



INCIDENTAL MAXILLARY SINUS ABNORMALITIES DETECTED BY CBCT IN ORTHODONTIC PATIENTS.

Medicine

Dr. Sugandha Verma	Junior Resident III, Department Of Oral Medicine And Radiology, Hazaribag College Of Dental Sciences And Hospital.
Dr. Priyanka Sonali*	Junior Resident I, Department Of Oral Medicine And Radiology, Hazaribag College Of Dental Sciences and Hospital. *Corresponding Author
Dr. K. Srikrishna	Professor and Head, Department Of Oral Medicine And Radiology, Hazaribag College Of Dental Sciences and Hospital.

ABSTRACT

Background: Cone beam computed tomography (CBCT) images of the maxillofacial region allow the inspection of the entire volume of the maxillary sinus (MS), identifying anatomic variations and abnormalities in the image volume, but this is frequently neglected by oral radiologists when interpreting images of areas at a distance from the dentoalveolar region, such as the full anatomical aspect of the MS. **Aims and Objectives:** The aim of this study was to investigate maxillary sinus abnormalities in asymptomatic orthodontic patients by using CBCT. **Methods:** 360 CBCT images were evaluated by an examiner and identification of abnormalities were recorded. Data were analyzed and statistical analysis was done. **Results:** Abnormalities were detected in 45% of cases, the most common abnormality detected was mucosal thickening (26%) followed by opacification (13.5%), sinus polyp (3%) and retention cyst (2.5%). Males were more frequently affected than the females. **Conclusions:** Abnormalities in maxillary sinus emphasizes the importance of proper analysis and interpretation of the entire maxillary sinus volume by the dento-maxillofacial radiologists.

KEYWORDS

CBCT, Maxillary sinus

INTRODUCTION

Cone-beam computed tomography (CBCT), which was introduced in 1998, is widely used by oral radiologists for 3-dimensional imaging in maxillofacial radiology.¹ The multiplanar images acquired by CBCT provide an opportunity to inspect the entire volume of the acquired image and the anatomic variations and abnormalities found in the image volume.²

The frequent indications for CBCT includes dental implant site assessment, maxillofacial trauma, and orthodontics in which the area of the nose and the maxillary sinus can be within the imaging field. The significant increase in the use of CBCT by dentists and maxillofacial surgeons in the assessing various diseases has led to increased incidental findings in the area of the maxillary sinus.³

The paranasal sinuses, along with the turbinates, facilitates warming and humidification of air, contribute to the body's defences against microbial ingress, decreases the weight of the facial skeleton and contribute to voice resonance.^{4,5} A broad spectrum of disease processes can involve the maxillary sinus. They may arise either from within the lining of the sinus, the adjacent paranasal sinuses, nasal space, dental and oral tissues, or in the adjacent bone with expansion into the sinus.⁵

Incidental findings of abnormalities of the maxillary sinus are common in spiral computed tomography (CT) scans and CBCT dental scans.⁶ these incidental findings need to be followed-up as most of the patients being asymptomatic are left untreated. The comprehensive radiologic examination of the maxillary sinus includes assessment of the maxillary mucosa, fluid levels, bone alterations, position and size.³ Combined with the clinical examination, further treatment options or referral to a specialist can be considered.

MATERIALS AND METHOD

The material required for the study includes Cranex 3D CBCT Machine (Soredex version 5.2, PaloDEX Group Oy, Finland), Server Workstation (Dell Precision, Model T5810XL), OnDemand 3D™ Dental Software Version 5.2 (Cybermed Inc., Finland), Dell Monitor 21 inches.

The study sample comprised of 360 CBCT scans depicting the maxillary sinus of the patients referred from the department of orthodontics, undertaken at the Department of oral medicine and maxillofacial radiology of Hazaribag college of dental sciences and hospital, which were retrospectively selected on the basis of convenience sampling.

All scans which showed the entire maxillary sinuses bilaterally were included in the study sample. Patients under 12 years of age were excluded from the study due to incomplete sinus development. Images of low resolution quality and/or presence of any artifacts (metallic, movement etc.) which impaired sinus visualization were also excluded from the study.

The tomographic images were aquired using a Cranex 3D CBCT Machine (Soredex version 5.2, PaloDEX Group Oy, Finland) operating at 90kV and 13mA, with a large FOV of 61 X 78mm, a voxel size 85µm and scan time of 20 seconds. The images were stored and converted into DICOM file format using the acquisition software integrated to the CBCT machine, OnDemand 3D™ Dental Software Version 5.2 (Cybermed Inc., Finland). The imported DICOM files were opened and examined. Diagnosis of the maxillary sinuses was performed on a 1:1 scale, using three orthogonal slice views (axial, coronal and sagittal). The PC workstation used the Dell Precision, Model T5810XL and Dell Monitor 21 inches.

The CBCT scans were analyzed by an experienced oral and maxillofacial radiologist. The examiner was trained and calibrated using 10% of the sample in a pilot study before data collection began. A screening procedure was undertaken to identify the presence or absence of sinus abnormalities using a yes/no scale. The criteria to classify the presence of an abnormality included the identification of at least one of the following deviations from normality: (1) radiographic density changes in the cortical bone of the sinus, (2) partial or complete opacification of the sinus cavity, and (3) increased thickening of the mucosa greater than 3 mm. The identification of an abnormality was registered separately for the right and left sinuses of each patient. The findings observed in our study were mucosal thickening, opacification, sinus polyp, retention pseudocysts (fig. 1-4).

The data were analysed using descriptive statistics and the chi-square tests. The inter-rater agreement was calculated using Kappa statistics. (SPSS) version -20 (2016) was used for statistical analysis.

RESULTS

The CBCT exams of 360 patients were included in the sample. Out of 360, 216 (60%) were males and 144 (40%) were females. 162 patients (45%) of which presented with maxillary sinus abnormalities. 198 (55%) of the total samples showed no abnormalities. 102 males i.e. (47.2%) and 60 females i.e. (41.6%) were detected with maxillary sinus abnormalities respectively.

The abnormalities detected in our study were mucosal thickening in 93

(26%), opacification in 49 (13.5%), sinus polyp in 11 (3%) and retention cyst in 9 (2.5%). (Table-1) Right and left side of the maxillary sinus involvement was seen in 93 (25.8%) and 64 (17.7%) samples respectively. Bilateral sinus involvement was seen in 5 (1.5%) samples. (Table 2) In males, mucosal thickening was seen in 60 (16.6%), opacification in 27 (7.5%), sinus polyp in 6 (1.6%) and retention cyst in 9 (2.5%) samples. In females, mucosal thickening was seen in 33 (9.4%), opacification in 22 (6%), sinus polyp in 5 (1.4%) samples.

DISCUSSION

Maxillary sinus abnormalities in asymptomatic orthodontic patients were highly prevalent in this study. This emphasizes the importance of proper examination of the entire volume of the CBCT image, including the maxillary sinus and the surrounding landmarks.

CBCT is one of the recent advances in the field of oral and maxillofacial radiology in terms of diagnostic imaging. Due to lack of familiarity with the anatomy of the area to be investigated, most often overlooked, lead to non-diagnosis of the abnormalities in asymptomatic patients.

The CBCT examination of the maxilla is commonly done for procedures such as orthodontics, surgical sinus lift for implant placement, maxillofacial trauma, endodontic treatment etc. Incidental findings such as mucosal thickening can be associated with a sinus outflow obstruction which can impact on the clinician's treatment decisions.³ This abnormality is frequently investigated in examinations for implant treatment planning, but other abnormalities are often overlooked.

There are several studies which have reported a variability in the prevalence of incidental findings in the maxillary sinuses of asymptomatic subjects using multiplanar images. CBCT studies reported a prevalence ranging from 24.6% to 56.3%^{6,7} and CT scanning studies found abnormalities in approximately 30% of cases.^{8,9}

In our study, we detected incidental abnormalities in 45% of the cases, which were in agreement with Havas *et al* 42.5%, Glacier *et al* 46.8%, Beaumont *et al* 40%, and Drumond *et al* 41.57%.⁹⁻¹²

Mucosal thickening was the most common abnormality in our study with the occurrence of 26%, which was in accordance with 21.25% by Drumond *et al*, 16.8% by Christopher *et al* and 19% by Vallo *et al*.¹²⁻¹⁴ However, Rege *et al* presented with a 66 % mucosal thickening.¹⁵ The differences obtained in the data could be attributed to several etiological factors such as traumatic, infectious or allergic. Among these, allergy could account for the maximum number of findings as the incidence of mucosal thickening is more common in allergic rhinitis.

Nonvital posterior maxillary teeth, periodontal abscesses, retained roots, embedded or impacted teeth, extensively carious teeth and oroantral fistulae could be etiological factors in pathologies of odontogenic origin.¹⁴

Opacification was the second most frequent finding with the occurrence of 13.5% which would suggest an occurrence of sinusitis. However, sometimes opacification can also be found in abnormalities such as mechanical trauma, barotraumas and hemorrhage.¹⁶

The polypoid lesions such as the sinus polyp and the retention cysts are worth noting for the epidemiological purpose of the representative population. In our study, the occurrence of sinus polyp was 3% and retention cyst was 2.5%. The incidence of sinus polyp reported was 7.6% by Christopher *et al* and 5.6% by Rege *et al*.^{13,15} Whereas, retention cyst reported was 29% by Beaumont *et al*, 7% by Vallo *et al*, and 10.1% by Rege *et al*.^{11,14,15} Discrepancies in abnormality rates may be due to influence of the climate among different geographical areas and subjects having different living & working environment.

In this study, the occurrence of abnormality was more common in males with 47.2% which is in accordance with several other studies suggesting involvement of males more frequently than females.^{14,15} In our study, the differences in the occurrence of the abnormality among males and females could be attributed to the fact that there were more male subjects included in the study than the females.

CONCLUSION

The high occurrence of abnormalities in asymptomatic maxillary sinus emphasizes how important it is for the dento-maxillofacial radiologist to undertake a comprehensive interpretation of the whole volume acquired in CBCT images, including the entire maxillary sinus when analyzing the imaging exams of routine patients. The study also highlights the importance of inclusion of the entire CBCT maxillary landmarks including the maxillary sinus and the surrounding structures and the soft tissues in the PG curriculum of Oral and Maxillofacial Radiology

TABLES

Table 1: Distribution of pathological findings in the subject

Findings		
	Frequency	Percent
Absent	198	55
Mucosal thickening	93	26
Opacification	49	13.5
Sinus polyp	11	3
Retention cyst	9	2.5
Total	360	100.0

Table 2: comparison of pathological findings of the subjects on the basis of side of occurrence

Sides		
	Frequency	Percent
Absent	198	55
Right side	93	25.8
Left side	64	17.7
Both sides	5	1.5
Total	360	100.0

Table 3: comparison of pathological findings of the subjects on the basis of gender

Findings	Gender		Total	Chi-Square	df	p value
	Male	Female				
Absent	114	84	198	5.709	4	.222
	31.6%	23.4%	55%			
Mucosal thickening	60	33	93			
	16.6%	9.4%	26%			
Opacification	27	22	49			
	7.5%	6%	13.5%			
Sinus polyp	6	5	11			
	1.6%	1.4%	3%			
Retention cyst	9	0	9			
	2.5%	0.0%	2.5%			
Total	216	144	360			
	60%	40%	100.0%			

FIGURES

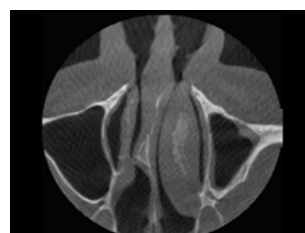


Fig. 1: Axial view of mucosal thickening

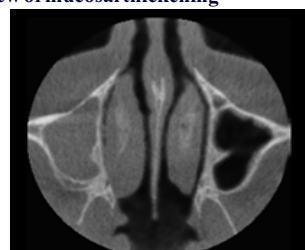


Fig. 2: Axial view of opacification



Fig. 3: Axial view of retention cyst



Fig. 4: Axial view of sinus polyp

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