that the effect of partial averaging could give the false impression of a defect. Sinus plate was observed to be intact in 39 (92.85%) cases and eroded in 4(7.14%) cases on HRCT. Intra-operatively, 4(9.52%) cases had erosion. The sensitivity and specificity in this study were 80% and 97.44 % respectively.

However we could not distinguish cholesteatoma from other soft tissue disease as supported by a study from Walshe<sup>(14)</sup> et al. Cholesteatoma characteristically causes bone erosion. When this erosion was seen in association with a soft tissue mass on HRCT, it was considered to be due to cholesteatoma. Both Jackler et al and O'Donoghue<sup>(13)</sup> et al found cholesteatoma to be present in 80% of cases explored. Using the same criteria, we detected 11 out of 42 cases to be having cholesteatoma in middle ear. The differential diagnosis of soft tissue mass<sup>(17)</sup> is often quite difficult with HRCT but can be done accurately with MRI scans. All cases showed sclerotic mastoid in HRCT and intra-operatively both.

Ossicles: On HRCT scan, Malleus appeared to be intact in 18(42.85%) cases, but found intact in 14 (33.33%) cases intra-operatively. Incus on HRCT appeared to be intact in 18(42.85%) cases, but was found to be intact in 13(30.95%) cases intra-operatively. On HRCT, stapes appeared to be intact in 21(50%) cases, eroded in left over 21(50%) cases out of the total Of 42 cases in this study. On inspection done intra-operatively 17(40.47%) cases had intact stapes structure. The Incus was the most frequently eroded ossicle followed by the malleus and the stapes. This is consistent with the findings of Chee et al<sup>(11)</sup>. The Stapes on HRCT scan usually appeared as a structure of soft tissue density in the oval window niche. For this reason

it is difficult to distinguish between the erosion of stapes and its mere envelopment by soft tissue. These findings are relatable with the findings of Jackler<sup>(6)</sup> et al in his study. The long process of the incus and the stapes superstructure and most importantly the state of the ossicular chain was correctly predicted in over 92 % of cases in HRCT done pre-operatively<sup>(18)</sup>.

Facial nerve canal: Facial nerve canal in its tympanic segment was intact in 41 cases (97.61%) and appeared eroded on HRCT in 1 case (2.37%). Intra-operatively, 2 cases (4.76%) showed facial canal erosion with 66.67% sensitivity and 97.56 % specificity. Facial nerve canal can be eroded by cholesteatoma. Dehiscence can be better seen in coronal cuts. Overlying soft tissues causes a loss of contrast gradient. Mostly horizontal part of facial nerve showed dehiscence. Similar findings were observed by others .O'Donoghue<sup>(13)</sup> et al in his study detected all 9 cases of facial canal dehiscence but also had 6 false positives. Eray Tuccar<sup>(12)</sup> et al carried concluded that adequate facial nerve anatomy could not be viewed from standard HRCT temporal scans. Mastoid segment erosions are best seen in both coronal and sagittal sections. O'Reilly<sup>(3, 5)</sup> reported that loss of contrast gradient due to overlying soft tissue in many cases obscured a small dehiscence in facial canal.

Semicircular canals: In this study, Lateral semicircular canal was eroded in 2 cases on HRCT and it was also confirmed intra-operatively. Hence, HRCT is sensitive and specific to 100% in detecting canal erosion as per this study. According to Rocher P, Carlier R, Attal p<sup>(2,7)</sup> and others, it is capable of showing the finest of the details of any lateral semicircular canal dehiscence. Though, studies by other researchers had reported higher false positive results. Anterior and posterior semicircular canals were intact in this study. B. J. O'Reilly<sup>(4,5)</sup> said in his study that HRCT is highly sensitive to identify soft tissue mass and osseous erosions whereas moderately sensitive to detect any dehiscence of lateral semicircular canal. It is also less sensitive to identify small areas of dural exposure, ossicular continuity. The coronal scan



planes are superior to detect such defect but ideally patients should be scanned in both coronal and axial planes. Findings are consistent with Silver et al<sup>(15,16)</sup>, according to whom patients complaining of vertigo and also having chronic middle ear disease may have a cholesteatoma with a labyrinthine fistula. Vanclooster<sup>(10, 11, 12)</sup> et al also reported lateral semicircular canal as the single most common location for the labyrinthine fistulas because of its anatomic position in the antrum. There was no erosion of the bony wall separating carotid and jugular canal from middle ear on HRCT which was also confirmed intra-operatively. So, the principle value of HRCT in CSOM is its ability to demonstrate disease which is not clinically apparent.

### Conclusion

HRCT temporal bone scan has been significantly valuable in diagnosing the attico-antral or unsafe type of CSOM and its complications preoperative. This study proves that HRCT temporal bone accurately shows the soft tissue mass and its extension in the middle ear and mastoid as well as osseous erosions such as dural plate and Sinus plate erosions, ossicular erosion. It also provides pre-operative information about the lateral semicircular canal integrity in unsafe type CSOM. However, the integrity of stapes and more so of facial nerve canal are not depicted effectively. Despite of this pitfall, it serves as a road map for surgeons to plan the type of surgery for each and every case specifically because it provides information on anatomical variations of temporal bone to a very great extent.

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