ISSN: 2091-2331 (Print) 2091-234X (Online)

Journal of Nobel Medical College

Volume 14, Number 02, Issue 27, July-December 2025, 32-36

Original Article

Computed Tomography Evaluation of Mucosal Thickening of Maxillary Sinus in Relation to Sinus Outflow Obstruction

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Article Received: 9th November, 2025; Accepted: 26th December, 2025; Published: 31st December, 2025

DOI: https://doi.org/10.3126/jonmc.v14i2.87826

Abstract

Background

Maxillary sinus mucosal thickening is a common radiologic finding, often incidentally detected on computed tomography scans. Its relationship with sinus outflow obstruction remains clinically significant but underexplored.

Materials and Methods

This prospective cross-sectional study was conducted at Birat Medical College Teaching Hospital over one year. A total of 106 patients undergoing CT scans of the paranasal sinuses were included based on the presence of mucosal thickening. Patients with facial trauma, suspected malignancy, or intubation were excluded. CT scans were analyzed for mucosal thickening patterns, grades, and presence of outflow obstruction. Statistical analysis was done using SPSS.

Results

Out of 106 patients, 51.9% were female and 48.1% male. Headache (60.4%) was the most common presenting symptom. Circumferential thickening was the predominant pattern (42.5%), followed by polypoidal (27.4%), focal (18.9%), and complete opacification (11.3%). Outflow obstruction was present in 60.4% of cases. A statistically significant association was found between both the grade and pattern of mucosal thickening and sinus outflow obstruction ($p < 0.001$). Notably, higher grades (>15 mm) and complete/circumferential patterns had a stronger correlation with obstruction.

Conclusion

Our study demonstrates a significant association between the grade and pattern of maxillary sinus mucosal thickening and sinus outflow obstruction on CT imaging. Higher grades of thickening, particularly those exceeding 15 mm, and complete or circumferential patterns, were more frequently associated with obstruction.

Key words: *Maxillary Sinus, Paranasal Sinuses, Sinusitis*

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Citation
Pathak MR, Gautam M, Bhattarai M, Khadka R, Computed Tomography Evaluation of Mucosal Thickening of Maxillary Sinus in Relation to Sinus Outflow Obstruction, JoNMC. 14:2 (2025) 32-36. DOI: https://doi.org/10.3126/jonmc.v14i2.87826.

Introduction

The maxillary sinuses are the largest paranasal sinus of the skull, which are located bilaterally in the maxillary bone and inferiorly to the orbit. They are pyramidal in shape, with the alveolar process of the maxilla being the base and orbital floor being the roof of the maxillary sinus [1]. The sinus ostium is a small bone canal through which nasal cavity and the maxillary sinus communicate [2]. It's diameter measures approximately 4mm and is located high up in the medial wall of the sinus cavity [3]. The diameter can be as wide as 10 mm [2]. The mucus is constantly transferred toward the ostium which is secreted by the mucociliary cells. From the ostium, the mucous has to pass through the infundibulum, which is a part of ethmoidal system and reach the nasal cavity. So, obstruction to the sinus outflow or damage to the function of the mucociliary cells could lead to mucous retention and rhinosinusitis [4].

Mucosal thickening of the maxillary sinus is a common incidental finding on CT scans, yet its clinical significance remains unclear. Distinguishing between physiological mucosal changes and pathology related to sinus outflow obstruction is essential to avoid unnecessary interventions. However, limited studies have correlated CT-detected mucosal abnormalities with the patency of the osteomeatal complex.

The objective of this study is to evaluate the mucosal thickening of maxillary sinuses in relation to the sinus outflow obstruction and assessing whether maxillary mucosal thickening is associated with obstruction of the sinus outflow pathway, thereby improving diagnostic interpretation in routine imaging practice.

Materials and Methods

This is a prospective cross-sectional study done at Birat Medical College, Teaching hospital over a period of 1 year from 1st October 2024 to 30th September 2025. Although patients were enrolled using consecutive purposive sampling over a one-year period, a sample size calculation was performed to demonstrate adequacy. The sample size was calculated using the formula n=Z^2 p(1-p)/d^2, where Z=1.96 for a 95% confidence level, p=0.46 based on the reported prevalence of incidentally detected sinus mucosal abnormalities on CT scans [5], and d=0.10as the allowable margin of error. The minimum required sample size was thus calculated to be 94. A total of 106 patients were included in this study, exceeding the minimum requirement and thereby ensuring adequate precision for statistical analysis.

Ethical clearance was obtained from the institutional review committee (IRC) of Birat Medical College. Patients with CT scan of paranasal sinuses showing mucosal thickening of maxillary sinuses were included in study. CT done for facial trauma, evaluating suspected malignancy and intubated patients were excluded from study. Data was collected using standard proforma. Informed consent was taken from the patient and relevant details were explained.

CT of paranasal sinuses were done in GE 128 slice multidetector CT scan using the standard protocol. After explaining the technique, the patients were asked to lie supine on the CT table with their eyes closed. Routine scout films were obtained. The axial sections were obtained in a supine position by a line drawn from the inferior orbital rim to the external auditory meatus. Coronal and sagittal reconstruction was done and images were viewed in multiplanar reconstruction. Interpretation of CT findings was done by a single radiologist.

Collected data were entered in SPSS version 2026 and analyzed. Association between pattern and grade with outflow obstruction was calculated using the Chi-square test and the difference was considered significant if the p value was less than 0.05.

Results

A total of 106 patients were included in this study. Among them 48.1% were male and 51.9% were female. The age distribution of the patients is shown in figure 1. Regarding symptoms, 60.4% had headache, 31.1% had nasal obstruction and 8.5% had nasal discharge. Distribution of the mucosal thickening according to the grade is shown in Table 1. Circumferential pattern of mucosal thickening was the most common seen in 42.5% of cases followed by polypoidal in 27.4 %, focal in 18.9% and complete in 11.3 % of cases. Obstruction of the sinus outflow was seen in 60.4% and absent in 39.6%. The association between mucosal thickening grading and outflow obstruction is shown in Table 2. All the outflow obstructed sinus had some grade of mucosal thickening and larger grade of mucosal thickening had more outflow obstruction (P<0.001). The association of the pattern of the mucosal thickening and outflow obstruction is shown in Table 3. (P<0.001). The combined association of mucosal thickening grade and pattern with sinus obstruction is shown in Table 4. (P<0.001)

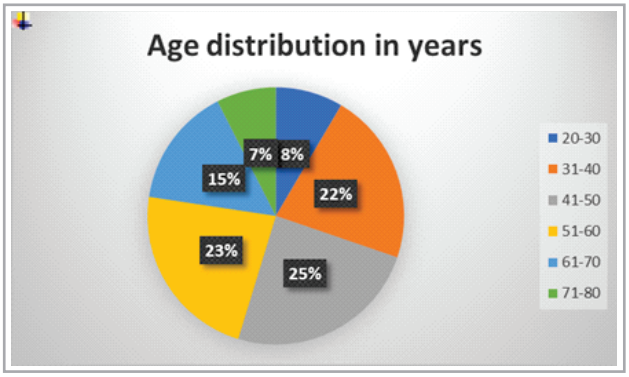

Figure 1: Age distribution

Table 1: Mucosal thickening grading

Size	Frequency	Percentage
5mm	17	16.0
5-10mm	23	21.7
10_15mm	18	17.0
15-20mm	18	17.0
20-25mm	18	17.0
Total	94	100.0

*12 patients had complete obstruction.

Table 2: Association between grade of mucosal thickening and outflow obstruction

Grade	Outflow obstruction		Total	P value
	Present	Absent		
5mm	3	14	17	<0.001
5-10mm	10	13	23	
10-15mm	8	10	18	
15_20mm	15	3	18	
20-25mm	16	2	18	
Total	52	42	94	

*12 patients had complete obstruction.

Table 3: Association between pattern of mucosal thickening and outflow obstruction

Pattern	Outflow obstruction		Total	P value
	Present	Absent		
Focal	5	15	20 (18.9%)	<0.001
Polypoidal	14	15	29 (27.4%)	
Circumferential	33	12	45 (42.5%)	
Complete	12	0	12 (11.3%)	
Total	64	42	106(100%)	

Table 4: Combined association of mucosal thickening grade and pattern with outflow obstruction

Pattern			Outflow Obstruction		Total	P value
			Present	Absent		
Focal	Size	5mm	0	5	5	
		5-10mm	0	3	3	
		10-15mm	1	4	5	
		15-20mm	3	1	4	
		20-25mm	1	2	3	
Poly poidal	Size	5mm	0	2	2	
		5-10mm	2	7	9	
		10-15mm	3	5	8	
		15-20mm	3	1	4	
		20-25mm	6	0	6	
Circum ferential	Size	5mm	3	7	10	
		5-10mm	8	3	11	
		10-15mm	4	1	5	
		15-20mm	9	1	10	
		20-25mm	9	0	9	
Complete			12	0	12	
Total					106	<0.001

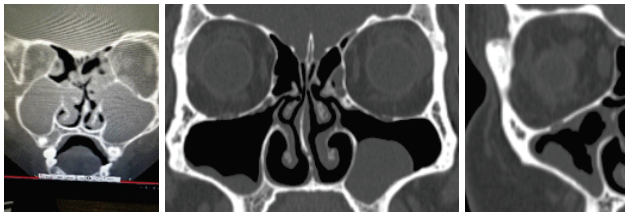

Figure 2, 3 and 4: Complete, Focal on right and polypoidal on left and circumferential patterns of mucosal thickening.

Discussion

In our study of 106 patients, we aimed to assess the relationship between mucosal thickening of the maxillary sinus and obstruction of the sinus outflow tract using computed tomography. Our findings demonstrated a statistically significant association between both the grade and pattern of mucosal thickening and sinus outflow obstruction ($p < 0.001$). The prevalence of incidentally detected sinus mucosal abnormalities on CT scan of head is as high as 42% in asymptomatic adults as shown in some studies [5]. A CT scan of head is used as the investigation in patients with headache especially when it is of abrupt or acute onset [6]. Approximately 15% of patients presenting with headache in department of emergency are referred to CT scan of head as one of the investigations [7].

The most common symptom among our patients was headache (60.4%), followed by nasal obstruction (31.1%) and nasal discharge (8.5%). This is similar to previous studies where headache was the most common symptom in patients

with chronic rhinosinusitis [8,9]. In our study, circumferential mucosal thickening was the most common pattern (42.5%), followed by polypoidal (27.4%), focal (18.9%), and complete opacification (11.3%). Complete opacification had a 100% association with obstruction. This finding is similar to the imaging studies which emphasized that morphology of thickening is as important as its size in predicting drainage issues [10,11, 12]. This study showed that the grade of thickening was also a strong predictor of obstruction. We found that more than 88% of sinuses with >15 mm mucosal thickening had outflow obstruction. Zinreich et al. [10] and Mafee et al. [11], in their study found that higher-grade mucosal changes are frequently associated with ostiomeatal complex obstruction.

In a study by Doud Galli et al. they found that mucosal edema and particulate graft material causes obstruction of the sinus outflow tract, which may result in sinusitis. They found 14 cases of chronic sinusitis after a sinus lift surgery [12]. Several studies have showed that dental infections, such as periapical lesions and periodontal bone loss, can lead to maxillary sinus mucosal thickening. Nunes et al. [13], Rege et al. [14] and Patel et al [15] also reported high rates of thickening in patients with dental disease, even without symptoms.

Our study did not include dental data, above findings suggest the importance of evaluating adjacent dental structures when interpreting CT scan of paranasal sinuses. Similar studies in future combining dental status with CT findings of paranasal sinuses could provide a complete understanding of maxillary sinus pathology. CT remains the gold standard for evaluating the paranasal sinuses, especially in patients being planned for functional endoscopic sinus surgery (FESS). The ability of CT to show the extent, pattern, and thickness of mucosal changes helps guide both diagnosis and surgical planning. Our results support its routine use in evaluating suspected sinus obstruction and chronic sinusitis, as in a study done by Arild et al. [16]

Our study assumes that various types of mucosal thickening of maxillary sinus may result in outflow obstruction which in turn significantly increases the risk of developing sinusitis. Beaumount et al. (2005) and Pignataro et al. (2008) emphasized about the importance of clinical and radiographic evaluation before performing sinus augmentation. [17,18]

Conclusion

This study demonstrates a significant association between the grade and pattern of maxillary sinus mucosal thickening and sinus outflow obstruction on CT imaging. Higher grades of thickening, particularly those exceeding 15 mm, and complete or circumferential patterns, were more frequently associated with obstruction. These findings underscore the importance of assessing both the extent and morphology of mucosal changes in routine CT evaluations. Therefore, CT remains a vital tool for diagnosing sinus outflow obstruction and can guide clinical decisions, especially in patients presenting with nonspecific symptoms like headache.

Acknowledgment: None
Conflict of interest: None

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