Retrospective Evaluation the Health and Pathology of Maxillary Sinus by Cone Beam Computed Tomography

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Abstract: Background: Pathological findings in the maxillary sinus are unexpected or unintended discoveries that are not directly related to the primary reason for conducting a cone beam computed tomography (CBCT) scan for dental imaging. In this study, we aimed to analyze the prevalence of maxillary sinus pathologies and its relation with dental pathology and implant position using CBCT.

Material and methods: 150 maxillary sinuses of 75 patients with CBCT image includes in this study for evaluation the pathology of sinus as related to dental pathology of 30 patients who have posterior implant was evaluated for sinus pathology as related to implant position to floor of sinus. Each image investigates in coronal, sagittal and axial section. Images were evaluated for presence of mucosal thickening, polypoid and opacification in maxillary sinus.

Result: In the present study 67 of the total cases had an odontogenic cause of maxillary sinus and the rest 83 cases had healthy sinus. The most common sinus pathology was opacification 26.6% followed by polypoidal thickening 10.6%, mucosal thickening 7.3%. There is relation between sinus pathology and age with increase the frequency of sinus pathology with aging. There is relation between sinus pathology and implant position.

Conclusion: CBCT, a three-dimensional method, can be used to evaluate anatomical and pathological changes in the maxillofacial region. Sinus pathologies were particularly associated with dental pathology and implant position.

Keywords: Maxillary sinus, CBCT, Dental pathology, Sinusitis.

Introduction

The maxillary sinuses are a pair of large air-filled cavities located superior to the posterior part of the dentoalveolar region of the maxilla. The maxillary sinus has the shape of a pyramid and is the largest among the four paranasal sinuses. It drains into the middle meatus of the nasal cavity. It has three recesses, the alveolar process, the zygomatic recess, and the infraorbital recess. Due to the proximity of the sinus floor with the alveolar ridge, the maxillary sinus is of high relevance to multiple dental procedures, ranging from tooth extraction to implant insertion. (**Martu** *et al*, **2022**)

Odontogenic pain originating from the maxillary sinus can pose a diagnostic challenge for the clinician. As the roots of the maxillary posterior teeth are close to the floor of the sinus, along with common innervation, there is a probable reason for pathosis of the sinus to cause dental symptoms. (**Radman, 1983**)

The progress of a periapical lesion in maxillary posterior teeth can give rise to inflammatory changes in the mucosal lining of the maxillary sinus and subsequently, the development of sinusitis. (**Maloney**

&Doku, 1968). Periapical inflammation was found to be proficient for affecting the sinus mucosa with or without perforation of the cortical bone of the sinus floor. **(Kim ,2019)**

Radiographic imaging has always played an imperative role in establishing the odontogenic etiology of (mostly chronic) maxillary sinusitis and complement results of the clinical examination. In recent years, CBCT has been preferred because it is inexpensive and minimizes radiation exposure. In addition to understanding the complex anatomical structure of the maxillary sinuses, CBCT is the best imaging method that can be used in this field, providing three-dimensional (3D) imaging to identify and measure pathologic conditions and variations in the region. The fact that it provides detailed imaging especially in bone tissue facilitates both surgical interventions and the detection of variations. **(Djorić *et al*,2022; Ata-Ali *et al*,2017) The present study aimed to investigate the occurrence of maxillary sinus abnormalities in CBCT scans, identify the frequency, type. and location of these finding, and find the correlation between the distance of implant changes in maxillary sinus.**

Material and methods

Study design

This is a retrospective to evaluate related between tooth infection and implant position on maxillary sinus between Iraqi male and female using CBCT image. The images of the selected subject will be retrieved from privet dental clinic in diyala from year 2015 to 2023.

Inclusion criteria

1. Images with adequate diagnostic quality.

2. Patient with no. extracted upper posterior teeth

3. patient with implant in upper posterior area (for implant study cases). 4.Patients with age 20-40.

Excluded criteria

1. Image with no adequate diagnostic quality.

2. Image with tumor, facial growth defect or trauma that affect the maxillary sinus.

Sample size calculation:

✓ No of subject with infected teeth: (75)

✓ Male subject: (41)

✓ Female subject: (34)

✓ No of subject with age 20-30: (41)

✓ No of subject with age 31- 40: (34)

✓ No of subject with implant: (30)

✓ Male subject: (13)

✓ Female subject: (17)

Research tools:

The New Tom Giano CBCT (voltage of 110 kv, exposure time of 24 seconds, electrical current of 5-7 mA) used in this research. CBCT image reconstructed in to sagittal, coronal and axial section to evaluate both right and left maxillary sinus.

Selected condition of maxillary sinus:

Normal: No pathologic changes in the mucosa and internal structure of the maxillary sinus
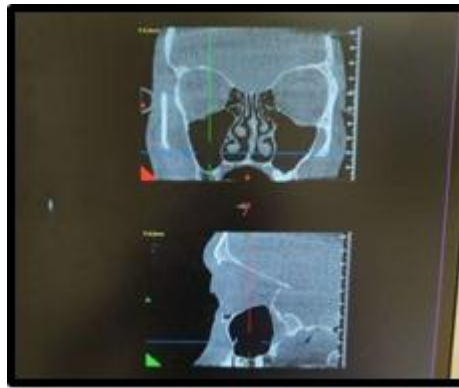
Figure 1: Normal maxillary sinus

Mucosal thickening: These are thickenings in the form of a diffuse radiopaque line parallel to the maxillary sinus wall.
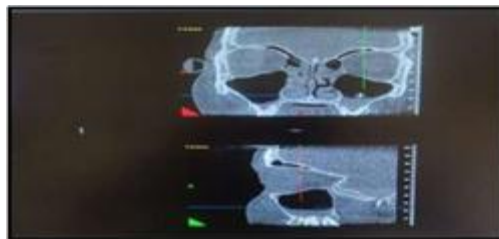

Figure 2: Mucosal thickening of maxillary sinus

Polypoid: These are rounded and stalked folds of tissue with smooth borders, originating from thickened maxillary sinus mucosa with chronic inflammation, isolated in a single area or present in different areas within the sinus.

Figure 3: Polypoid of maxillary sinus

Opacification: obstruction of sinus because of an accumulation of secretions.

Figure 2.4: Opacification of maxillary sinus

Image analysis:

CBCT images were evaluated on the right and left sides for the presence of polypoid, mucosal thickening and opacification. Observation and examination were performed in all planes to avoid missing inflammatory pathologies of the maxillary sinus as follows.

For implant in upper posterior area: we assess the selected sinus disease according to relation between implant apex and maxillary sinus.
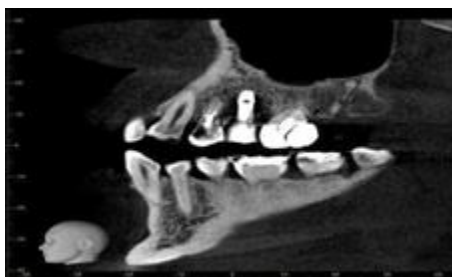
About 2mm fromsinus floor.

Figure 5: implant about 2mm from sinus floor
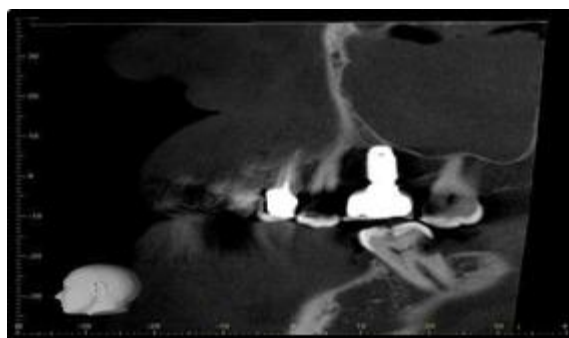
With sinus floor

Figure 6: implant with sinus floor

Apical third of implant in sinus

Figure 7: Apical third of implant in sinus

Results

Data from 75 patients were evaluated for maxillary sinus pathology in 150 CBCT scan, 82 (54.6%) males and 68 (45.3%) females aged between 20 and 40 years. 83(55.3%) maxillary sinuses were free of pathology while 67 (46.6%) showed pathologic changes. As shown in Table 1, the most widespread of these maxillary sinus pathologies was mucous opacification 26.6%, followed by polypoidal thickening 10.6%, mucosal thickening 7.3%.

Pathology	Right side N	N%	Left side N	N%	Both side N	N%
Normal	45	60%	38	50.6%	83	55.3%
Mucosal Thickening	3	4%	8	10.6%	11	7.3%
Polypoid	8	10.6%	8	10.6%	16	10.6%
opacification	19	25.3%	21	28%	40	26.6%
Total	75		75		150	

Table 1: Distribution of maxillary sinus pathologies in right and left side.

A total of 67 patients had pathologic findings in one or both sinuses, such as mucosal thickening, polypoid and opacification. Of the 82 male patients' image, 38 had pathologies, whereas only 29 of the 68 scans of the female patients revealed radiographically abnormal findings in sinus. (Table 2).

Pathology	Male N	N%	Female N	N%
Normal	44	53.6%	39	57.3%
Mucosal Thickening	6	7.3%	5	7.3%
Polypoid	9	10.9%	7	10.2%
Opacification	23	28.0%	17	25%
Total	82	54.6%	68	45.3%

Table 2: Distribution of maxillary sinus pathologies in male and female

The result of this study showed that the age effect on prevalence of pathologic findings in the maxillary sinus with frequency higher in age >31. (Table3)

Pathology	Total N	20-30 N	N%	31-40 N	N%
Normal	83	52	62.6%	31	37.3%
Mucosal Thickening	11	3	27.2%	8	72.7%
Polypoid	16	7	43.7%	9	56.2%
Opacification	40	19	47.5%	21	52.5%
Total	150	81	54%	69	46%

Table 3: Distribution of maxillary sinus pathologies according to age.

In the present study, out of the 150 maxillary sinuses, 83 were healthy, 67 had sinusitis. On the other hand, out of the 150 maxillary sinus scan, 83 cases had healthy teeth while 67 (out of 150) had a history of infected teeth. 9(out of 67) had carious teeth with no periapical pathology,8 (out of 67) had failure restoration, 29 (out of 67) had history of root canal treatment, 19 (out of 67) had granuloma or abscess and 2 (out of 67) had bone resorption and the frequency of sinus pathology is higher in endo treatment (43.2%). (Table4)

Pathology	Caries	Restoration	Endo	Granuloma or abscess	Bone Resorption	Total
Mucosal thickening	2(22.2%)	1(12.5%)	5(17.2%)	3(15.7%)	0	11(16.4%)
Polypoid	1(11.1%)	3(37.5%)	7(24.1%)	5(26.3%)	0	16(23.8%)
Opacification	6(66.6%)	4(50%)	17(58.6%)	11(57.8%)	2(100%)	40(59.7%)
Total	9(13.4%)	8(11.9%)	29(43.2%)	19(28.3%)	2(2.9%)	67(44.6%)

Table 3.4: Relationship between sinus pathology and odontogen pathology

On 30 patients with posterior implant the result shows that more frequency of sinusitis is when the apical part of implant inside sinus (47.0%) while more frequency normal sinus is when the implant about 2mm below sinus floor (69.2%) (Table 3.5)

Position of implant	normal	sinusitis	Total
2mm below sinus floor	9(69.2%)	3(17.6%)	12(40%)
With sinus floor	3(23.0%)	6(35.2%)	9(30%)
Inside sinus	1(7.6%)	8(47.0%)	9(30%)
Total	13(43.3%)	17(56.6%)	30(100%)

Table 5: Relationship between the maxillary sinus pathology and implant position

Discussion

In the present study, the incidence of odontogenic-related sinusitis was more commonly seen in males than in females. this was in accordance with the study done by. (Vallo et al,2010)

In the present study, when the tip of implanted tooth root was in contact with the floor of maxillary sinus, the incidence of sinusitis was lower than when the tip of implanted root exceeded and protruded within the floor of the maxillary sinus. This finding was in accordance with the study done by (Lu et al,2012). There is histological evidence of a thin cortical bone surrounding the maxillary sinus with perforation. Due to this perforation or absence of thin layers of cortical bone, the periodontal tissues are in direct contact with the maxillary sinus mucosa. The knowledge of which is essential for planning dental treatment. (Sharan et al,2006)

Distinguishing a healthy and a diseased sinus radiographically is not so problematic because the sinus it is air-filled, the sinus appears radiolucent and has clearly defined margins (Maloney and Doku,1968). In case of diseased sinus, a clinician may easily identify opacifications, mucosal thickening and or polypoid (Thunthy ,1998). The present study showed relation between odontogenic pathology and sinus pathology and this result seem to agree with the result of study made by (Maillet et al in 2011) who conclude that maxillary sinusitis associated with dental conditions.

Kuligowski in 2021 reached a similar conclusion with this study, he found that mucosal thickening was higher in maxillary sinuses associated with tooth roots condition. The close relationship of the maxillary posterior tooth roots with the sinus may cause pathogenic microorganisms and toxins in the oral cavity to reach the sinus through the spongy bone and cause inflammation of the mucosa and sinusitis symptoms. (Nascimento, 2016)

Our study showed that there is relation between sinus pathology with age, the result showed ageing increase possibility of sinus pathology present and this result agree with the study made by Sánchez et al in 2016 who has been suggested that tooth loss and aging increase the likelihood of the presence of sinusitis.

Conclusion

1. Radiographic analysis plays a pivotal role in the diagnosis of odontogenic sinusitis.

2. CBCT is particularly useful to establish a definitive diagnosis in the treatment of chronic maxillary sinusitis of odontogenic origin.

3. Sinus pathology is associated with dental condition.

4. Sinus pathology is associated with ageing.

5. Before dental implant and sinus surgery applications, detecting the presence of variations and pathologies can reduce complications.

6. There is a relation between sinus pathology and implant position to the floor of sinus

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