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Original Research Article

Contralateral Ear Findings in Patients with Unilateral Chronic Otitis Media and their Association with Sinonasal Disease

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Abstract

Background: Chronic otitis media (COM) is a persistent inflammatory condition of the middle ear cleft characterised by an irreversible tympanic membrane (TM) defect and a history of ear discharge exceeding three months. Because both Eustachian tubes communicate with the nasopharynx, pathology in one ear may silently develop in the contralateral ear. Sinonasal diseases, particularly deviated nasal septum and turbinate hypertrophy, are recognised contributors to Eustachian tube dysfunction and, consequently, to the pathogenesis and persistence of COM.

Aim: To assess contralateral ear findings in patients with unilateral COM and their association with sinonasal disease.

Methods: This cross-sectional study enrolled 100 patients (aged ≥15 years) presenting to the ENT OPD at Santosh Medical College and Hospital, Ghaziabad, from 5th March 2024 to 28th February 2026. All patients underwent detailed bilateral otorhinolaryngological examination, otoendoscopy, pure tone audiometry (PTA), and diagnostic nasal endoscopy (DNE). Contralateral ears were assessed for TM retraction (graded by Sade classification), tympanosclerosis, and otitis media with effusion (OME; diagnosed clinically on the basis of a dull, retracted, or amber tympanic membrane with restricted mobility where feasible; tympanometry was not routinely performed and this limitation should be acknowledged). Associations between qualitative variables were tested using the Chi-square test; $p < 0.05$ was considered statistically significant.

Results: The mean patient age was 36.71 ± 13.16 years; 55% were male. Mucosal COM predominated (79%); squamous COM accounted for 21%. Abnormal contralateral ear findings were detected in 57% of patients. TM retraction was the most common contralateral finding (66.67%), followed by tympanosclerosis (29.82%) and OME (3.51%). Squamous COM was associated with a higher prevalence of contralateral abnormalities (66.7%) than mucosal COM (54.4%). Mild conductive hearing loss (CHL) was the most frequent audiological finding in the contralateral ear. On DNE, deviated nasal septum (DNS) was the most common sinonasal finding, identified in 61 side-specific observations (right: 23, left: 38). A statistically significant association was observed between abnormal contralateral ears and sinonasal disease: 84.21% of patients with abnormal contralateral ears had positive DNE findings versus 65.12% of those with normal contralateral ears ($p = 0.013$).

Conclusion: Abnormal contralateral ear findings were detected in 57% of patients with unilateral COM, with TM retraction being the most prevalent finding. A statistically significant association exists between sinonasal pathology and contralateral ear disease, supporting consideration of DNE during the evaluation of patients with unilateral COM. Prospective studies are required to determine whether treatment of sinonasal disease improves contralateral ear outcomes.

Keywords: Chronic Otitis Media; Contralateral Ear; Sinonasal Disease; Tympanic Membrane Retraction; Eustachian Tube Dysfunction; Diagnostic Nasal Endoscopy; Deviated Nasal Septum.

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Introduction

Chronic otitis media (COM) is a persistent inflammatory disease of the middle ear cleft characterised by a permanent tympanic membrane (TM) defect and a clinical history of ear discharge lasting more than three months, resulting in irreversible mucosal and structural changes.[1] Globally, the World Health Organization (WHO) estimates that 65–330 million individuals are affected by chronic suppurative otitis media (CSOM), with over 50% experiencing clinically significant hearing loss, and complications of otitis media contributing to approximately 28,000 deaths annually.[2] India has been classified as a high-prevalence country with a national CSOM prevalence of approximately 4%, placing it in the group requiring urgent public health attention.[3]

The middle ear cleft — comprising the Eustachian tube, tympanic cavity, attic, aditus, antrum, and mastoid air cells — is anatomically and physiologically continuous with the nasopharyngeal mucosa. This anatomical intimacy means that pathological processes within the nasal cavity and paranasal sinuses (PNS) can impair normal middle ear ventilation and drainage by disrupting Eustachian tube function.[4,5] Conditions such as allergic rhinitis, chronic sinusitis, nasal polyposis, deviated nasal septum (DNS), and adenoid hypertrophy are well-established causes of Eustachian tube dysfunction (ETD), which in turn predisposes to negative middle ear pressure, TM retraction, otitis media with effusion (OME), and ultimately COM.[6,7]

A fundamental yet underappreciated observation in COM management is the state of the contralateral, clinically asymptomatic ear. Because both Eustachian tubes share a common nasopharyngeal opening, systemic and regional risk factors — including sinonasal inflammation and ETD — may act bilaterally, albeit asymmetrically.[8] Histopathological studies have confirmed inflammatory changes in clinically asymptomatic contralateral ears of patients with unilateral COM: Rosito et al. demonstrated that 91.8% of contralateral temporal bones from COM patients harboured histopathological changes on light microscopy, including granulation tissue (81%), middle ear effusion (58%), and TM retraction (35%).[9] Clinical studies corroborate these findings; Selaimen da Costa et al. found pathological contralateral ear findings in 75.2% of 500 consecutive COM patients, with TM retraction (38.2%), TM perforation (26.2%), and tympanosclerosis (3.6%) predominating.[10]

The 'continuum theory' proposed by Paparella et al. posits that otitis media progresses through an uninterrupted sequence of events — from OME through acute otitis media (AOM) to COM — and that in the absence of arresting mechanisms, bilateral progression is an expected rather than exceptional outcome.[11] This conceptual framework has been used in the literature to give clinical meaning to the aphorism: 'What the diseased ear was yesterday, the contralateral ear is today.'[11]

Despite the biological plausibility and existing evidence, the contralateral ear is frequently overlooked in routine clinical assessment, and its relationship to concurrent sinonasal pathology is understudied, particularly in the North Indian population. Furthermore, systematic use of diagnostic nasal endoscopy (DNE) in evaluating patients with unilateral COM — and correlating endoscopic nasal findings with contralateral ear status — remains infrequent in clinical practice. Addressing sinonasal disease as part of the management of COM has been shown to improve middle ear mucosal status and surgical outcomes.[13,14] This study was therefore designed to comprehensively evaluate the contralateral ear in patients presenting with unilateral COM, to characterise the pattern and severity of contralateral ear disease, and to determine whether a statistically significant association exists between sinonasal pathology detected on DNE and contralateral ear abnormality.

To the best of the authors' literature search, no previously published study of this design was identified in the population of Western Uttar Pradesh, India, making the present investigation both timely and geographically novel.

Materials and Methods

This cross-sectional observational study was conducted in the Department of ENT, Santosh Medical College and Hospital, Santosh Deemed to Be University, Ghaziabad, Uttar Pradesh, India, from 5th March 2024 to 28th February 2026, after obtaining clearance from the Institutional Ethics Committee (IEC). Written and informed consent was obtained from all participants prior to enrolment.

A total of 100 patients were enrolled from the ENT outpatient department (OPD) using consecutive sampling. Sample size was calculated based on a reported prevalence of contralateral ear abnormalities ranging from 37% to 60%; a midpoint estimate of 48.5% (derived from Abou-Elhamd et al.[24] and Damghani et al.[22], who reported contralateral abnormality rates of 37% and 60% respectively; midpoint = 48.5%) was used as the expected proportion ($p = 0.485$, $q = 0.515$, $Z = 1.96$, $d = 0.10$; formula: $n = Z^2pq/d^2$), yielding a

minimum requirement of 96 patients at a 5% level of significance and 10% margin of error.

Inclusion criteria comprised patients of either sex, aged 15 years or above, presenting to the ENT OPD with unilateral COM as diagnosed by clinical and otoendoscopic examination. COM was classified as mucosal (characterised by central tympanic membrane perforation with or without active discharge) or squamous (characterised by attic or marginal perforation, retraction pocket with keratin accumulation, or confirmed cholesteatoma on otoendoscopy). Exclusion criteria included patients below 15 years of age, those with bilateral COM, patients with a history of previous ear surgery, traumatic tympanic membrane perforations, and patients with middle ear carcinoma. All enrolled patients underwent a systematic otorhinolaryngological evaluation comprising detailed medical history, bilateral otoscopic and otoendoscopic examination (4 mm zero-degree Hopkins rod-lens telescope), and tuning fork tests (Rinne, Weber, Absolute Bone Conduction). Pure tone audiometry (PTA) was performed for both ears to assess air conduction and bone conduction thresholds. The degree of hearing loss was graded according to WHO classification guidelines.[15] Contralateral ear TM retraction was graded using the Sade classification.[16] DNE was performed in all patients using a 4 mm, 0° Hopkins rigid rod-lens telescope after nasal decongestion with 4% xylocaine and 0.1% xylometazoline (1:1), with examination of first, second, and third passes. Nasal endoscopy findings documented included deviated nasal septum (DNS), inferior turbinate hypertrophy (ITH), middle turbinate hypertrophy, discharge in middle meatus, paradoxical middle turbinate, bulla ethmoidalis, medialised uncinate process, and nasal polyps. DNE positivity was defined as the presence of one or more abnormal sinonasal findings on diagnostic nasal endoscopy. Data were recorded in a structured proforma and entered into a Microsoft Excel spreadsheet. Statistical analysis was performed using the R programming language (version 4.3.1). Categorical variables were expressed as frequencies and percentages. Associations between qualitative variables were evaluated using the Chi-square test or Fisher's exact test where appropriate. A p-value of <0.05 was considered statistically significant.

Results

The study enrolled 100 patients with unilateral COM. Key demographic, clinical, and investigational findings are presented across the tables and figures below.

Demographic and Clinical Profile (Table 1)

Patient ages ranged from 15 to 70 years (mean 36.71 ± 13.16 years). The largest age cohort was 21–30 years (30%), followed by 31–40 years (26%), indicating a predominantly young-to-middle-aged study population. Males constituted 55% of the cohort (M:F ratio 1.22:1). Left-sided ear disease was more common (56%) than right-sided disease (44%), though this numerical difference was not tested for statistical significance as the affected side is a descriptive clinical variable, not an outcome. Ear discharge was the most frequent presenting complaint (91%), followed by hearing loss (86%). Mucosal COM accounted for 79% of cases, while squamous COM represented 21%.

Table 1: Demographic and Clinical Profile of Patients with Unilateral Chronic Otitis Media (n=100)

Parameter	Category	n	%	Statistical Value
Age Distribution	≤ 20 years	10	10.0%	Mean ± SD
	21–30 years	30	30.0%	36.71 ± 13.16 yrs
	31–40 years	26	26.0%	Range: 15–70 yrs
	41–50 years	16	16.0%	
	51–60 years	13	13.0%	
	> 60 years	5	5.0%	
Total		100	100%	
Sex Distribution	Male	55	55.0%	M:F = 1.22:1
	Female	45	45.0%	
Side of Diseased Ear	Left ear	56	56.0%	
	Right ear	44	44.0%	
Mode of Presentation	Ear discharge	91	91.0%	Most common
	Hearing loss	86	86.0%	2nd most common
	Tinnitus	18	18.0%	
Type of COM	Mucosal type	79	79.0%	
	Squamous type	21	21.0%	
Contralateral Ear	Normal	43	43.0%	57% abnormal
	Abnormal	57	57.0%	
COM = Chronic Otitis Media; SD = Standard Deviation; M:F = Male-to-Female ratio.				

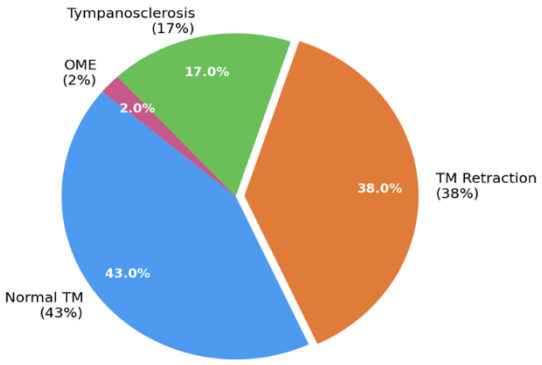


Figure 1: Distribution of Contralateral Ear Findings among all 100 patients. TM retraction was the most prevalent finding (38/100, 38%), followed by tympanosclerosis (17/100, 17%) and OME (2/100, 2%). Among the 57 patients with abnormal contralateral ears, percentages were: TM retraction 66.67%, tympanosclerosis 29.82%, OME 3.51%. 43% had a normal contralateral tympanic membrane

Status and Findings of the Contralateral Ear (Table 2): Of 100 patients with unilateral COM, 57 (57%) demonstrated abnormal contralateral ear findings on otoendoscopic examination, while 43 (43%) had a normal contralateral ear. Among the 57 abnormal ears, TM retraction was the most frequent finding, observed in 38 patients (66.67%), followed by tympanosclerosis in 17 patients (29.82%) and OME in 2 patients (3.51%). In patients with mucosal COM (n=79), the contralateral ear was abnormal in 54.4% (43/79). In squamous COM (n=21), a higher proportion — 66.7% (14/21) — had contralateral ear pathology. Although squamous COM showed a higher prevalence of contralateral abnormality, this difference was not statistically significant (p = 0.32), likely due to the smaller number in the squamous subgroup. TM retraction grading (Sade classification, pars tensa) in the contralateral ear revealed: Grade 1 in 11 patients, Grade 2 in 10, Grade 3 in 11, and Grade 4 in 6 patients. In mucosal COM, Grade 1 retraction predominated (39.3% of 29 mucosal-COM patients with retraction); in squamous COM, Grade 3 (44.4% of 9 squamous-COM patients with retraction) and Grade 4 (33.3%) retractions were more prevalent. This pattern indicates greater severity of contralateral disease in the squamous subtype.

Table 2: Contralateral Ear Findings Stratified by Type of Chronic Otitis Media (n=100)

Contralateral Ear Finding	Mucosal COM (n=79)		Squamous COM (n=21)		Overall (n=100)	
	N	(%)	n	(%)	n	(%)
Normal TM	36	45.6%	7	33.3%	43	43.0%
TM Retraction (Pars Tensa)	29	36.7%	9	42.9%	38	38.0%
Tympanosclerosis	12	15.2%	5	23.8%	17	17.0%
OME	2	2.5%	0	0.0%	2	2.0%
Total	79	100%	21	100%	100	100%
Chi-square test: Overall abnormal contralateral ear — Mucosal: 54.4%, Squamous: 66.7%; p = 0.32 (NS). OME = Otitis Media with Effusion; TM = Tympanic Membrane; NS = Not Significant. Contralateral ear findings (Normal TM, TM Retraction, Tympanosclerosis, OME) were coded as mutually exclusive categories; each patient is counted in one category only.						

Audiological Findings in the Contralateral Ear: PTA revealed hearing impairment in contralateral ears. Among those with documented hearing loss categories, mild CHL was observed in 25 patients, moderate CHL in 17, moderate sensorineural hearing loss (SNHL) in 2, and moderate mixed hearing loss (MHL) in 1 (total categorised = 45 patients; 45% The proportions within the categorised group were: mild CHL 55.6%, moderate CHL 37.8%, moderate SNHL 4.4%, and moderate MHL 2.2%. In mucosal COM contralateral ears, normal hearing was retained in 49/79 (62.0%); in squamous COM, normal hearing was found in only 7/21 (33.3%), with the remainder demonstrating varying degrees of hearing loss.

Diagnostic Nasal Endoscopy Findings and Association with Contralateral Ear (Table 3): DNE revealed abnormal findings in 76% of patients. Deviated nasal septum (DNS) was the single most common endoscopic finding, observed in 61 side-specific observations (right 23, left 38; some patients had bilateral DNS, and the figure of 61 reflects side-level counts rather than unique

patients). Other findings included inferior turbinate hypertrophy (24% right, 20% left), paradoxical middle turbinate (7% right, 6% left), discharge in middle meatus (6% bilateral), medialised uncinate process (4% right, 7% left), bulla ethmoidalis (4% right, 3% left), middle turbinate hypertrophy (6% right, 2% left), and nasal polyps (3% right, 1% left). A statistically significant association was found between abnormal sinonasal findings on DNE and contralateral ear pathology. Of 57 patients with abnormal contralateral ears, 48 (84.21%) had positive DNE findings. In contrast, among 43 patients with normal contralateral ears, positive DNE findings were present in 28 (65.12%). Chi-square analysis yielded p = 0.013, indicating a statistically significant association between sinonasal pathology and contralateral ear involvement.

Table 3: Diagnostic Nasal Endoscopy Findings and Association with Contralateral Ear Status (n=100)

Part A: DNE Findings (n=100)				
DNE Finding	**Right Side (n)**	**Right Side (%)**	**Left Side (n)**	**Left Side (%)**
Normal	34	34.0%	29	29.0%
Deviated Nasal Septum (DNS)	23	23.0%	38	38.0%
Inferior Turbinate Hypertrophy	24	24.0%	20	20.0%
Middle Turbinate Hypertrophy	6	6.0%	2	2.0%
Discharge in Middle Meatus	6	6.0%	6	6.0%
Paradoxical Middle Turbinate	7	7.0%	6	6.0%
Bulla Ethmoidalis	4	4.0%	3	3.0%
Medialised Uncinate Process	4	4.0%	7	7.0%
Nasal Polyps	3	3.0%	1	1.0%
Any DNE Abnormality (Total)	66	66.0%	71	71.0%
Part B: Association of DNE Findings with Contralateral Ear Status				
Contralateral Ear Status	**Total (n)**	**DNE Positive (n)**	**DNE Positive (%)**	**p-value**
Abnormal Contralateral Ear	57	48	84.21%	0.013 *
Normal Contralateral Ear	43	28	65.12%	
Overall	100	76	76.00%	

* $p < 0.05$, statistically significant (Chi-square test). DNE = Diagnostic Nasal Endoscopy; DNS = Deviated Nasal Septum; n = number of patients. Right- and left-side percentages in Part A represent side-specific observations and are not intended to sum to the patient-level prevalence (76%). Multiple DNE findings could be present in the same patient; therefore, findings are not mutually exclusive and individual percentages do not sum to 100%.

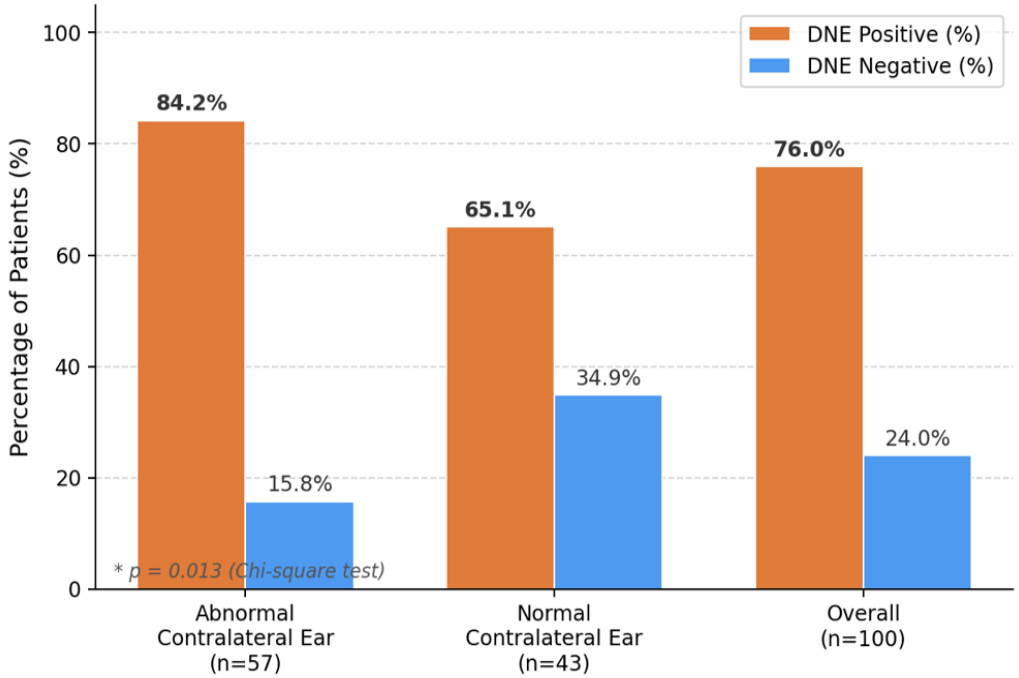


Figure 2: DNE Positivity Rate by Contralateral Ear Status. Patients with abnormal contralateral ears showed higher DNE positivity (84.21%) than those with normal contralateral ears (65.12%; p = 0.013, Chi-square test)

Discussion

This cross-sectional observational study evaluated the contralateral ear in 100 patients with unilateral COM using otoendoscopy and PTA, supplemented by DNE to assess the sinonasal contribution to contralateral ear disease. The findings suggest that contralateral abnormalities are frequently detected among patients presenting with unilateral COM, and that systematic evaluation of the contralateral ear and sinonasal tract is integral to comprehensive ENT management.

Age and Sex Distribution: The mean age of 36.71 ± 13.16 years, with the peak prevalence in the 21–30 years age group (30%), is consistent with findings reported by Munish K.S. et al.,[17] who identified the third decade of life as the peak age group. The male predominance (55%) in our cohort corroborates observations by Sonawale et al., who reported a male-to-female ratio of 1.39:1 (58.3% males),[18] and Adhikari et al., who documented 64.4% males in their COM cohort.[19] The reasons for male predominance may be multifactorial; however, as occupational exposure and other potential confounders were not measured in this study, no specific explanation can be attributed.

Type of COM: Mucosal COM predominated (79%), consistent with Thomas AM et al., who reported mucosal COM in 81.5% of cases,[20] and with Bijan Basak et al., who documented mucosal COM in 76.3%.[21] The lower prevalence of squamous COM in hospital-attending populations may reflect differences in symptomatic presentation between disease subtypes, though healthcare-seeking behaviour was not assessed in this study and this explanation therefore remains speculative.

Contralateral Ear Findings: Our finding of 57% contralateral ear abnormality aligns closely with the global literature. Damghani MA et al.[22] reported abnormalities in 60% of contralateral ears; Munish K.S. et al.[17] found pathological findings in 55%; and Shireen Aziz Kutty et al.[23] reported TM abnormalities in 68.8% of contralateral ears.

In contrast, Kamal-Eldin A. Abou-Elhamd et al.[24] found the contralateral ear to be normal in 63% of their cases, which may reflect differences in study design, COM severity, and examination modality. Selaimen da Costa et al.[10] reported the highest prevalence, with 75.2% of 500 contralateral ears showing abnormalities on otoendoscopy. The present prevalence of 57% was within the range reported in previous studies.

TM retraction was the most frequent contralateral finding (66.67%), a pattern consistently reported in the literature. Kutty et al.[23] identified pars tensa retraction as the leading abnormality (52.3% in squamous cases), and Selaimen da Costa et al.[10] documented retraction as the predominant finding (38.2%) in their large series. A similar prevalence of myringosclerotic changes has been reported by Ramakrishnan Narayanaswamy et al.,[25] who found myringosclerotic patches in 29/100 cases (the most common single finding in their series), followed by TM retraction (28/100); in the present study tympanosclerosis was the second most common contralateral finding (29.82%).

TM Retraction Severity and COM Type: Squamous COM was associated with higher grades of contralateral TM retraction (Grade 3–4 predominating) compared to mucosal COM (Grade 1 predominating). This is consistent with findings by Sady Selaimen da Costa et al.,[10] who demonstrated severe retractions in 24.7% of contralateral ears in COM-with-cholesteatoma patients versus only 3.6% in COM-without-cholesteatoma cases. Jadia S et al.[26] similarly observed more pronounced contralateral ear changes in squamous COM, consistent with the hypothesis that more severe ipsilateral disease may share common aetiological factors with more pronounced contralateral changes, though no formal severity-graded analysis was performed in this study.

This relationship is biologically explained by the 'continuum theory' of Paparella et al.,[11] wherein disease severity reflects the cumulative burden of Eustachian tube dysfunction and inflammatory mediator exposure, which act bilaterally through the shared nasopharyngeal opening.

Audiological Findings: Contralateral ear hearing impairment was the predominant audiological finding, with mild CHL most frequent. This pattern is consistent with the 48% reported by Damghani MA et al.[22] and the 39.58% by Mohammed Radef Dawood.[27] Numerically, normal hearing was more common in contralateral ears of mucosal COM patients (62.0%) than squamous COM patients (33.3%); however, no formal statistical analysis of hearing severity by COM subtype was performed. The aggregate audiological count is pending verification against the primary dataset.

Sinonasal Disease and Association with Contralateral Ear ($p = 0.013$): The statistically significant association between sinonasal pathology detected on DNE and contralateral ear abnormality ($p = 0.013$) is the most clinically important finding of this study. DNS, identified in 61 side-specific observations (right: 23, left: 38; see note on side-level versus patient-level data above; exact patient-level prevalence requires verification for bilateral DNS cases), has been proposed as a contributor to nasal obstruction, impaired mucociliary clearance, and Eustachian tube dysfunction through altered nasopharyngeal airflow dynamics.[28] The present study did not directly measure Eustachian tube

function or airflow dynamics. Bozkus et al.[7] demonstrated that sinonasal abnormalities and allergic rhinitis play a prevalent role in the pathogenesis of COM, while Thomas AM et al.[20] found a significant association between nasal endoscopy findings and COM in 222 patients. Sajitha K.B. et al.[29] reported sinonasal pathology in 82% of their COM patients on combined clinical and DNE assessment, with nasal obstruction being the most common complaint (63%).

A study by Gopalakrishnan Sankaranarayanan et al.[14] at Kilpauk Medical College demonstrated that all 60 COM patients with refractory disease had one or more sinonasal abnormalities on DNE, and that 52/60 patients showed improvement in middle ear mucosal status following septoplasty or functional endoscopic sinus surgery (FESS). These findings collectively reinforce the conclusion that concurrent abnormal sinonasal findings on DNE may be associated with persistence of ipsilateral COM and may be associated with the pathological milieu observed in the contralateral ear.

Our data support systematic DNE evaluation in patients presenting with unilateral COM. Identification of sinonasal pathology is clinically warranted; however, whether treatment of sinonasal disease alters the course of contralateral ear disease remains unproven and requires prospective interventional studies.

The primary limitation of this study is its cross-sectional design, which precludes causal inference and assessment of temporal disease progression. The relatively small squamous COM subgroup (n=21) limits statistical power for subgroup comparisons. Additionally, CT temporal bone imaging and tympanometry, which would further characterise middle ear pathology, were not routinely performed. Future longitudinal studies incorporating CT imaging, tympanometry, and post-treatment follow-up in larger cohorts — specifically designed to assess whether effective sinonasal intervention alters the natural history of contralateral ear disease — are warranted.

Conclusion

This study demonstrates that abnormal contralateral ear findings were detected in 57% of patients with unilateral COM, with TM retraction being the most prevalent finding (66.67%), followed by tympanosclerosis (29.82%) and OME (3.51%).

Squamous COM showed numerically higher prevalence and greater severity of contralateral ear pathology than mucosal COM, though this difference was not statistically significant ($p = 0.32$), likely due to the small squamous subgroup. Audiological assessment revealed predominantly mild conductive hearing loss; however, the aggregate hearing-impairment count requires verification against the primary dataset before a final percentage is reported. Abnormal sinonasal findings were detected on DNE in 76% of patients, and a statistically significant association was found between sinonasal pathology and contralateral ear abnormality ($p = 0.013$). These findings support the value of systematic evaluation of the contralateral ear and sinonasal tract in patients presenting with unilateral COM. Timely identification of sinonasal pathology is warranted in patients presenting with unilateral COM. Prospective studies comparing management strategies are required before specific surgical recommendations can be made.

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