Research Article

A Cone Beam Computed Tomographic Evaluation of Maxillary Molars Relation to the Floor of Maxillary Sinus

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Abstract

Introduction: Maxillary sinus varies greatly in shape, size, and position between different individuals and in different sides of the same individual. CBCT scan is very important in evaluating maxillary sinus characteristics including the relation between maxillary teeth and the sinus. It has many advantages including decreased scanning time and better resolution.

Material and Method: This retrospective study included 100 Patients (45 females, 55 males) with 480 maxillary molars who were referred to Dental Radiology clinic in Baghdad, during the period from December 2020 to July 2021 for CBCTs. 60 patients with 360 teeth were assessed bilaterally and 40 Patients with 120 teeth were assessed unilaterally to determine the vertical relationship between their roots apices and maxillary sinus (MS) floor; using The Trans axial images from a panoramic view of CBCTs according to the classification of Kwak., *et al*.

Result: We found that 168(35%) of teeth in this study were in class (V) relationship to the floor of maxillary sinus, followed by class (I); 139 (28.95%) teeth, class (II); 129 (26.88%), class (IV); 29 (6.04%) and class (III); 15 (3.13%) respectively. Class (V) relationship was the most frequently seen with 1st and 2nd molars 81(50.63%), 62 (38.75%) respectively. While a class (I) was most commonly observed relation with the 3rd maxillary molars. The relationship between maxillary molars to MS floor were significant (P = 0.000), also it was significant according to age group and gender. Non-significant association were found between left and right side for the 1st, 2nd and 3rd molars in their relationships to the MS floor.

Conclusion: Most of the maxillary molars especially maxillary 1st and 2nd molars are in close proximity to the maxillary sinus floor while maxillary 3rd molars showed safer relation with sinus. There were significant association in the relation of maxillary molars to the sinus floor and also according to the age groups and gender of patients, while the relation was non-significant between right and left side of the maxilla.

Keywords: Maxillary Molars; Maxillary Posterior Roots Species; Maxillary Sinus Floor; CBCT

Introduction

Maxillary sinus is a pyramidal shaped air sinus located in the body of the maxilla, its base at the nasal wall and its apex directed to the zygomatic bone. It is the largest bilateral air sinus opens in the middle meatus of the nasal cavity. Maxillary sinus varies greatly in shape, size, and position between different individuals and in different sides of the same individual [1]. Maxillary sinus is the first developing paranasal sinuses, and its development process

completed with the 3rd molar eruption about the age of 20 years of individuals [2]. The anatomical variability of the maxillary sinus can be explained by its relation to the maxillary posterior teeth and by the degree and size of its pneumatization [3]. The floor of maxillary sinus shaped by the maxillary alveolar process and it has variant extension in adults [4]. Maxillary sinus inferior wall is curved and extended between the adjacent roots or teeth in about half of the population, and this create root apices protrusions into the sinus cavity [5]. Maxillary sinus dimensions can also be different between ethnic and gender groups [6]. There are many clinical implications of posterior roots protrusion into the maxillary sinus [7]. Tooth extraction or endodontic surgery may lead to perforation and formation of an oroantral fistula or can cause displacement of root into the maxillary sinus in cases of roots protrusion into the maxillary sinus [8]. When dental roots are closely related to the maxillary sinus, dental problems as periapical lesions; may be a possible cause for directing inflammation to the sinus cavity [9]. Previous studies showed that the association between maxillary sinus floor and maxillary posterior teeth roots may affect the spread of odontogenic infection caused by these teeth [10,11]. Expansion of maxillary sinus after teeth extraction may greatly decrease bone height available for future implant placement [12]. Accurate evaluation for the anatomic relation between posterior teeth roots and maxillary sinus is very important in preoperative treatment planning and in diagnosing maxillofacial pathologies [11]. Localization of teeth relation to the maxillary sinus can be evaluated by many radiographic techniques. Although panoramic radiographic view is of considerable help to the dentist, it may present certain disadvantages in terms of blurred images, distortion and 2D image, while the real relations are 3D [13]. CT scan was concluded to be more accurate than panoramic view in evaluating tooth roots and their relationship with maxillary sinus [14]. A cone beam computed tomography (CBCT) technology, has advantageous over CT scanning technology, as it has a comparable image quality but at reduced cost and dose [15]. CBCT scan is very important in evaluating maxillary sinus characteristics including the relation between maxillary teeth and the sinus with decreased scanning time and better resolution [16]. CBCT is a three-dimensional image and has accurate cross-sectional slices that could identify the relationship between maxillary sinus and the maxillary posterior teeth roots precisely [17]. CBCTs help the practitioners making more accurate evaluation of hard tissues, as they help in decreasing the distortion and superimposition of the related anatomic landmark [18].

The Aim of this Study

This study aimed to determine the relationship between the inferior surface of the maxillary sinus floor and the roots apices of maxillary molars teeth using CBCT technology.

Materials and Methods

The present study examined data involved 185 patients who were referred to Dental Radiology Clinic in Iraq, Baghdad during the period from December 2020 to July 2021 for CBCTs. Patients who were looking for dental procedures related to dental implants in the maxillary premolar - molar regions, any periapical pathology related to upper molars, impacted maxillary wisdom tooth, cysts or any tumors in maxillary molars region, patients with orthodontic appliances, and CBCT images with artifacts; all these conditions had been excluded from this study. Therefore, this retrospective study included information's about 100 Patients (45 female, 55 male), with 480 maxillary molars. 60 patients with 360 teeth were assessed bilaterally and 40 Patients with 120 teeth were assessed unilaterally to determine the vertical relationship between their roots apices and the maxillary sinus (MS) floor. The patients aged between 20 - 50 years and they were divided into 3 age groups (20 - 30), (31 - 40) and (41 - 50) years. In order to be sure of the complete development of the maxillary sinus and the accurate relation between teeth and maxillary sinus, patients younger than 20 years old were not included in the study [12]. The CBCT scans were obtained by 3D exam (Villa Dental Studio plus, Digital Imaging, Italy) with a medium size (14 cm length ×32 cm diameter) field of view (FOV) at a tube voltage of 80 kV and a tube current of 8 mA, with exposure time 11.2 seconds. The voxel size of the images was 0.3 mm. A calibrated radiologist, who is experienced in interpreting CBCTs images, was responsible about assessing all CBCT images. The same examiner assessed all CBCT images a second time after 4 weeks and there was 97% agreement. The Trans axial images from panoramic view of CBCT were used to assess the vertical relationship between molars roots apices and floor of the MS according to the classification of Kwak., *et al.* [14]. as follows:

- **Type (I):** Inferior wall of MS floor; located above the buccal and palatal roots apex.

- **Type (II):** Inferior wall of MS floor; located below level that connecting the palatal and buccal root apices with no apical protrusion over the MS floor.

- **Type (III):** Apical protrusion of buccal root apex over the inferior wall of the MS floor.

- **Type (IV):** Apical protrusion of palatal root apex over the inferior wall of the MS floor.

- **Type (V):** Apical protrusions of the buccal and palatal root apices over inferior wall of the MS.
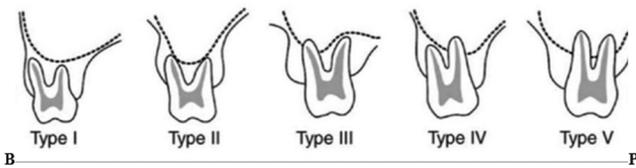

Figure 1: Vertical relationship between inferior wall of MS and the roots of the maxillary molars.

Figure 2: Shows all variant types of relationship between the roots of maxillary molars teeth and MS floor. A: Type (I), B: Type (II), C: Type (III), D: Type (IV), E: Type (V).

Statistical Package for Social Science (SPSS-21, Chicago, Illionis, USA) was used for statistical analyses of our results. Descriptive statistics as frequency and Percentage while the inferential is Pearson Chi square with multiple posthoctest adhusted by Holm method, Fisher exact and Goodness of fit test (One sample Chi square), level of significance is 0.05.

Our results had been categorized in tables and a clustered bar charts or diagrams for more easily understanding the outcome of our study results.

Results

In this study, 480 maxillary molars had been assessed in their relationship to inferior wall of maxillary sinus floor: according to

the classification of Kwak [14]. We found that 168 (35%) of the molars were in type (V) relationship to the floor of maxillary sinus, followed by type (I); 139 (28.95%) teeth, type (II); 129 (26.88%), type (IV); 29 (6.04%) and type (III); 15 (3.13%) respectively. Type (V) relationship was the most frequently detected with 1st and 2nd molars 81(50.63%), 62 (38.75%) respectively. While type (I) relationship to the MS floor was the most commonly observed with maxillary 3rd molars 64 (40%). Table (1), figure (3).

The relationship between 1st, 2nd and 3rd maxillary molars to MS floor were significant P = 0.000, table (1), while non-significant association were found between the left and right side for the 1st, 2nd and 3rd molars in their relationships to the MS floor. Table (2), figure (4).

Our study included 100 patients: 55 male and 45 female patients. The association between the maxillary molars and the floor of MS according to the gender was significant (P= 0.0167).

Type (V) was the most commonly found relation to the sinus floor in male patients 106 (40.15%). Class (II) was the most common relation in female patients 73 (33.80%). Table (3), figure (5).

According to the age groups in this study in which the patients have been divided in; the relationship of maxillary molars to MS floor sinus and age was significant P = 0.001.We found that type (V) relation was the most commonly observed between (20 - 30) years age group,112 (43.92%) while type (I) was the most commonly detected relation between (31 - 40) years and between (41 - 50) years age groups 62 (36.20%), 20 (39.22%) respectively. Table (4), figure (6).
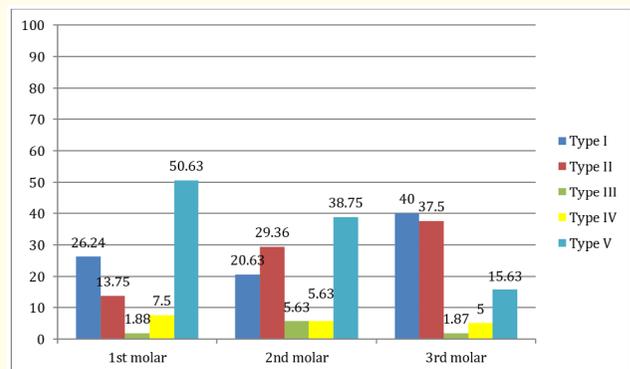

Figure 3: Maxillary molars classification in relation to their proximity to maxillary sinus floor.

Molar's classification / Maxillary molars	Type (I) N%	Type (II) N%	Type (III) N%	Type (IV) N%	Type (V) N%	Total N
1st molar	42 26.24	22 13.75	3 1.88	12 7.50	81 50.63	160
2nd molar	33 20.63	47 29.36	9 5.63	9 5.63	62 38.75	160
3rd molar	64 40	60 37.5	3 1.87	8 5	25 15.63	160
Total	139 28.95	129 26.88	15 3.13	29 6.04	168 35	480
P value = 0.000 Sig.						
1st molar X 2nd molar	P value = 0.002 Sig.					
1st molar X 3rd molar	P value = 0.000 Sig.					
2nd molar X 3rd molar	P value = 0.000 Sig.					

Table 1: Maxillary molars classification in relation to their proximity to maxillary sinus floor.

*= Significant at p < 0.05, ^= Not Significant at p > 0.05.

Molars Classification / Tooth position	Type (I) N%	Type (II) N%	type (III) N%	Type (IV) N%	Type (V) N%	P value		Total N
Bilateral (60 patients)								
Right 1st molar	18 30	6 10	1 1.67	5 8.33	30 50	0.0065 *	1st X 2nd = 0.177 ^	60
2nd molar	15 25	16 26.67	2 3.33	3 5	24 40		1st X 3rd = 0.000 *	60
3rd molar	24 40	21 35	1 1.67	4 6.67	10 16.66		2nd X 3rd = 0.06 ^	60
Total	57 31.67	43 23.89	4 2.22	12 6.67	64 35.55			180
Left 1st molar	18 30	11 18.33	1 1.67	4 6.67	26 43.33	0.005 *	1st X 2nd = 0.050^	60
2nd molar	11 18.33	22 36.68	5 8.33	2 3.33	20 33.33		1st X 3rd = 0.008 *	60
3rd molar	22 36.67	25 41.67	1 1.67	2 3.33	10 16.66		2nd X 3rd = 0.04 *	60
Total	51 28.33	58 32.22	7 3.90	8 4.44	56 31.11			180
Total	108 30	101 28.06	11 3.06	20 5.55	120 33.33			360
Unilateral (40 patients)								

1st molar	6 15	5 12.5	1 2.5	3 7.5	25 62.5	0.000*	1st X 2nd = 0.586^	40
2nd molar	7 17.5	9 22.5	2 5	4 10	18 45		1st X 3rd = 0.000 *	40
3rd molar	18 45	14 35	1 2.5	2 5	5 12.5		2nd X 3rd = 0.006 *	40
Total	31 25.83	28 23.33	4 33.34	9 7.5	48 40			120
Total	139 28.95	129 26.88	15 3.13	29 6.04	168 35			480

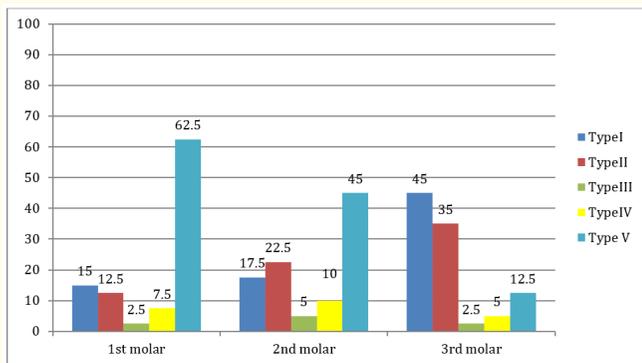*= Significant at p < 0.05, ^= Not Significant at p > 0.05.

	Overall P value	CLI	CLII	CLIII	CLIV	CL V
R X L 1st molar	0.760^	1	0.087	1^	0.638^	0.447^
R X L 2nd molar	0.491^	0.267^	0.167 ^	0.110^	0.529^	0.395^
R X L 3rd molar	0.894^	0.674^	0.407	1^	0.250^	1^

^= Not Significant at p > 0.05.

Table 2: Maxillary molars classification in relation to the proximity to maxillary sinus floor according to the site (tooth position).
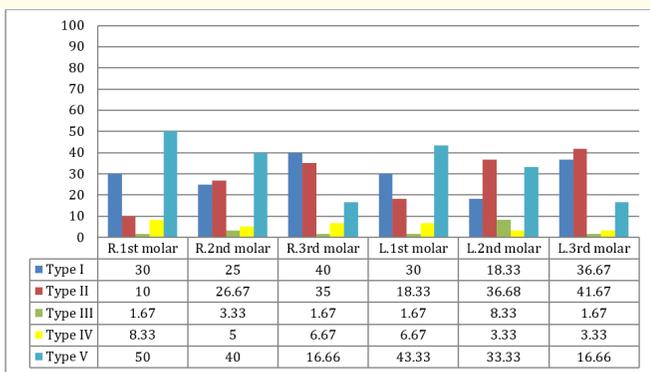
A

B

Figure 4: Maxillary molars classification in relation to the proximity to maxillary sinus floor according to the site (tooth position). A: Bilateral relation, B: Unilateral relation.
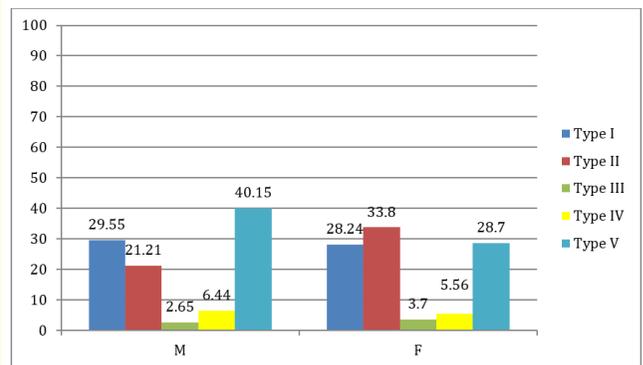

Figure 5: Maxillary molars classification in relation to their proximity to the maxillary sinus floor according to the gender.
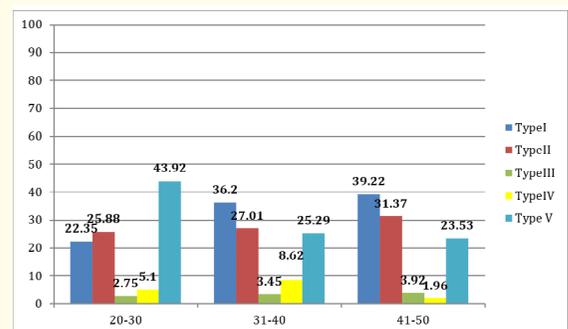

Figure 6: Maxillary molars classification in relation to their proximity to the maxillary sinus floor according to the age groups.

Molars Classification		Type I[1] N %	Type II[2] N%	Type III[3] N%	Type IV[4] N%	Type V[5] N%	Total
Gender	Patient number						
Male	55	78 29.55	56 21.21	7 2.65	17 6.44	106 40.15	264
Female	45	61 28.24	73 33.80	8 3.70	12 5.56	62 28.70	216
Total	100	139 28.95	129 26.88	15 3.13	29 6.04	168 35	480
P value = 0.0167 *							
1 x 2 = 0.038*	1 x 3 = 0.740^	1 x 4 = 0.855^	1 x 5 = 0.214^	2 x 3 = 0.634^	2 x 4 = 0.210^	2 x 5 = 0.0007*	3 x 4 = 0.546^
3 x 5 = 0.210^	4 x 5 = 0.211^						

Table 3: Maxillary molars classification in relation to their proximity to the maxillary sinus floor according to the gender.
*= Significant at $p < 0.05$, ^= Not Significant at $p > 0.05$.

Molars Classification		Type I N%	Type II N%	Type III N%	Type IV N%	Type V N%	P value		Total
Age groups	Patients number								
20-30[1]	50	57 22.35	66 25.88	7 2.75	13 5.10	112 43.92	0.001 *	1 x 2 = 0.001*	255
31-40[2]	37	62 36.20	47 27.01	6 3.45	15 8.62	44 25.29		1 x 3 = 0.029*	174
41-50[3]	13	20 39.22	16 31.37	2 3.92	1 1.96	12 23.53		2 x 3 = 0.568^	51
Total	100	139 28.95	129 26.88	15 3.13	29 6.04	168 35			480

Table 4: Maxillary molars classification in relation to their proximity to the maxillary sinus floor according to the age groups.
*= Significant at $p < 0.05$, ^= Not Significant at $p > 0.05$.

Discussion

The most important structure has to be considered especially in a surgical or even in a nonsurgical procedure in the maxillary posterior region, is the maxillary sinus (MS) or maxillary antrum [19]. In which the relationship between the posterior teeth roots apices and the maxillary sinus has a significant effect on surgical planning, especially if the root apices are in close proximity to the maxillary sinus [20]. So, it is very important to assess the relation and the proximity of maxillary posterior teeth to the floor of maxillary antrum, in order to avoid any possible complications that may result during and even after dental managements, especially the potential risks of teeth roots penetration into the maxillary antrum [21]. Usually, maxillary posteriors teeth roots apices are in close proximity to the maxillary antrum, in some cases may be less than 1 mm, which may result in sinus perforation during dental procedures [22]. To evaluate the relationship between maxillary posterior teeth and the inferior wall of MS floor CBCT is the preferred imaging technique; because of its high contrast and in order to avoid limitations present in conventional images as OPG such as horizontal and vertical magnification, superimposition and the lack of cross-sectional data [23]. Freisfeld., *et al*. found in a panoramic radiographic study, that 64 of 129 roots appeared to be penetrating into the floor of maxil-

lary sinus; while in a CT transverse section, this was only 37 roots [24]. In a study by Lopes., *et al*. the panoramic view and the CBCT have been compared in evaluating the protrusion of roots into the maxillary sinus and it had been found that CBCT can predict the root protrusion [25]. Ali., *et al*. found that CT scan is essential in providing information about the relation to the maxillary antrum when there is a protrusion detected in OPG view [26].

In this study, we found that type (V) was the most commonly observed relation of maxillary molars to the floor of MS according to the classification of Kwak [14]. that represented 35% from the all examined data; in which there are an apical protrusions of buccal and palatal roots apices over inferior wall of the MS. and 28.95% of the molars were with no close relation to the floor of the sinus that represented by type (I), followed by type (II), (III) and type (IV). 26.88%, 3.13%and 6.04% respectively. The Maxillary arch shape and the location of the posterior teeth in relation to the sinus can usually explain the closer distance of the posterior teeth to the maxillary sinus floor. Maxillary sinus usually tends to expand between the roots of molars and usually results in much proximity between them. On Radiographs, the roots of posterior teeth appear to penetrate the sinus floor, but as actually; maxillary sinus itself has extended around and between the roots of teeth [23,27]. The most common type (V) relation with MS was more commonly detected with the first maxillary molars followed by second molars and this relation was the least commonly detected with maxillary 3rd molar 81 (50.63%), 62 (38.75%) and 25 (15.63%) respectively, while most of the 3rd molars were in a safe; type (I) relation with MS floor 64 (40%). We agree with a study by Shokri., *et al*. and Jung and Cho, in which they found Type (3) relation in which an apical protrusion over the maxillary sinus floor, was more common in 1st and 2nd molars depending on Jung classification, but we disagree with them in that they found the 2nd molar was nearer than 1st molar to the floor of maxillary sinus [11,23]. also we disagree with Kwak., *et al*. study that suggested that the roots of the second molars are the closest to the sinus which is the same suggestion by Talo., *et al.* [14,22].

We agree with Yurdabakan., *et al*. who found that the most frequent vertical relationship to the MS floor in 3rd molar was Type I (43.5%) [28]. Also, Wallace., *et al*. found that the roots of the 1st and 2nd molars are closely related to maxillary sinus floor in 40% of cases [29]. These close approximation of 1st and 2nd molars to the sinus may be due to the shape of maxillary antrum floor that take a convex shape; in which the lowest margin is located around 1st and 2nd molars [30]. These findings should be seriously considered and evaluated before planning root canal treatment, apical surgery, extraction of maxillary posterior teeth and in implant surgical procedures.

As comparison between right and left maxillary molars in their relations to the MS floor, we agree with Razumova., *et al*. Talo., *et al*. [20,22]. in which there was non-significant association in the relation between maxillary molars and the floor of MS between right and left sides.

In this study, we agree with Shokri., *et al*. [23]. in which there was significant association between maxillary molars relation to the floor of maxillary sinus and the gender. In our study; the most hazardous relation of maxillary molars to the MS floor; type (V) was detected in male more than that in female. This result may be due to the fact that male differ in their growth and skeletal developments from female skeletal and body growth, also females' teeth roots pattern is shorter than that in males. So, roots protrusion probability into the sinus may be higher in males than in females and this should be taken in consideration, especially during dental surgeries. The same finding showed in a study by Ok., *et al.* [31].

The relation of maxillary molars to the MS floor was significant according to the age groups. The closest proximity to the sinus floor Type (V) was detected between (20 - 30) years age group and the least percentage of this relation was detected with the older age group (41 - 50) years. On the other hand, the highest percentage for safe relation to the maxillary sinus floor Type (I) was detected between the age of (41 - 50) years; followed by the (31 - 40) and (20 - 30) years age groups respectively. Differences in the relation to the maxillary sinus between the age groups may be associated with the development of maxillary sinus and maxillary bone in relation to the roots of the teeth over time [22]. Maxillary sinus starts developing during intrauterine fetal life which continues to develop after birth. Size and shape of adult maxillary sinus are variable, and it may differ according to age of an individual in their size and in the degree of pneumatization [11,23]. Dental operators should take such relation in consideration and the close proximity of maxillary molars to the sinus especially in younger patients; during performing dental procedure that interfere with apical area related to the maxillary molars.

Conclusion

- The most common relation of maxillary molars to the maxillary sinus floor according to Kwak classification was type (V); that include apical protrusions of buccal and palatal root apices over the inferior wall of the maxillary sinus floor.

- Maxillary 1st and 2nd molars were more commonly protruded over the sinus floor than that of the 3rd molar which presented type (I) relationship more commonly; in which the inferior wall of MS floor; above the buccal and palatal roots apex.

- There was non-significant association in the relation of maxillary molars to the sinus floor between right and left side.

- Maxillary molars more commonly protruded over maxillary sinus floor in male than female and in younger age group than older one.

- Generally, the relationship of maxillary molars to the inferior wall of the maxillary sinus floor was significant and the relation was also significant according to the age groups and gender.

- CBCT can clearly detect the kind of relation between the maxillary posterior teeth and the maxillary sinus, so it is very important in case of posterior teeth roots close proximity to the sinus floor, a CBCT is taken before any dental management interfere with the posterior teeth as in case of surgical extraction or before dental implants surgeries.

Suggestions

- Increase the sample of the study for more detailed results.
- Evaluate the relationship of each maxillary molar to the maxillary sinus floor according to the age and gender of the patient.

Bibliography

1. Standring S., *et al.* "Gray's Anatomy: The Anatomical Basis of Clinical Practice". 40th ed. New York, NY: Churchill Livingstone (2008): 547-560.

2. Jun BC., *et al.* "The analysis of maxillary sinus aeration according to aging process; volume assessment by 3-dimensional reconstruction by high-resolutional CT scanning". *Otolaryngology-Head and Neck Surgery* 132 (2005): 429-434.

3. Hamdy RM and Abdel-Wahed N. "Three-dimensional linear and volumetric analysis of maxillary sinus pneumatization". *Journal of Advanced Research* 5 (2014): 387-395.

4. Hauman CH., *et al.* "Endodontic implications of the maxillary sinus: A review". *International Endodontic Journal* 35 (2002): 127-141.

5. Svetlana Razumova., *et al.* "Evaluation of the relationship between the maxillary sinus floor and the root apices of the maxillary posterior teeth using cone-beam computed tomographic scanning". *Journal of Conservative Dentistry* 22.2 (2019): 139-143.

6. Kilic C., *et al.* "An assessment of the relationship between the maxillary sinus floor and the maxillary posterior teeth root tips using dental cone-beam computerized tomography". *European Journal of Dentistry* 4 (2010): 462-467.

7. Hassan BA. "Reliability of periapical radiographs and orthopantomograms in detection of tooth root protrusion in the maxillary sinus: correlation results with cone beam computed tomography". *Journal of Oral and Maxillofacial Research* 1.1 (2010): e6.

8. Harrison DF. "Oroantral fistula". *British Journal of Clinical Practice* 15 (1961): 169-174.

9. Goller-Bulut D., *et al.* "Cone beam computed tomographic analysis of maxillary premolars and molars to detect the relationship between periapical and marginal bone loss and mucosal thickness of maxillary sinus". *Medicina Oral, Patologia Oral, Cirugia Bucal* 20 (2015): e572-579.

10. Ariji Y., *et al.* "Roots of the maxillary first and second molars in horizontal relation to alveolar cortical plates and maxillary sinus: computed tomography assessment for infection spread". *The journal Clinical Oral Investigations* 10 (2006): 35-41.

11. Jung YH and Cho BH. "Assessment of the relationship between the maxillary molars and adjacent structures using cone beam computed tomography". *Imaging Science in Dentistry* 42 (2012): 219-224.

12. Misch CE. "Contemporary implant dentistry". 3rd ed. St Louis:Mosby (2008).

13. Bouquet A., *et al.* "Contributions of reformatted computed tomography and panoramic radiography in the localization of third molarsrelative to the maxillary sinus". *Oral Surgery, Oral Medicine, Oral Pathology, and Oral Radiology and Endodontic* 98.3 (2004): 342-347.

14. Kwak HH., *et al.* "Topographic anatomy of the inferior wall of the maxillary sinus in Koreans". *International Journal of Oral and Maxillofacial Surgery* 33.4 (2004): 382-388.

15. Tsiklakis K., *et al.* "Dose reduction in maxillofacial imaging using low dose Cone Beam CT". *European Journal of Radiology* 56.3 (2005): 413-417.

16. Lu Y., *et al.* "Associations between maxillary sinus mucosal thickening and apical periodontitis using cone-beam computed tomography scanning: a retrospective study". *The Journal of Endodontics* 38 (2012): 1069-1074.

17. Sharan A and 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 Medicine, Oral Pathology, and Oral Radiology and Endodontic* 102 (2006): 375-381.

18. Guncu GN., *et al.* "Location of posterior superior alveolar artery and evaluation of maxillary sinus anatomy with computerized tomography: a clinical study". *Clinical Oral Implants Research* 22 (2011): 1164-1167.

19. Tian XM., *et al.* "An Analysis of the Proximity of Maxillary Posterior Teeth to the Maxillary Sinus Using Cone-beam Computed Tomography". *The Journal of Endodontics* 42 (2016): 371-377.

20. Razumova S., *et al.* "Evaluation of the relationship between the maxillary sinus floor and the root apices of the maxillary posterior teeth using cone-beam computed tomographic scanning". *Journal of Conservative Dentistry* 22 (2019): 139-143.

21. Koch F., *et al.* "Abscess of the orbit arising 48 hours after root canal treatment of a maxillary first molar". *International Endodontic Journal* 39.8 (2006): 657-664.

22. Talo-Yildirim T., *et al.* "Topographic relationship between maxillary sinus and roots of posterior teeth:a cone beam tomographic analysis". *European Oral Research* 55 (1 (2021): 39-44.

23. Shokri A., *et al.* "Assessment of the Relationship between the Maxillary Sinus Floor and Maxillary Posterior Teeth Roots using Cone Beam Computed Tomography". *The Journal of Contemporary Dental Practice* 15.5 (2014): 618-622.

24. Freisfeld M., *et al.* "The maxillary sixth-year molar and its relation to the maxillary sinus. A comparative study between the panoramic tomogram and the computed tomogram". *Fortschr Kieferorthop* 54.5 (1993): 179-186.

25. Lopes LJ., *et al.* "Comparison of panoramic radiography and CBCT to identify maxillary posterior roots invading the maxillary sinus". *Dentomaxillofacial Radiology* 45 (2016): 20160043.

26. Ali SM., *et al.* "The relation of maxillary posterior teeth roots to the maxillary sinus floor using panoramic and computed tomography imaging in a sample of Kurdish people". *Tikrit Journal for Dental Sciences* 1 (2012): 81-88.

27. Ramesh Ram Fry., *et al.* "A Proximity of maxillary posterior teeth roots to maxillary sinus and adjacent structures using Denta scan". *Indian Journal of Dental Research* 7.3 (2016): 126-130.

28. Yurdabakan ZZ., *et al.* "Evaluation of the maxillary third molars and maxillary sinus using cone-beam computed tomography". *Nigerian Journal of Clinical Practice* 21 (2018): 1050-1058.

29. Wallace JA. "Transantral endodontic surgery". *Oral Surgery, Oral Medicine, Oral Pathology, and Oral Radiology and Endodontic* 82 (1996): 80-83.

30. Chanavaz M. "Maxillary sinus: Anatomy, physiology, surgery, and bone grafting related to implantology - Eleven years of surgical experience (1979-1990)". *Journal of Oral Implantology* 16 (1990): 199-209.

31. Ok E., *et al.* "Evaluation of the relationship between the maxillary posterior teeth and the sinus floor using cone-beam computed tomography". *Surgical and Radiologic Anatomy* 36 (2014): 907-914.