Evaluating the Maxillary sinus pathologies through Cone Beam Computed Tomography- A Radiographic study

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ABSTRACT

Introduction: The maxillary sinuses are the largest of the paranasal sinuses. These are located bilaterally in the maxillary body with an opening in the middle meatus of the nasal cavity. Its development occurs in the third month of intrauterine life. It enlarges by pneumatization and reaches adult size by eruption of the permanent teeth. The orbital floor serves as the roof of the maxillary sinus, and the sinus floor closely resembles the roots of the posterior maxillary teeth. The aim of this study is to evaluate the prevalence of various maxillary sinus pathologies through CBCT.

Material and Methods: The present study was carried in out-patient department of oral Medicine and Radiology at Teerthanker Mahaveer Dental College and Research Centre, Moradabad. This retrospective study comprises of 30 CBCT scans age between 20-70 years.

Results: Among the subjects on left maxillary sinus 38% were having Dentigerous cyst, 8% were having Mucocoele, 30% were having mucous retention cyst, 10% were having Osteophyte, 8.0% were having septated lesion and 0% were having thickened maxillary Sinusitis. Among the subjects on right maxillary sinus 38% were having Dentigerous cyst, 12% were having Mucocoele, 10% were having mucous retention cyst, 8% were having Osteophyte, 10.0% were having septated lesion and 18% were having thickened maxillary Sinusitis.

Conclusion: According to the study, asymptomatic dental patients had a high rate of incidental maxillary sinus anomalies. As a result, awareness of incidental discoveries in CBCT scans by oral radiologists can help the patient's with early diagnosis, treatment, and follow-up. The use of CBCT was recommended for examining disorders of the maxillary sinus. According to our research, asymptomatic patients with mucosal thickness frequently have incidental maxillary sinus infections. As a result, for the vast majority of patients, a complete three-dimensional CBCT scan is advised for treatment planning.

Keywords: Cone beam computed tomography, CBCT, maxillary sinus, paranasal sinus

INTRODUCTION

The largest paranasal sinuses are the maxillary sinuses. These are positioned bilaterally in the maxillary body, with an aperture in the nasal cavity's middle meatus. Its development occurs in the third month of intrauterine life as an evagination of mucous membrane of lateral wall of nasal cavity with a minute space expanding in an inferior direction into the maxilla. It enlarges by pneumatization and reaches adult size by eruption of the permanent teeth. The orbital floor serves

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as the roof of the maxillary sinus, and the sinus floor closely approximates the roots of the posterior maxillary teeth.[1] The maxillary sinus can have a variety of anatomic abnormalities, including hypoplasia, septa, and exostosis. Furthermore, maxillary sinus lesions such as mucosal thickening, sinusitis, mucous retention cyst, and antrochoanal polyp are widespread, as are acute or chronic sinusitis, pseudocyst, sinus mucocele, antrolith, osteoma, papilloma, odontogenic cysts and tumours, central ossifying fibroma, and malignant neoplasms.[2] To examine the maxillary sinuses region, many imaging modalities such as panoramic, waters, Caldwell, CT, MRI, and CBCT can be used.[3] For a long time, skull projections such as Waters, Caldwell, and lateral sinus were utilised to assess the paranasal sinuses. Waters view is effective for gross examination of the maxillary sinus, particularly for localised mucosal thickening along the sinus floor, generalised mucosal thickening throughout the entire sinus wall, and near full or total radiopacification of the sinus.[4] Cone beam computed tomography (CBCT) is a low-cost dose sparing technique. It provides detailed three-dimensional images of the scanned structures and can accurately capture, display and provide 3D visualization of maxillofacial anatomy and pathology.[4,5] The multiplanar images acquired by CBCT provide the radiologists an opportunity to detect the abnormalities that can be found on inspecting the entire image volume. Thus, it is a useful tool in examination and diagnosis of maxillary sinus pathologies. It also plays an important part in treatment planning in the craniofacial region.[5] Hence this study is planned to evaluate the occurrence and prevalence of abnormalities in maxillary sinus by using CBCT, as it is essential for diagnostic and treatment planning purposes. Also comparison of right and left sides of maxillary sinus pathologies using CBCT have been done in this study.

MATERIALS AND METHOD

The present study was conducted in the Out-patient Department of oral Medicine and Radiology at Teerthanker Mahaveer Dental College and Research Centre, Moradabad. This retrospective study comprises of 30 CBCT scans age between 20-70 years retrieved from diagnostic centre. Permission has been obtained from the ethical committee Teerthanker Mahaveer Dental College & Research Centre Moradabad, Uttar Pradesh. This study included only CBCT images showing bilaterally of maxillary sinus and pathology involving the maxillary sinus unilaterally or bilaterally. This study excludes CBCT images with any artifacts or blurring effect and any previous history of maxillary sinus surgery. These images were acquired using a CBCT scanner (CS9300 Carestream) with the following parameters-84 kVp, 8mA and FOV of 12×15mm and exposure time of 13.3 sec. The slice thickness was 1mm and voxel size- 0.25mm-3mm for this FOV. DICOM files were retrieved from the system attached to the CBCT machine and later the DICOM files were imported to ASUS VivoBook 14 laptop for further assessment. During the evaluation laptop's screen brightness was fixed and an external mouse pointer was used for accurate measurements and assessments. Images were processed using Carestream's CS3D software to create axial, coronal, sagittal and reconstructed images. Subsequently, these images were analysed. This retrospective study includes 30 CBCT scans retrieved from a computer database of Vaibhav Diagnostic Centre, Moradabad. On cross-section images presence of various pathologies involving right and left maxillary sinuses will be evaluated in all three planes (axial, sagittal, coronal and 3D of CBCT. The variations in the sinuses wall and internal structures will be detected by all three sections of CBCT.

These pathologies of maxillary sinuses will be categorized based on the presence of inflammatory, non-inflammatory, neoplastic, non-neoplastic, traumatic and miscellaneous findings. Later these findings will be analysed and tabulated. The bilateral maxillary sinus will be evaluated by the features given by Al-Zoubi IA et al.[2]

OBSERVATION AND RESULTS

The current study's data was imported into Microsoft Excel 2007 and evaluated with the SPSS statistical programme 23.0 Version. The descriptive statistics were frequency and percentage. The significance level for the current study was set at 5%. The Chi Square test was used to compare the frequency differences between independent groups. Among the 30 CBCT scans, distribution and comparison of maxillary sinus pathologies were compared between right & left and males & females in table and graphs 1, 2 and 3. The whole difference between the left sides and right sides was statistically non- significant when analyzed using Chi Square test (p=0.873). The difference between the left sides and right sides in males was statistically non- significant when analyzed using Chi Square test (p=0.873). The difference between the left sides and right sides in females was statistically non- significant when analyzed using Chi Square test (p=0.873).

Table1- Side-wise distribution of the pathologies

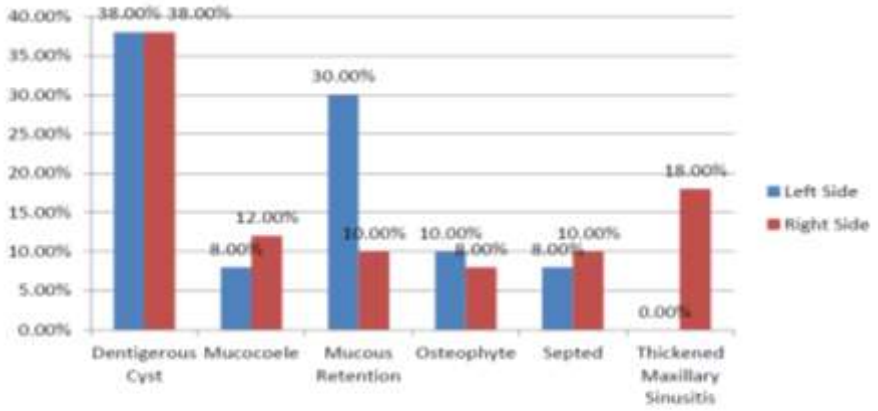
	Dentigerous Cyst	Mucocoele	Mucous Retention	Osteophyte	Septed	Thickened Max illary Sinusitis
Left	19	4	15	5	4	0
	38.0%	8.0%	30.0%	10.0%	8.0%	.0%
Right	19	6	5	4	5	9
	38.0%	12.0%	10.0%	8.0%	10.0%	18.0%

Table 2- Side-wise distribution of the pathologies among males

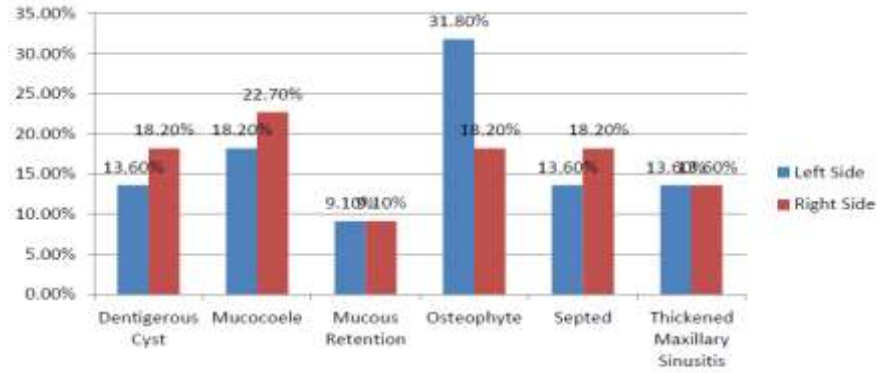
	Dentigerous Cyst	Mucocoele	Mucous Retention	Osteophyte	Septed	Thickened Maxillary Sinusitis
Left	3	4	2	7	3	3
	13.6%	18.2%	9.1%	31.8%	13.6%	13.6%
Right	4	5	2	4	4	3
	18.2%	22.7%	9.1%	18.2%	18.2%	13.6%

Table 3- Side wise distribution of the pathologies among females

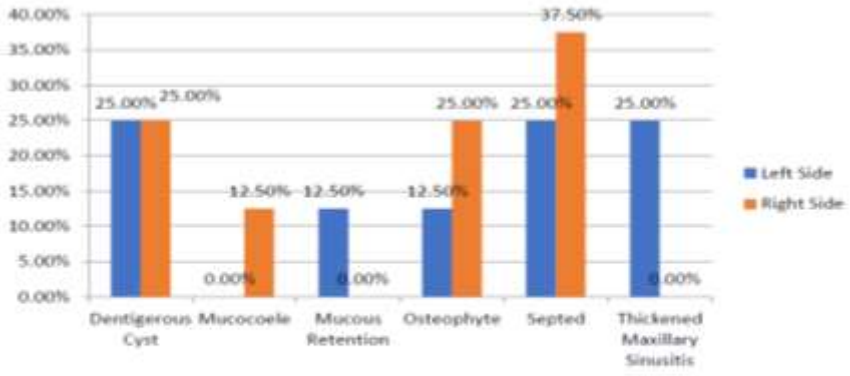
	Dentigerous Cyst	Mucocoele	Mucous Retention	Osteophyte	Septed	Thickened Maxillary Sinusitis
Left	2	0	1	1	2	2
	25.0%	.0%	12.5%	12.5%	25.0%	25.0%
Right	2	1	0	2	3	0
	25.0%	12.5%	.0%	25.0%	37.5%	.0%



Graph 1: SIDE-WISE DISTRIBUTION OF THE PATHOLOGIES

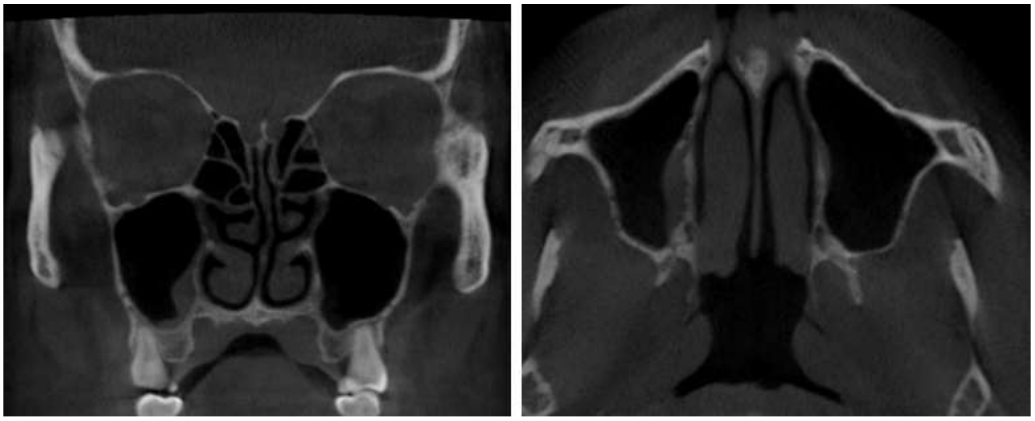


Graph 2: SIDE-WISE DISTRIBUTION OF THE PATHOLOGIES AMONG MALES

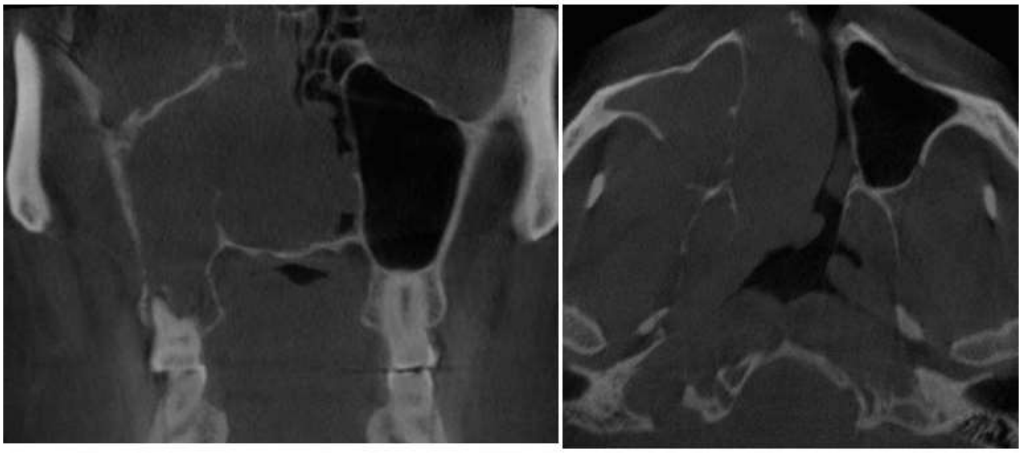


Graph 3: SIDE WISE DISTRIBUTION OF THE PATHOLOGIES AMONG FEMALES

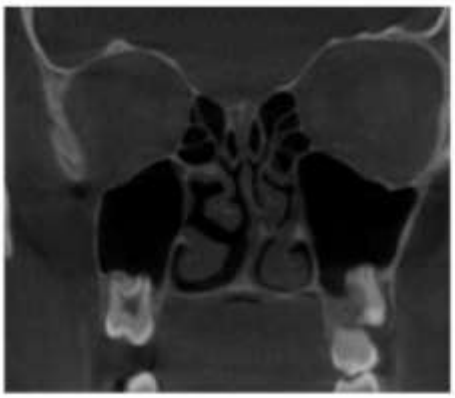
Figure A: CBCT machine- Carestream CS9300



B. Mucosal Thickening



C. Complete Opacification of the sinus



D. Maxillary Root Involvement in Maxillary Sinuses

E. Mucosal Polyp

DISCUSSION

The CBCT volume encompasses the entire maxillofacial region, preventing the superimposition of anatomical features. On CBCT pictures, the full picture volume should be reviewed (i.e., the analysis should not be limited to evaluation of the region of interest). In addition to paranasal sinuses being discovered incidentally in the craniofacial region, a thorough investigation can uncover structural alterations and diseases that affect the area

and have clinical significance.[6-12] The use of CBCT by otolaryngologists as a vital tool for the diagnosis and planning of paranasal sinus diseases has only recently begun. CBCT allows faster dataset acquisition across the entire field of view than conventional CT scanners due to less patient movement during the acquisition of the images and superior imaging of high contrast structures like teeth and the bone architecture of the craniofacial area.[13] However, a normal CT often has a smaller viewing area, less contrast for soft tissues, and greater picture noise. The paranasal sinuses can be imaged with CBCT, which has a reduced radiation dosage and an isotropic volume resolution, making it easier to identify delicate structures in multiplanar reconstructions.[14] In the current study, 60 maxillary sinuses from CBCT scans of 30 patients were retrospectively analysed for abnormalities in the maxillary antrum. There were 35% of maxillary sinuses that had abnormal signs which were reportedly smaller as compared to some of the earlier investigations Elwakeel et al, Rege et al. & Jangam et al.[15] A range of odontogenic illnesses, such as nonvital posterior maxillary teeth, periodontal infections, retained roots, impacted teeth, and highly carious teeth, can cause mucosal thickenings, which are inflammatory changes in the maxillary sinus. In addition to these other factors, allergies, trauma, and microbial infections are additional etiological causes.[16] These could appear as linear mucosal thickening in the maxillary sinus, progressing to partial and total opacification. According to Rege et al., Elwakeel et al., Jangam et al., Raghav et al., and Ritter et al., mucosal thickening was the most prevalent observation in the current investigation. Regarding prevalence, they discovered no discernible gender difference. In comparison to the research mentioned above, the current study's rate of paranasal sinus pathoses was greater at 88.4%.[17] Sick sinuses were defined as cysts with mucus retention and thickening of the mucosa. The sinus mucosa is classified as thickened when the membrane is 2–6 mm thick. Allergies or odontogenic cysts are examples of irritants that are linked to the etiological causes. Mild mucosal thickening of the maxillary sinus is frequently observed in asymptomatic patients. A thickness of more than 2 mm, however, can signify maxillary sinusitis. Using previous research as a guide, mucosae that were at least 3 mm thick were considered to be thickened in the current study. As the sinus ostium becomes clogged, mucous retention cysts, which usually disappear on their own, develop. Despite their regular appearance in CBCT images, they are challenging to identify without the proper dental radiology understanding. It is important to highlight them in CBCT picture reports even though they frequently appear in asymptomatic patients.[18,19] The current study's conclusions regarding the frequency of tooth roots in the maxillary sinus are thus similar with earlier studies. Mucous retention cysts and sinus mucosal thickening are the two most common diseases of the maxillary sinus. Mucocele represented complete opacification, and the margins were expanded and usually thin. Similar to the research of Raghav M et al., it was discovered that males were more likely to experience mucosal thickening. As a result, similar to the current investigation, the statistical comparison of mucosal thickening between the right and left sinuses was shown to be non-significant. Despite being the most frequent radiographic finding relating sinus disease, mucosal thickening was nonetheless noted. Our finding indicates the most prevalent finding was mucosal thickening which was in similarity to the study conducted by Vallo J et al., the prevalence of abnormality was higher in the male subjects of the current investigation. Despite being the most frequent radiographic finding relating

sinus disease, mucosal thickening was nonetheless noted.[20-22]

Males were shown to have a higher prevalence of mucosal thickening, which is consistent with the research done by Raghav M. et al. As a result, it is impossible to compare the incidence of mucosal thickening between the right and left sinuses. There is frequent spontaneous regression of maxillary sinus retention cysts. Cysts of retention in the maxillary sinus are a typical thickening. According to our findings, mucosal thickening was the most frequent finding. Similar to the study conducted by Vallo J et al., the prevalence of abnormality was higher in the male subjects of the current investigation. In females, mucous retention cysts were more frequently seen on the left side.[23-25] Similar to Shekhi M.'s work, the current study found that males on the right side had a higher incidence of the dentigerous cyst, mucocele, osteophyte, and septated.[26, 27] The mucocele was more prominent on the right side. On comparison to the study conducted by Raghav et al. in 2014[28-31] the osteophyte and thickened maxillary sinus were more prevalent on the left side. According to a study by Due et al., septae, oseophytes, and dentigereous cysts were discovered in our investigation as additional pathogenic traits. The most frequent accidental finding in the current investigation was the presence of septa, which is consistent with research by Tadinada A. et al. and Lana J.P. et al.[17,18]

CONCLUSION

According to the study mentioned above, the incidental maxillary sinus pathologies are very common in asymptomatic dental patients. Awareness of incidental pathologies and its evaluation can help in patient's early diagnosis, treatment, and follow-up. The study emphasises the value of CBCT in detecting abnormalities in the maxillary sinus. The use of CBCT was recommended for examining disorders of the maxillary sinus. According to our research, asymptomatic patients with mucosal thickness frequently have incidental maxillary sinus infections. As a result, for the vast majority of patients, a complete three-dimensional CBCT scan is advised for treatment planning.

REFERENCES

1. Michelle Maillet,Walter R. Bowles, Scott L. McClanahan, Mike T. John, and Mansur Ahmad.Cone-beam Computed Tomography Evaluation of Maxillary Sinusitis. J Endod 2011.
2. InaraCarneiro Costa Rege, Thiago Oliveira Sousa, Cláudio Rodrigues Leles and Elismauro Francisco Mendonça. Occurrence of maxillary sinus abnormalities detected by cone beam CT in asymptomatic patients. BMC Oral Health 2012, 12:30.
3. IlzeDobele, LigijaKise, Peteris Apse, GintsKragis, AndrisBigestans. Radiographic assessment of findings in the maxillarysinus using cone-beam computed tomography. Stomatologija, Baltic Dental and Maxillofacial Journal, 15: 119-122, 2013.
4. MamtaRaghav, Freny R. Karjodkar, and KaustubhSansare. Prevalence of incidental maxillary sinus pathologies in dental patients on cone-beam computed tomographic images. ContempClin Dent. 2014 Jul-Sep
5. AnithaRaghunathan, SaraswathiGopal, C. Sumathy. Occurrence of Abnormalities and Anatomical Variations in Maxillary Sinus detected by CBCT. International Journal of Oral Health and Medical Research 2016; 2(6): 18-23.
6. Eman E. Elwakeel, Ekta Ingle, Yusra A. Elkamali, HebaAlfadel,

NoufAlshehri, and Kholoud A. Madin. Maxillary Sinus Abnormalities Detected by Dental Cone-Beam Computed Tomography. AnatPhysiol 2017.
7. Michael Dau, Paul Marciak, Bial Al-Nawas, Henning Staedt, AbdulmonemAlshiri, Bernhard Frerich and Peer Wolfgang Kämmerer. Evaluation of symptomatic maxillary sinus pathologies using panoramic radiography and cone beam computed tomography-influence of professional training. International Journal of Implant Dentistry (2017) 3:13.
8. Sangeeta S Malik, AarfaNasim, Ravi Prakash S Mohan, NagarajuKamarthi, SumitGoel, Swati Gupta. Cone Beam Computed Tomography Analysis of Incidental Maxillary Sinus Pathologies in North Indian Population. J Indian Acad Oral Med Radiol 2017
9. Bozdemir, Esin & Gormez, Ozlem & Yıldırım, Derya & Erik, Ayse. (2016). Paranasal sinus pathoses on cone beam computed tomography. Journal of Istanbul University Faculty of Dentistrykonik
10. Al-Zoubi, Ibrahim & Patil, Santosh & Kato, Ikuro & Sugita, Yoshihiko & Maeda, Hatsuhiko & Alam, Mohammad. (2017). 3D CBCT Assessment of Incidental Maxillary Sinus Abnormalities in a Saudi Arabian Population. Journal of Hard Tissue Biology
11. Roque-Torres GD, Ramirez-Sotelo LR, Vaz SL, Bóscolo SM, Bóscolo FN. Association between maxillary sinus pathologies and healthy teeth. Braz J Otorhinolaryngol. 2016 Jan-Feb
12. Waite D.E. Maxillary sinus. Dent Clin North Am. 1971
13. McGrowan D.A., Baxter P.W., James J. 1st ed. Wright; London: 1993. The maxillary sinus and its dental implications.
14. Wehrbein H., Diedrich P. The initial morphological state in the basally pneumatized maxillary sinus – a radiological–histological study in man. Fortschr Kieferorthop. 1992
15. Eberhardt J.A., Torabinejad M., Christiansen E.L. A computed tomographic study of the distances between the maxillary sinus floor and the apices of the maxillary posterior teeth. Oral Surg Oral Med Oral Pathol. 1992
16. Sharan A., Madjar D., Hashomer T. Correlation between maxillary sinus floor topography and related root position of posterior teeth using panoramic and crosssectional computed tomography imaging. Oral Surg Oral Med Oral Pathol Oral Radiol Endod.
17. Kilic C., Kamburoglu K., Pehlivan S., Ozen T. An assessment of the relationship between the maxillary sinus floor and the maxillary posterior teeth root tips using dental cone-beam computerized tomography. Eur J.
18. Selden H. Endo-Antral syndrome and various endodontic complications. J Endod. 1999
19. Hauman C.H., Chandler N.P., Tong D.C. Endodontic implications of the maxillary sinus: a review. Int Endod J. 2002
20. Howe R. First molar radicular bone near the maxillary sinus: a comparison of CBCT analysis and gross anatomic dissection for small bony measurement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009.
21. Nair U.P., Nair M.K. Maxillary sinusitis of odontogenic origin: cone-beam volumetric

computerized tomography-aided diagnosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod.
22. Lofthag-Hansen S., Huumonen S., Grondahl K., Grondahl H.G. Limited conebeam CT and intraoral radiography for the diagnosis of periapical pathology. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007
23. Hauman CHJ, Chandler NP, Tong DC. Endodontic implications of the maxillary sinus: A review. Int Endod J 2002
24. Sharan A, Madjar D. Correlation between maxillary sinus floor topography and related root position of posterior teeth using panoramic and cross-sectional computed tomography imaging. Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology 2006.
25. White SC, Pharaoh MJ. Oral Radiology - Principles and Interpretation. 6th ed. Noida, India: Elsevier; 2010.
26. Shanbhag S, Karnik P, Shirke P, Shanbhag V. Association between periapical lesions and maxillary sinus mucosal thickening: A retrospective cone-beam computed tomographic study. J Endod 2013.
27. Ritter L, Lutz J, Neugebauer J, Scheer M, Dreiseidler T, Zinser MJ, Rothamel D, Mischkowski RA: Prevalence of pathologic findings in the maxillary sinus in cone-beam computerized tomography. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 2011 May.
28. Bell GW, Joshi BB, Macleod RI.Maxillary sinus disease: diagnosis and treatment. British Dental Journal 2011.
29. Cha J-Y, Mah J, Sinclair P: Incidental findings in the maxillofacial area with 3-dimensional cone-beam imaging. Am J Orthod Dentofacial Orthop 2007.
30. Pazera P, Bornstein MM, Pazera A, Sendi P, Katsaros C: Incidental maxillary sinus findings in orthodontic patients: a radiographic analysis using cone-beam computed tomography (CBCT). OrthodCraniofac Res.
31. Diament MJ, Senac MOJR, Gilsanz V, Baker S, Gillespie T, Larsson S: Prevalence of incidental paranasal sinuses opacification in pediatric patients: a CT study. J Comput Assist Tomogr 1987.