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RESEARCH ARTICLE
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"STRUCTURAL AND FUNCTIONAL CHANGES IN CONTRALATERAL EAR IN UNILATERAL CSOM"

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ABSTRACT

Background: Chronic Suppurative Otitis Media (CSOM), traditionally considered a unilateral disease, has shown increasing evidence of contralateral ear (CLE) involvement, even in clinically silent presentations. This study aimed to evaluate the structural and functional changes in CLEs among patients with unilateral CSOM.

Objectives: To identify and analyze pathological changes in the CLE in patients with clinically unilateral CSOM.

Methods: This was a cross-sectional observational study conducted over 18 months in a tertiary care center in Karnataka. A total of 120 patients aged 12–50 years with unilateral CSOM were recruited. Detailed otoscopic, radiological, and audiological evaluations (including PTA, tympanometry, OAE, and BERA) were performed on both ears. Data were analyzed using SPSS with statistical significance set at $p<0.05$.

Results: Among 120 patients, 64.2% showed structural abnormalities in the CLE, with Type II retraction (22.5%) and myringosclerosis (14.2%) being most common. Audiological assessment revealed hearing loss in 26.7% of CLEs, primarily mild to moderate. Tympanometry showed abnormal Type B and C curves in 80.8% of CLEs. Sclerotic changes in mastoid air cells were found in 6.7% of CLEs.

Conclusion: Contralateral ears in unilateral CSOM cases frequently exhibit subclinical pathological changes, reinforcing the need for bilateral assessment in diagnosis and treatment planning.

Keywords: Chronic Suppurative Otitis Media, Contralateral Ear, Tympanic Membrane Retraction, Eustachian Tube Dysfunction, Hearing Loss

INTRODUCTION

Chronic Suppurative Otitis Media (CSOM) is a persistent middle ear infection that affects millions globally and remains a significant health burden in developing countries like India. Although CSOM is often classified and treated as a unilateral disease, growing evidence suggests that it may involve both ears—either simultaneously or sequentially—making it necessary to examine the contralateral ear (CLE) even in seemingly unilateral cases.

CSOM is traditionally categorized into two types—mucosal and squamosal—depending on the site and severity of the pathology. In cases where one ear is actively discharging or perforated, the contralateral ear often appears clinically silent. However, detailed otoscopic, radiological, and audiological assessments have revealed a significant rate of pathological changes in the CLE. These include tympanic membrane (TM) abnormalities, eustachian tube dysfunction, ossicular chain issues, and subtle hearing loss.

A landmark study reported that structural abnormalities such as tympanic membrane retraction, myringosclerosis, and thinning were seen in about 47.91% of CLEs in patients with unilateral CSOM. These changes were especially prominent in squamous-type CSOM, where 50% showed TM abnormalities in the CLE.[1] Similarly, a more recent Indian study found that 44% of patients with unilateral CSOM had abnormal tympanic membranes in the CLE, most commonly TM retraction, emphasizing the need for routine CLE examination.[2]

Audiologically, functional deficits in the CLE are frequently overlooked. Nigam et al. found that conductive hearing loss was present in a substantial proportion of CLEs in both mucosal and squamosal CSOM patients, with TM thinning and retraction being common findings.[3] Another study analyzing 300 patients reported that 21.6% had conductive hearing loss in the CLE, challenging the notion of unilateral CSOM as a truly localized condition.[4]

Further evidence suggests that even radiological anomalies are not confined to the affected ear. Bairwa et al. noted significant mastoid air cell changes and audiometric deviations in the CLE, reinforcing the concept that CSOM could be a bilateral disease process with asynchronous progression.[5] Their findings were echoed in another cross-sectional study that identified retracted TM and conductive hearing loss in more than 40% of CLEs in mucosal-type CSOM.[6]

Contralateral ear changes may develop silently. A comparative study that included a control group found that abnormalities like TM retractions and myringosclerosis occurred in 58% of CLEs in CSOM patients compared to only 11% in healthy subjects.[7] Another cohort study reaffirmed that squamous CSOM had higher rates of CLE involvement, particularly with structural changes like TM retraction, as evidenced through endoscopy and radiological imaging.[8]

From a surgical outcome perspective, the presence of CLE disease has been shown to influence postoperative hearing results. A pediatric study demonstrated that children with CLE involvement had poorer functional outcomes after ear surgery, although anatomical success was not significantly impacted.[9] A major observational study from India concluded that 70% of patients with unilateral CSOM had detectable alterations in the CLE—including abnormal tympanometry, mastoid sclerotic changes, and hearing loss—suggesting a systemic disease progression.[10]

The contralateral ear in unilateral CSOM is far from unaffected. Structural and functional changes are not only prevalent but may influence long-term management strategies, especially in resource-limited settings. This necessitates a bilateral approach in evaluation and treatment of CSOM, rather than focusing solely on the symptomatic ear.

The aim of this study was to assess structural and functional changes in the contralateral ear of patients with unilateral CSOM, to identify subclinical involvement and emphasize the importance of bilateral evaluation for early diagnosis and effective management.

METHODOLOGY

1. Study Design

This was an observational cross-sectional study designed to assess structural and functional changes in the contralateral ear among patients with unilateral CSOM. No interventions were made, and data were collected at a single point from each participant.

2. Study Setting

The study was conducted in the Department of ENT at Adichunchanagiri Hospital and Research Centre, BG Nagara, Mandya District, a tertiary care hospital with adequate diagnostic facilities and patient volume.

3. Study Duration

The study was carried out over 18 months, from July 2023 to January 2025, allowing sufficient time for patient recruitment, data collection, and analysis.

4. Participants – Inclusion & Exclusion

Included were patients aged 12–50 years with unilateral CSOM. Excluded were those with prior ear surgery, family history of hearing loss, noise/ototoxic exposure, head trauma, or contralateral ear discharge.

5. Study Sampling

A periodic sampling method was used. All eligible patients presenting during the study period were enrolled consecutively based on set criteria.

6. Study Sample Size

Based on outpatient flow, a sample size of 120 was chosen as feasible over 18 months, ensuring adequate statistical power and representation.

7. Study Groups

Patients were grouped by CSOM type—mucosal or squamosal—for comparative analysis of contralateral ear findings across disease variants.

8. Study Parameters

Parameters included tympanic membrane status, PTA thresholds, tympanometry patterns, OAEs, and BERA responses. Demographic and clinical data were also recorded.

9. Study Procedure

After consent, a detailed history and ENT exam were conducted. Audiological tests (PTA, impedance, OAE) and BERA (if needed) were performed and documented.

10. Data Collection

Data were recorded in a structured proforma. Otoscopy and audiology tests were done by trained professionals, and findings were securely stored and coded.

11. Data Analysis

Data were analyzed using SPSS. Means and proportions were calculated, and the unpaired t-test was used. A p-value <0.05 was considered significant.

12. Ethical Considerations

Ethical approval was obtained. Informed consent was taken. Patient confidentiality was maintained, and no invasive procedures were involved in the study.

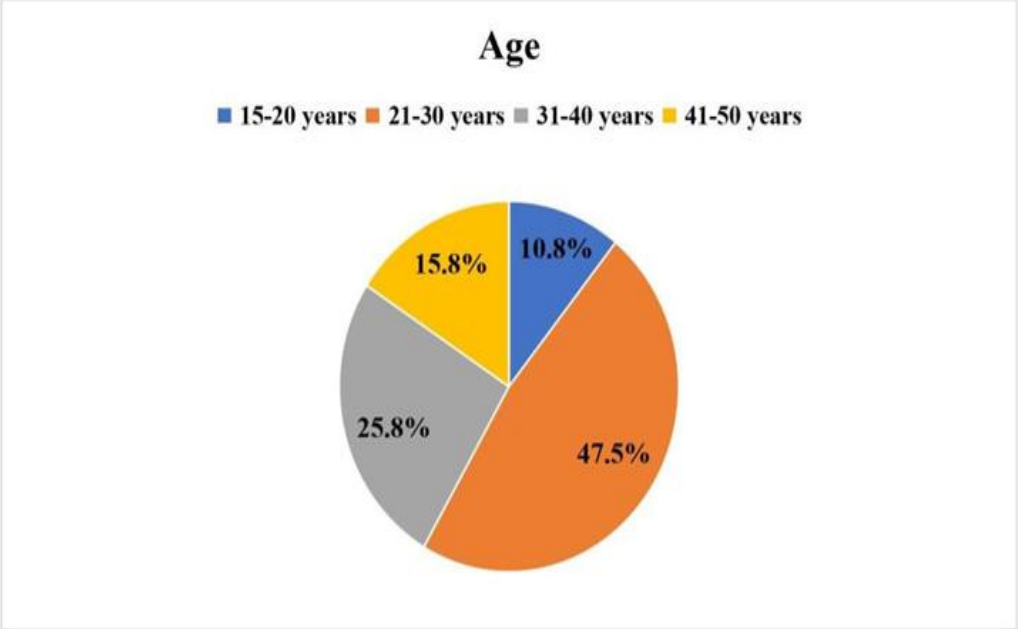
RESULTS

1. Age Distribution

The highest prevalence of CSOM was observed in the 21–30 year age group (47.5%), indicating young adults are most affected. The second most common age group was 31–40 years (25.8%) (Table1).

Table 1: Age-wise distribution of study participants

Age Group	Frequency (N)	Percentage (%)
15–20 years	13	10.8
21–30 years	57	47.5
31–40 years	31	25.8
41–50 years	19	15.8



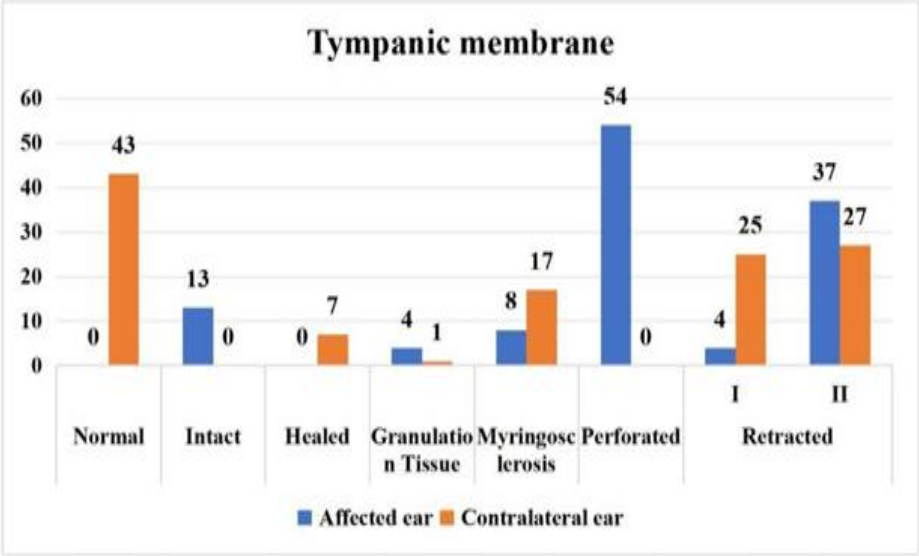
Graph 1: Age-wise distribution of study participants

2. Tympanic Membrane Findings

Perforation was the most common abnormality in the affected ear (45%), while contralateral ears commonly showed Type II retraction and myringosclerosis, indicating subclinical involvement (Table 2).

Table 2: Tympanic membrane findings in affected and contralateral ears

Tympanic membrane	Affected ear		Contralateral ear	
	N	%	N	%
Normal	–	–	43	35.8
Intact	13	10.8	–	–
Healed	–	–	7	5.8
Granulation Tissue	4	3.3	1	0.8
Myringosclerosis	8	6.7	17	14.2
Perforated	54	45	–	–
Retracted I	4	3.3	25	20.8
Retracted II	37	30.9	27	22.5



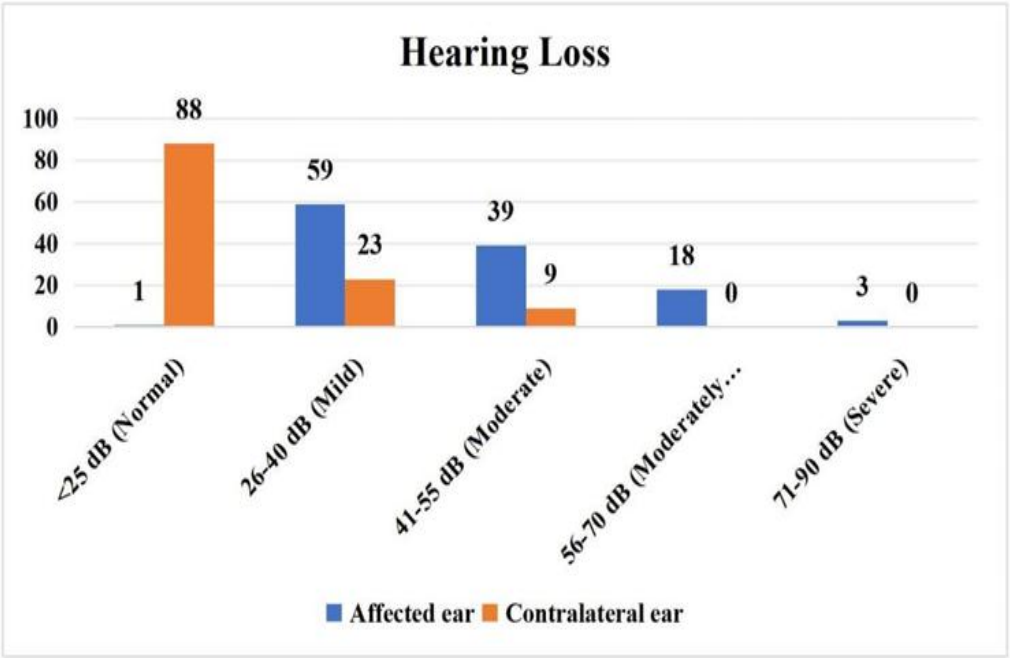
Graph 2: Tympanic membrane findings in affected and contralateral ears

3. Hearing Loss

While 73.3% of contralateral ears had normal hearing, 26.7% showed varying degrees of hearing loss, suggesting functional changes even in the non-diseased ear (Table 3).

Table 3: Hearing loss levels in affected and contralateral ears

Hearing Loss	Affected ear		Contralateral ear	
	N	%	N	%
<25 dB (Normal)	1	0.8	88	73.3
26–40 dB (Mild)	59	49.2	23	19.2
41–55 dB (Moderate)	39	32.5	9	7.5
56–70 dB (Moderately Severe)	18	15	–	–
71–90 dB (Severe)	3	2.5	–	–



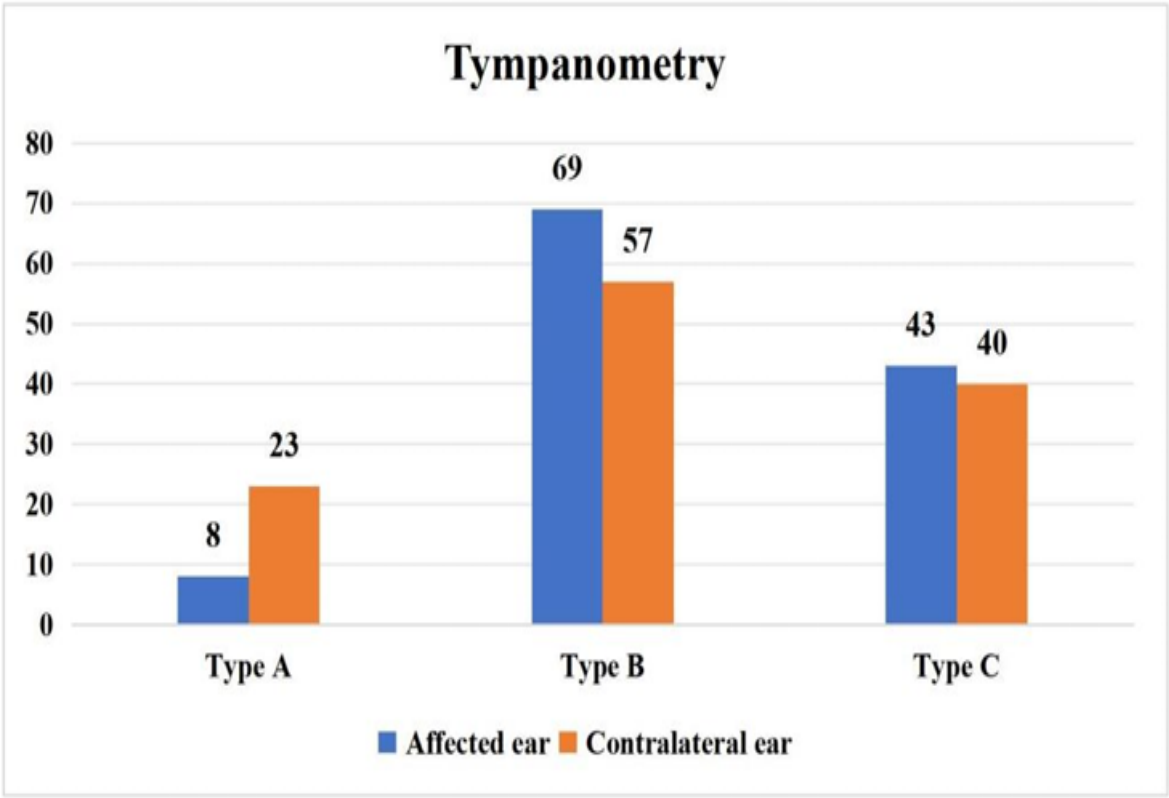
Graph 3: Hearing loss levels in affected and contralateral ears

4. Tympanometry (Table 4)

In contralateral ears, only 19.2% had normal middle ear pressure (Type A), while 80.8% had Type B or C curves, highlighting subclinical Eustachian tube dysfunction (Table 4).

Table 4: Tympanometry findings in affected and contralateral ears

Tympanometry	Affected ear		Contralateral ear	
	N	%	N	%
Type A	8	6.7	23	19.2
Type B	69	57.5	57	47.5
Type C	43	35.8	40	33.3



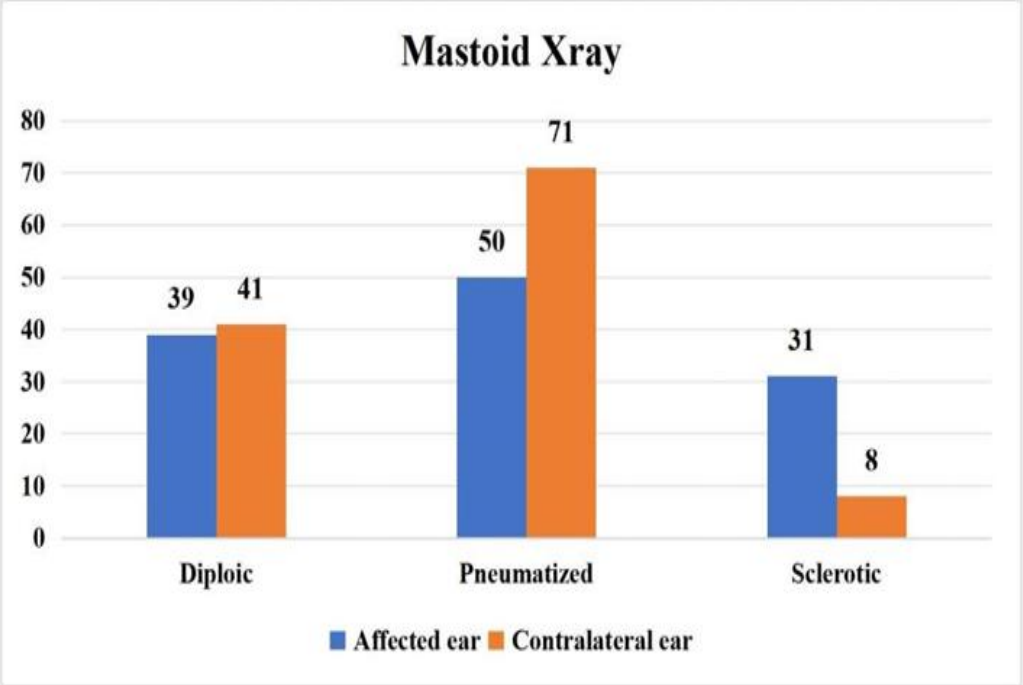
Graph 4: Tympanometry findings in affected and contralateral ears

5. Mastoid X-ray Findings

Sclerosis was notably more common in affected ears (25.8%) than contralateral ears (6.7%), while pneumatization was preserved in most contralateral ears (59.2%) (Table5).

Table 5: Mastoid air cell patterns in affected and contralateral ears

Mastoid X-ray	Affected ear		Contralateral ear	
	N	%	N	%
Diploic	39	32.5	41	34.2
Pneumatized	50	41.7	71	59.2
Sclerotic	31	25.8	8	6.7



Graph 5: Mastoid air cell patterns in affected and contralateral ears

DISCUSSION

This study aimed to evaluate the structural and functional changes in the contralateral ear in patients with unilateral CSOM. Our findings support the growing body of evidence that CSOM, though clinically unilateral, often affects both ears to varying degrees.

Age distribution in our study revealed that the majority of cases (47.5%) were within the 21–30 year age group, consistent with previous studies such as Nigam et al. (2019), where young adults constituted the majority of CSOM patients.[3] This suggests that the disease primarily affects the productive age group, likely due to repeated upper respiratory tract infections and lack of early treatment.

Tympanic membrane evaluation showed that 64.2% of contralateral ears had abnormalities, the most common being Type II retraction (22.5%) and myringosclerosis (14.2%). These findings align closely with the results of Dawood (2018), who reported TM retraction and myringosclerosis as frequent contralateral changes.[1] Similarly, Narayanaswamy and Awasthi (2018) found contralateral abnormalities in 58% of cases, reinforcing that the disease often progresses bilaterally at a subclinical level.[7]

In terms of hearing, 26.7% of contralateral ears in our study showed hearing loss, mostly mild to moderate. Gupta et al. (2022) reported similar trends, with 23% of contralateral ears affected.[4] These findings suggest early cochlear or middle ear involvement, even in asymptomatic ears. Additionally, our tympanometry findings demonstrated that only 19.2% of contralateral ears had a normal Type A curve, with a majority showing Type B (47.5%) and Type C (33.3%) patterns. Comparable results were observed by Bairwa et al. (2020), indicating widespread subclinical Eustachian tube dysfunction in contralateral ears.[5]

Mastoid X-ray analysis revealed sclerotic changes in 6.7% of contralateral ears, contrasting with 25.8% in affected ears. This supports the study by Thampi et al. (2020), who also noted better pneumatization in contralateral ears but emphasized their vulnerability to future disease.[10]

In conclusion, our study confirms that unilateral CSOM frequently involves the contralateral ear structurally and functionally. Routine assessment of the contralateral ear is essential for early detection and comprehensive management, aligning with current recommendations from recent Indian literature.

CONCLUSION

The present study highlights that contralateral ears in patients with unilateral CSOM often demonstrate significant structural and functional abnormalities, even in the absence of symptoms. Findings such as tympanic membrane retraction, myringosclerosis, impaired tympanometry, and early hearing loss suggest subclinical disease. These results advocate for routine examination of the contralateral ear to enable early intervention and prevent future complications. A bilateral approach is essential for holistic management and improved outcomes in CSOM, especially in resource-limited settings.

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