

# Incidental Maxillary Sinus Pathologies in Asymptomatic Subjects—A CBCT Study

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## ABSTRACT

**Objective:** The objective of the present study was to record the prevalence of incidental maxillary sinus pathologies in patients using cone beam computed tomography (CBCT) scans performed for maxillofacial diagnostic purposes.

**Methods:** This study was carried out retrospectively on CBCT records from January 2017 to July 2019. Pathologic findings were categorized as mucosal thickening, opacification, polypoidal mucosal thickening, others (such as antralolith, septa, or discontinuity of the sinus floor), and no pathologic findings. The incidence of maxillary sinus changes and their correlation with age and gender was analyzed.

**Results:** A total of 683 scans were identified out of which 252 cases met the inclusion criteria. Pathologies were similar across age groups with a slight male predilection. The incidence of maxillary sinus pathologies overall was 68.2%. Both sinuses showed changes in 39% cases, and 29% cases had unilateral findings while 32% cases had no sinus abnormalities. Mucosal thickening, opacification, and polyps were higher in males on both left and right sides. Females showed an increase in incidence in other findings such as antraloliths, septa, and discontinuity of the sinus floor more on the right side. The results were not statistically significant.

**Conclusion:** Incidental maxillary sinus abnormalities are highly prevalent in asymptomatic dental patients. Oral radiologists should be aware of these incidental findings and comprehensively evaluate the entire captured CBCT volume, which can help in early diagnosis, treatment, and follow-up of the patient.

**Keywords:** Maxillary sinus, cone beam computed tomography, pathology

## INTRODUCTION

Maxillary sinuses are a pair of paranasal sinuses in the head-and-neck region.<sup>1</sup> The evaluation of maxillary sinuses is essential in cases of trauma, sinusitis, and implant placement and can be performed using different imaging methods.<sup>2</sup> Maxillary dental infections can also cause changes in the maxillary sinus. A 1-mm thick sinus membrane is considered normal and is not evident in radiographs, while pathological conditions can cause increased mucosal thickness which is seen as a radiopacity within the sinus.<sup>1</sup> The maxillary sinus can be visualized using conventional radiographs as well as imaging modalities such as computed tomography (CT), cone beam computed tomography (CBCT), and magnetic resonance imaging (MRI).<sup>2</sup>

CBCT is a 3D imaging modality with the advantages of good image quality without distortion and superimposition of surrounding structures. In addition, it is comparatively low cost, and radiation exposure has made it a preferred imaging method.<sup>2</sup> CBCT has a variety of applications in dentistry such as in implantology, endodontics, orthodontics, temporomandibular joint evaluation, and maxillofacial surgery. In many cases,

the maxillary sinus falls within the field of view of CBCT, and incidental findings in the sinus can be visualized.<sup>3</sup>

Maxillary sinus can be visualized on the panoramic radiograph, water's view, CT, MRI, and CBCT.<sup>1</sup> CT is considered as the "gold standard" for in depth examination of maxillary sinuses. However, in dentistry, CT machines have limitations that include high cost and high radiation exposure. CBCT addresses these limitations of CT and provides many dental advantages.<sup>3</sup> The area of the maxillary sinus can be within the imaging field when the CBCT is indicated for various reasons such as dental implant site assessment, periapical bony and inflammatory pathologies, endodontic lesions, sinus augmentation, impacted, and supernumerary teeth, and in orthodontic applications. Hence, incidental findings are frequently viewed in the area of the maxillary sinus by maxillofacial radiologists. The extent of incidental findings varies from 10 to 69% in various studies.<sup>4</sup>

The present study was designed to record incidental maxillary sinus pathologies in asymptomatic individuals using CBCT scans performed for maxillofacial diagnostic purposes and to

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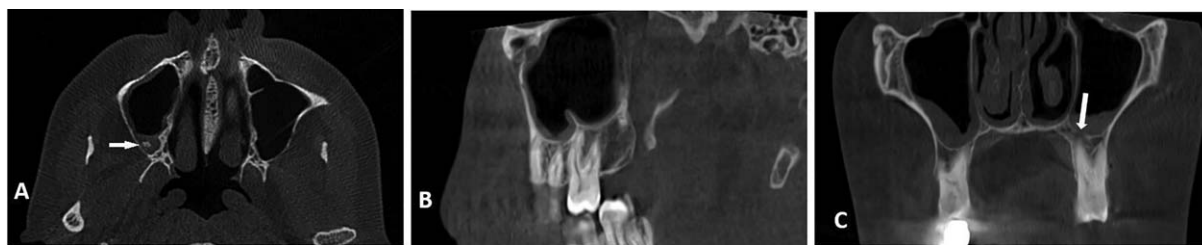
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Figure 1. (A) Coronal CBCT section showing mucosal thickening in the right maxillary sinus. (B) Axial CBCT section showing polypoidal thickening in the left maxillary sinus. (C) Coronal CBCT section showing opacification of bilateral maxillary sinuses.



Figure 2. (A) Axial CBCT section showing antrolith (white arrow). (B) Coronal CBCT section with septa in the floor of the left maxillary sinus. (C) Coronal CBCT section showing discontinuity in the floor of the left maxillary sinus (white arrow).



compare and correlate these pathologies with age, gender, and side of the involved maxillary sinus.

## METHODS

This retrospective study used CBCT scans of bilateral maxillary sinuses from the archives of the Department of Oral Medicine and Radiology, from 2017 to 2019. Institutional ethical consent was obtained for the study from AB Shetty Memorial Institute of Dental Sciences, Mangalore, India (ABSM/EC/11/2020). Inclusion criteria consisted of asymptomatic subjects with CBCT scans of bilateral maxillary sinuses, where data regarding gender and age were available. CBCT scans of subjects with congenital defects such as cleft palate, known pathologies, or trauma involving the maxillary sinuses as well as subjects below 10 years were excluded.

All CBCT scans had been obtained with the Planmeca Romexis 3D MID model. The exposure factors were field of view ranging from  $5 \times 5 \text{ cm}^2$  to  $17 \times 13.5 \text{ cm}^2$ , 80–90 kV, 8 mA, and the voxel

size of 90–500  $\mu\text{m}$ . All scans were examined by a single trained observer twice with a time interval of two weeks. Axial, coronal, and sagittal planes were evaluated under standardized conditions, and pathologic findings were recorded as present or absent. If present, pathologic findings were categorized as mucosal thickening, polypoidal mucosal thickening, sinus opacification, and others.

Mucosal thickening was measured from the air–mucosal interface to the inner margin of the bone lining the sinus and was noted when the distance was greater than 3 mm. Dome shape opacity within the maxillary sinus was considered as polypoidal mucosal thickening. Polyps and retention cysts are seen as smooth, convex radiopacities and cannot be differentiated. Hence, both were included under polypoidal thickening. Both complete and partial radiopacity of the sinus was included under sinus opacification (Figure 1). Antroliths, septa, and discontinuity of the sinus floor were included under other findings (Figure 2). The data, thus, recorded was tabulated and statistically analyzed.

## Main Points

- Maxillary sinus abnormalities are highly prevalent in asymptomatic subjects.
- The most common pathology is mucosal thickening followed by mucosal polyps and sinus opacification.
- Oral and maxillofacial radiologists should record any changes within the maxillary sinus noted during CBCT for dental purposes in order to ensure appropriate diagnosis and management.

## Statistical Analysis

The Statistical Package for the Social Sciences version 26.0 (IBM SPSS Corp.; Armonk, NY, USA) was used to analyze the data. Qualitative data were presented by using counts and percentages. The association between categorical variables was tested by using Chi square test.  $P < .05$  was considered statistically significant.

## RESULTS

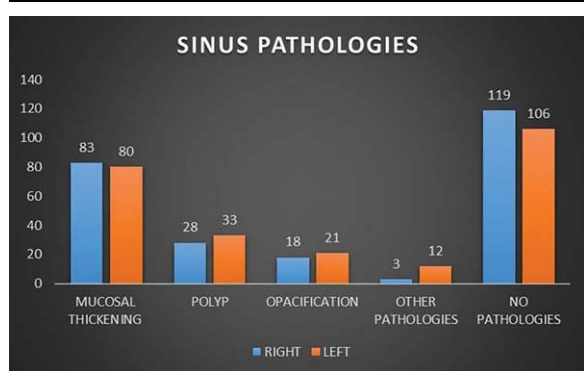
A total of 683 scans were identified out of which 252 met the inclusion criteria and were analyzed. Thus, a total of 504 sinuses

**Table 1.** Comparison of Pathologies based on Age Groups

		N	Age				Chi square	P value
			≤30		>30			
			Count	Column N %	Count	Column N %		
Right mucosal thickening	Absent	169	95	69.90	74	63.80	1.041	.308
	Present	83	41	30.10	42	36.20		
Left mucosal thickening	Absent	172	102	75.00	70	60.30	6.205	<b>.013</b>
	Present	80	34	25.00	46	39.70		
Right opacification	Absent	234	124	91.20	110	94.80	1.258	.262
	Present	18	12	8.80	6	5.20		
Left opacification	Absent	231	122	89.70	109	94.00	1.487	.223
	Present	21	14	10.30	7	6.00		
Right polyp	Absent	224	124	91.20	100	86.20	1.565	.211
	Present	28	12	8.80	16	13.80		
Left polyp	Absent	219	118	86.80	101	87.10	0.005	.943
	Present	33	18	13.20	15	12.90		
Right other findings	Absent	244	132	97.10	112	96.60	0.052	.819
	Present	8	4	2.90	4	3.40		
Left other findings	Absent	240	129	94.90	111	95.70	0.097	.756
	Present	12	7	5.10	5	4.30		
Right no findings	Absent	158	84	61.80	74	63.80	0.11	.74
	Present	94	52	38.20	42	36.20		
Left no findings	Absent	159	83	61.00	76	65.50	0.541	.462
	Present	93	53	39.00	40	34.50		

Left mucosal thickening was significantly greater in subjects above 30 years of age

**Figure 3.** Sinus pathologies in the study group.



were evaluated for any abnormality. Highest incidence of pathologies was in the 20-29 years age group. On comparison, pathologies were similar across age groups with no statistically significant difference except for left mucosal thickening which was significantly greater in subjects above 30 years of age (Table 1). Male predilection was observed with 61.9% pathologies in males as compared to 38.1% in females, and the difference was statistically significant. The overall incidence of maxillary sinus pathologies was 68.2%. Both sinuses showed changes in 39% cases; 29% cases had unilateral findings, while 32% cases had no sinus abnormalities. Mucosal thickening was noted in the right sinus in 32.9% cases and in the left sinus in 31.7% cases; opacification was noted in the right sinus in 7.1% cases and in the left sinus in 8.3% cases; polyps were noted in the right sinus in 11.1% cases and in the left sinus in 13% cases; and other findings were noted in the right sinus in 3.1% cases and in the left sinus in 4.7% cases (Figure 3). Mucosal

**Table 2.** Comparison of Pathologies Based on Gender

		N	Sex				Chi square	P value
			Male		Female			
		Count	Column N %	Count	Column N %			
Right mucosal thickening	Absent	169	103	66.00	66	68.80	0.2	.655
	Present	83	53	34.00	30	31.20		
Left mucosal thickening	Absent	172	101	64.70	71	74.00	2.329	.127
	Present	80	55	35.30	25	26.00		
Right opacification	Absent	234	141	90.40	93	96.90	3.774	.052
	Present	18	15	9.60	3	3.10		
Left opacification	Absent	231	140	89.70	91	94.80	1.983	.159
	Present	21	16	10.30	5	5.20		
Right polyp	Absent	224	135	86.50	89	92.70	2.291	.13
	Present	28	21	13.50	7	7.30		
Left polyp	Absent	219	133	85.30	86	89.60	0.978	.323
	Present	33	23	14.70	10	10.40		
Right other findings	Absent	244	154	98.70	90	93.80	4.772	<b>.029</b>
	Present	8	2	1.30	6	6.20		
Left other findings	Absent	240	148	94.90	92	95.80	0.121	.728
	Present	12	8	5.10	4	4.20		

In the right maxillary sinus, other findings such as antroliths and floor defects were significantly higher in females.

thickening, opacification, and polyps were higher in males on both left and right sides. Females showed an increase in incidence in other findings like antroliths and sinus floor defects such as septa and discontinuity of the sinus floor more on the right side. The difference in occurrence of these findings between males and females was not statistically significant. However, in relation to the other findings in right maxillary sinus which included antroliths and floor defects, the difference was statistically significant with more cases observed in females (Table 2).

**DISCUSSION**

Preoperative 3D imaging is essential for both diagnosis and formulation of an appropriate treatment plan. Pathologies of the maxillary sinus can be identified in many cases necessitating the modification of dental treatment. CT prior to invasive endoscopic sinus surgery has been associated with decreased risk of complications due to early identification of anatomical variants.<sup>5</sup> Thus, it provides additional information and helps in surgical management.<sup>6</sup> Some cases may need referral to different specialties for treatment.<sup>7</sup> Sinus floor elevation (SFE) is a common procedure in implant placement in the posterior maxillary region with deficient alveolar height. Septa in the

sinus floor can lead to accidental perforation of the Schneiderian membrane during SFE. Preoperative CBCT can identify such variations. Alternate surgical approaches such as the use of “W” shaped or two trapdoors instead of the traditional lateral approach can avoid such complications.<sup>8</sup> In the present study, CBCT scans taken for dental purposes which visualized bilateral maxillary sinuses within the field of view were included.

In the present study, the incidence of maxillary sinus pathologies using CBCT was 68.2%, which is in accordance with the study conducted by Rege et al.<sup>9</sup> An incidence up to 73% was noted by Elwakeel et al.<sup>10</sup> Other studies conducted by Cho and Jung,<sup>11</sup> Ritter et al.,<sup>12</sup> and Raghav et al.<sup>4</sup> found the incidence of maxillary sinus pathologies varying from 37 to 59%. This wide difference in incidence can be attributed to the indication for which CBCT was taken, difference in the imaging modality used, and climate and geographical variations.<sup>9,10</sup> Previous studies have used different imaging methods to detect sinus abnormalities. Hansen et al.<sup>13</sup> found incidental maxillary sinus abnormalities in 66% cases using MRI. Vallo et al.<sup>14</sup> found mucosal changes in 19% subjects using panoramic radiography. Malina-Altzinger et al.<sup>15</sup> compared maxillary sinus

abnormalities in panoramic radiographs and CBCT and found increased risk for false diagnosis when using panoramic radiographs alone. Hahnel et al.<sup>16</sup> compared CT and MRI and found that fine bony details were clearer in CT while MRI is preferred for the visualization of sinusitis. Ritter et al.<sup>12</sup> found that CT and CBCT offer similar visualization quality with CBCT having the advantages of high resolution and lower radiation dose.

The prevalence of pathological findings varies from second to sixth decades of life.<sup>10,12</sup> In the present study, subjects showed higher incidence in the third decade, which is in accordance with the study by Raghav et al.<sup>4</sup> Elwakeel et al.<sup>10</sup> found increased incidence in both second and third decades, while Ritter et al.<sup>12</sup> found maximum incidence in subjects above 60 years of age. The present study excluded CBCT scans in children below 10 years of age due to incomplete sinus development and higher incidence of mucosal thickening and opacification.<sup>9</sup> The present study results showed that there is no variation in the incidence of maxillary sinus pathologies with age.

The present study showed increased maxillary sinus pathologies in males as compared to females, although the difference was not statistically significant, which is similar to the results of Ritter et al.,<sup>12</sup> Da Silva et al.,<sup>17</sup> and Rege et al.<sup>9</sup> Vallo et al.<sup>14</sup> mentioned that males have higher incidence of dental pathologies causing increased mucosal thickening in the maxillary sinus. In contrast, the study by Elwakeel et al,<sup>10</sup> had significantly higher incidence of pathologies in females. Periapical infection in the maxillary molars can extend to the sinus causing mucosal thickening with or without cortical perforation of the sinus floor. Thus, CBCT plays a key role in endodontic treatment planning by allowing visualization of the size and location and relation to anatomic structures in a 3D view.<sup>18</sup>

A higher frequency of pathological findings was found on the right side of the sinus as compared with other studies conducted by Ritter et al.<sup>12</sup> and Rege et al.,<sup>9</sup> but the result was not statistically significant.

The most prevalent finding was mucosal thickening, which is in accordance with the studies conducted by Elwakeel et al.,<sup>10</sup> Rege et al.,<sup>9</sup> Raghav et al.,<sup>4</sup> DaSilva et al.,<sup>17</sup> and Ritter et al.<sup>12</sup> This increased incidence of mucosal thickening in asymptomatic individuals may be due to odontogenic pathologies, allergens, and microbial infections. These manifest in the maxillary sinus as linear mucosal thickening which may progress to partial and total opacification. Ata-Ali et al.<sup>19</sup> in their systematic review of 23 studies including a total of 11,971 subjects found that mucosal thickening, sinusitis, and sinus opacification were the most common sinus pathologies identified in CBCT scans of the maxillofacial region. Amine et al.<sup>8</sup> reported that mucosal thickening as the most frequent finding. Maillet et al.<sup>18</sup> in their study on maxillary sinusitis found an average mucosal thickening of 7.4 mm. Mucosal polyps showed the next higher incidence followed by opacification and other pathologies such as antroliths and floor defects, which is in accordance with the studies conducted by Rege et al.,<sup>9</sup> Rodrigues et al.,<sup>20</sup> Bosio et al.,<sup>21</sup> and Rhodus et al.<sup>22</sup> Some studies have found polypoidal thickenings as the most prevalent finding, while some studies found opacification as the most prevalent

finding. This may be due to the system of classification used or the visualization technique used.

There are some limitations in the above study. Since this was a retrospective analysis, data regarding the smoking habits of the subjects were not available which may be a cause for sinus changes in males. Differentiation between polyps and retention cysts could not be done as both are radiographically similar.

## CONCLUSION

The present study highlights the high incidence of maxillary sinus changes in asymptomatic individuals and the role of CBCT in the identification of sinus pathologies. This study also emphasizes that oral radiologists should carefully examine and report all changes of the sinus in CBCT images taken for dental purposes so that appropriate management of sinus abnormalities can be done.

**Ethics Committee Approval:** from AB Shetty Memorial Institute of Dental Sciences, Mangalore, India (ABSM/EC/11/2020).

**Informed Consent:** N/A

**Peer-review:** Externally peer-reviewed.

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