Medical Journal of Ahl al-Bayt University, Vol.4, No.1,2025

Comparison between Maxillary Molars in Relation to Maxillary Sinus Floor According to Age and Gender using a cone beam computed tomography

Nagham H. Ali
nagham.h74@gmail.com
Department of oral and maxillofacial surgery, College of Dentistry, Ibn Sina University of Medical and Pharmaceutical Sciences, Iraq, Baghdad.

ABSTRACT

Background: Understanding the close relationship that exists between the posterior maxillary teeth and maxillary sinus and the differences of this relation between gender and age groups is important for the workers in the dental field, who may perform treatments and face complications in this area regularly. **Aim of study**: to compare maxillary 1st ,2nd, and 3rd molars in their proximity to the floor of (maxillary sinus) and the effect of age and gender on this relation. **Material and method**: This study involved 160 maxillary 1st, 2nd, and 3rd molars respectively; collected from 45 female and 55 male patients CBCTs in Iraq); from the 1st of January 2020 to the end of July 2021. 60 patients were assessed bilaterally and 40 Patients assessed only unilaterally. Kwak classification for molars related to the maxillary sinus floor have been dependent on. **Result:** in relation to the age groups we found that the most common relation to the sinus floor for maxillary 1st molar was class V 50(58.82%) 26 (44.82%) in the age groups (20-30) and (31-40), and class I, 6 (35.29%) in the (41-50) age group. For maxillary 2nd molars; it was class V 43(50.59%) between (20-30) years, and class I and II between (31-40) years 18(31.04%) for each and a class II. In the age between (41-50) years 7 (41.17%). For maxillary 3rd molars; the most detected relation in the age group (20-30) years was class II 35(41.17%), while in the age groups 31-40 and 41-50 they were class I 26 (44.83%),10 (58.82%) respectively. The association between maxillary 1st , 2nd and 3rd molars relation to maxillary sinus floor and age groups was non-significant P value =0.389 ^ , 0.089 ^ and 0.154^.In relation to the patient's gender; For the maxillary 1st molars; the most commonly detected relation to the maxillary sinus floor in both gender groups were class V; 50 (56.83%) in male and 31(43.06%) in female group. For the maxillary 2nd molars a class V was the most commonly detected relation in male 41(46.59%) while in female groups, it was class II 27(37.5%) The maxillary 3rd molar : represented most commonly by class I 41 (46.58%) in male group, while in female group it was class II 34 (47.22%) .The association between maxillary 1st , 2nd and 3rd molars to the base of maxillary sinus and gender showed a non-significant P value 0.4923^, 0.091^ and 0.223^ .**Conclusion**: Maxillary molars show a close relation to the base of the maxillary sinus; especially in male, younger age groups patients, analysis and preparation should be done for patients before any dental treatment interfere with periapical region of maxillary molars using CBCT is very helpful.

Key Words: maxillary sinus, maxillary antrum, CBCT, maxillary molars

INTRODUCTION

The maxillary sinus represents the 1st developed paranasal sinuses, in which this development shows its complete result during 3rd molar eruption, at 20 years of age (Jun et al, 2005). Anatomically, maxillary sinus variability included its relationship to the molars in the maxilla and the effect of its pneumatization percentage of (Hamdy et al, 2014; Carlos et al,2016). The extraction of Maxillary molars can affect the size of the sinus and reduce the distances between the remaining root apices and the maxillary sinus (Hameed et al, 2019

Teeth and oral cavities always have a close relationship to the neighboring anatomic structures. Especially the relationship of posterior maxillary teeth to the maxillary antrum that is important to be evaluated by dentists who may interfere with sinus during their dental treatments in this area. (Hu et al,2019; Junqueira et al,2020). There is always a risk of maxillary sinus odontogenic infection that may reach approximately 40% of all infections that may involve the sinus because of the effect of maxillary posterior teeth and its direct proximity to the sinus. (Vestin et al,2017; Mehra et al;2004). Number of dental treatments in the posterior maxilla may be compromised because the proximity of the root apices to the sinus foor as in case of periapical surgery and extraction in this region. (Nunes et al,2016).Maxillary sinus presented in the form of a small air space at birth, its growth is slow for both gender and steady until 14 to 18 years. Providing normal values for maxillary sinus size and their changes with age could be helpful for dental treatment planning procedures such as surgical extraction and implant surgery. (Suresh et al,2014) The accuracy of the Cone Beam CT scan compared to OPG in terms of the relation between teeth or teeth roots in the maxilla to the antrum is unquestionable (Rakhi et al, 2021). It decreases the distortion and eliminates the superimposition with the related structures, furthermore; CBCT provides as accurate as CT images with lower doses and cost (Tsiklakis et al, 2005). CBCT is more suitable for the evaluation of the sinus dimension and its relation to the maxillary molar roots, due to its accurate cross-sectional slices, decreased scanning time, and lower radiological exposure (Lu Y et al, 2012; Shokri et al,2014 and Oberli et al 2007).).

The Aim of the Study: To compare between the maxillary 1st ,2nd and 3rd molars in their close relation to the floor of maxillary sinus between different age groups and genders.

Material and Method

The present study examined data involving 170 patients who were referred to AL-Sader specialized dental center, ALRusaffa medical health center in Baghdad. Excluded criteria:

- Dental implant patients for maxillary posterior teeth.
- Posterior teeth with periapical lesions.
- Any cystic lesion related to area of examination.
- Any appliances in upper arch like fixed or removable orthodontic appliance and removable partial dentures related to upper posterior teeth.

Therefore, this retrospective study included information about 100 Patients (45 female, 55 male), with 480 maxillary molars (1st,2nd, and 3rd). 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 of age. 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 selected.(Misch,2008). CBCT scans obtained by 3D Kodak 9500, Carestream, France, 2012, The CBCT images analyzed automatically using the program software, and expert Radiologist examined them separately. Trans axial images from panoramic view of CBCT were used to assess the vertical relationship between roots apices and floor of the MS according to Kwak classification who classified this relation to the following types or classes (Kwak, et al 2004; Talo, et al 2021):

Type I: Buccal and palatal roots apex were not in contact with sinus floor.

Type II: Buccal and Palatal roots apex were in contact with sinus floor.

Type III: Buccal root apex penetrated the sinus cavity over MS floor.

Type IV: Palatal root apex penetrated the sinus cavity over MS floor.

Type V: Buccal and palatal roots apex were penetrated the sinus cavity over MS floor.

Figure (1) and (2).Statistical Package for Social Science (SPSS-21, Chicago, Illionis, USA), Descriptive statistics as frequency and Percentage while the inferential is Pearson Chi square with multiple posthoctest adhusted by Holm method , Fisher exact and Goddness of fit test (One sample Chi square) , level of significance is 0.05.Our data results had been displaced in tables and clustered bar charts or diagram for more easily understanding the outcome of the study.

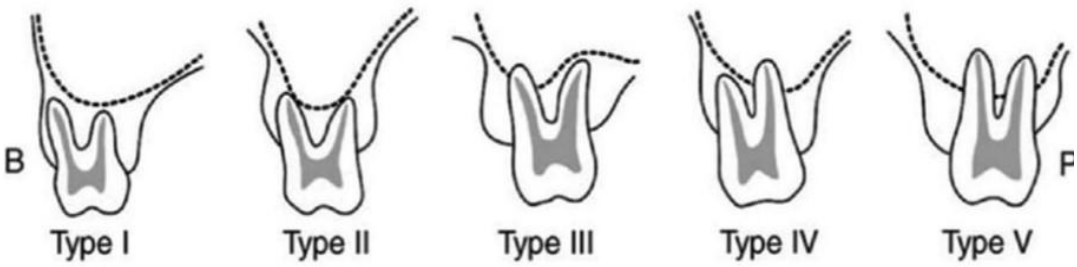

Figure (1): Vertical relationship between inferior wall of MS and the roots of the maxillary molars.

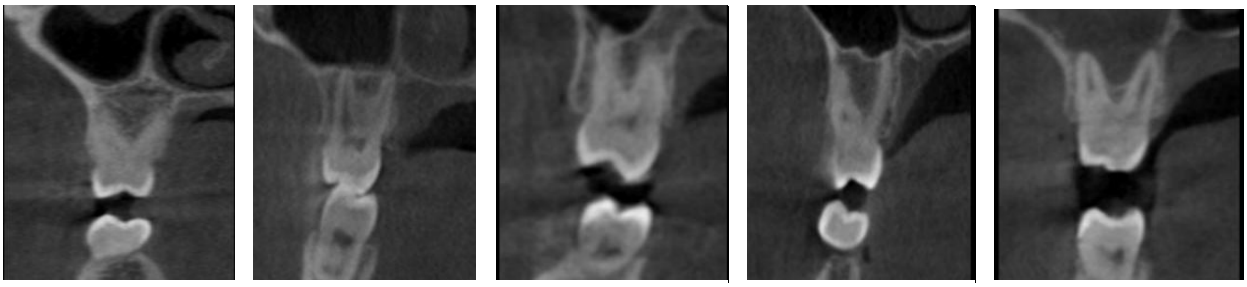

Figure (2): I II III IV V

Results and Discussion

In this study, a comparison is made between the relation of 160 maxillary first, second and third molar respectively according to Kwak classification to the inferior wall of maxillary sinus floor according to age and gender.

According to age groups; for each 1st ,2nd, and 3rd molar teeth; 85 (53.13%) teeth were in the age group between (20-30) years and 58 (36.25%) and 17 (10.62%) teeth were distributed between (31-40) and (41-50) years age groups. The most commonly detected relation between each maxillary molar the sinus floor: In relation to the age groups; For the 1st maxillary molars it was class V 50(58.82%), 26 (44.82%) for the age groups (20-30) and (31-40) years, it was class I 6 (35.29%) in the (41-50) age group. Table (1). For the maxillary 2nd molars; it was class V 43(50.59%) between (20-30) years, while class I and II were the most detected relation in (31-40) years age group; 18(31.04%) for each. In the age between (41-50) years it was a class II relation 7 (41.17%). Table (2). For the maxillary 3rd molars for the age group (20-30) years it was class II 35(41.17%), while the most detected relation in the age groups (31-40) and (41-50) years; were class I 26 (44.83%),10 (58.82%) respectively. Table (3).The association between maxillary first, second and third molars relation to maxillary sinus floor and age groups was non-significant P value =0.389 ^, 0.089 ^ and 0.154^, respectively.We found that the distance between maxillary molar apices and the maxillary antrum floor increases with the age, in which the percentages of class V decrease with advancing in age. On the other hand, class I was almost increasing with age. We agree with Pei et al. Who found in age analysis of their study that distance between maxillary antrum floor and molar apices increases with age, also we agree with Gu et al, who found that ; distances between the apices of maxillary posterior teeth and the sinus floor increased with age between Chinese individuals, This study showed no significance in the effect of age on the proximity of each maxillary molar to the maxillary antrum floor was. We disagree with Pei et al. and Talo Yıldırım T, et al.in which such relation was a statistically significant in their studies. (Jun Pei et al 2020; Gu et al 2918; Talo et al 2021). During maxillary sinus development, its volume decreased, and the inferior wall of the sinus will become in a more superior relation, unless an interference is established as in case of tooth extractions that may lead to sinus pneumatization. (Kim et al, 2008; Ikeda et al 1998). This result indicated that the risks of maxillary sinus trauma during molar extraction, dental implantation or even endodontic therapy were greater in adolescents, so dental operator should be carefuller during interfering with maxillary molars apical area, especially in younger individuals.In relation to the patient's gender, this study involved 45 female and55 male patients for the 1st 2nd and 3rd maxillary molars; each tooth sample was distributed as 88 (55%) teeth in male and72 (45%) teeth in female patients. For the maxillary 1st molar; the most detected relation to floor of maxillary sinus in male and female patients' group were represented by class V; 50 (56.83%) in male and 31(43.06%) in female group, table (4). For the maxillary 2nd molars, a class V was the most detected relation in male 41(46.59%) while in female groups, it was class II 27(37.5%), table (5). The maxillary 3rd molar: the most detected relation in male group was class I 41 (46.58%), while in female group it was class II 34 (47.22%) table (6).The association between maxillary first, second and third molars relation to the maxillary

sinus floor and gender was non-significant P value = 0.4923^, 0.091^ and 0.223^, respectively. We found that class V was the most commonly present relation for the 1st and 2nd molars in both male and female with higher percentage in male than in female patients. Even in maxillary 3rd molar in which class V was not the most common relation to the sinus floor, we found this close relation also showed higher percentage in male group than that in female. Our study found this relation not significant so; we disagree with Talo Yıldırım T, et al 2021. who found a significant difference between the gender and maxillary first molar relation to the sinus floor, but we agree with Jun Pei et al,2020 who found the effect of gender on maxillary molars relation to the sinus floor is non-significant. Although we disagree with them in which they found that molars were closer in vertical relation to the base of the sinus in female group than in male. This is probably because molars have longer, broader roots in male than that in females that may affect their proximities to the antrum floor that could be lager in size. In maxillary third molar we found that the most detected relation to the sinus floor was class I in both male and female that represent a safe distance from the sinus floor, also the percentage in male group was higher than in females. This may be related to the effect of the shape of maxillary antrum floor that has a convex shape, with the lowest margin approximate maxillary 1st and 2nd molars. Chanavaz et al,1990. Greater bone mass in male in relation to their skeletal structure; may explain the safer distance of the maxillary 3rd molars from the sinus base in men than that in female.

Table (1): Classification of maxillary 1st molar vertical relationship to maxillary sinus in relation to age groups.

1st molar Age groups	Class I	Class II	Class III	Class IV	Class V	P value	Total
20-30[1]	18 (21.17)	9 (10.60)	2 (2.35)	6 (7.06)	50(58.82)	0.402 ^	85 (53.13)
31-40 [2]	18 (31.03)	9(15.51)	0 (0)	5 (8.62)	26 (44.82)		58 (36.25)
41-50[3]	6 (35.29)	4(23.54)	1(5.88)	1(5.88)	5 (29.41)		17 (10.62)
Total	42 (26.25)	22 (13.75)	3 (1.87)	12(7.5)	81(50,62)		160

^=not significant at p>0.05, *=significant at p<0.05.

Table (2): Classification of maxillary 2nd molar vertical relationship to maxillary sinus in relation to the age groups.

2nd molar	Class I	Class II	Class III	Class IV	Class V		Total
20-30[1]	11(12.94)	22(25.88)	5(5.88)	4(4.71)	43(50.59)	0.089 ^	85 (53.13)
31-40 [2]	18(31.04)	18(31.04)	4 (6.90)	4 (6.89)	14 (24.13)		58 (36.25)

41-50[3]	4(23.54)	7 (41.17)	1(5.88)	0 (0)	5(29.41)		17 (10.62)
Total	33(20.62)	47(29.38)	10(6.25)	8(5)	62(38.75)		160

^=not significant at p>0.05, *=significant at p<0.05.

Table (3) Classification of maxillary 3rd molar vertical relationship to maxillary sinus in relation to the age groups.

3rd molar	Class I	Class II	Class III	Class IV	Class V		Total
20-30[1]	28 (32.94)	35(41.17)	0 (0)	3(3.53)	19(22.35)	0.253^	85 (53.13)
31-40 [2]	26 (44.83)	20 (34.48)	2(3.45)	6(10.34)	4 (6.89)		58 (36.25)
41-50[3]	10 (58.82)	5(29.41)	0 (0)	0 (0)	2 (11.77)		17 (10.62)
Total	64 (40)	60 (37.5)	2(1.25)	9(5.63)	25 (15.62)		160

^=not significant at p>0.05, *=significant at p<0.05.

Table (4) Classification of maxillary 1st molar vertical relationship to maxillary sinus according to gender.

1st molar Gender	Class I	Class II	Class III	Class IV	Class V	P value	Total
Male	21 (44.83)	10 (11.37)	1(1.14)	6 (6.81)	50 (56.81)	0.4923^	88 (55)
Female	21 (29.17)	12 (16.67)	2 (2.78)	6 (8.33)	31(43.06)		72 (45)
Total	42(26.25)	22(13.75)	3(1.87)	12(7.5)	81(50,62)		160

^=not significant at p>0.05, *=significant at p<0.05.

Table (5): Classification of maxillary 2nd molar vertical relationship to maxillary sinus according to gender.

2nd molar	Class I	Class II	Class III	Class IV	Class V		Total
Male	16 (18.18)	20 (22.72)	5 (5.68)	6 (6.83)	41(46.59)	0.091^	88(55)
Female	17(23.61)	27(37.5)	5 (6.94)	2 (2.78)	21 (29.17)		72(45)
Total	33(20.62)	47 (29.38)	10(6.25)	8(5)	62(38.75)		160

^=not significant at p>0.05, *=significant at p<0.05.

Table (6) Classification of maxillary 3rd molar vertical relationship to maxillary sinus according to gender.

3rd molar	Class I	Class II	Class III	Class IV	Class V		Total
Male	41 (46.58)	26 (29.55)	1(1.14)	5 (5.68)	15 (17.05)	0.223^	88(55)
Female	23 (31.94)	34 (47.22)	1(1.39)	4(5.56)	10(13.89)		72(45)
Total	64(40)	60 (37.5)	2 (5.56)	9 (5.63)	25 (15.63)		160

^=not significant at p>0.05, *=significant at p<0.05.

Conclusions

1. Maxillary molars are in close relation to the maxillary antrum; especially in male, younger age groups patients, analysis of this proximity should be done before treatment to avoid interfering with the sinus and complications,
2. CBCT can be helpful used to achieve individualized and precise patients' preparation and managements preoperatively.
3. No significant differences in the relationship between gender and age effect on the proximity of maxillary molar roots tips to the maxillary sinus floor.

REFERENCES

1. Carlos Estrela1, Carla A. B. C. M. Nunes1, Orlando Aguirre Guedes2, Ana Helena G. Alencar1, Cynthia R. A. Estrela1, Ricardo Gariba Silva3, Jesus Djalma Pécora3, Manoel Damião Sousa-Neto3, Study of Anatomical Relationship between Posterior Teeth and Maxillary Sinus Floor in a Subpopulation of the Brazilian Central Region Using Cone-Beam Computed Tomography – Part 2, Brazilian Dental Journal (2016) 27(1): 9-15 http://dx.doi.org/10.1590/0103-6440201600679.

2. Chanavaz M. Maxillary sinus: Anatomy, physiology, surgery, and bone grafting related to implantology – Eleven years of surgical experience (1979-1990). J Oral Implantol 1990;16:199-209.

3. Gu Y, Sun C, Wu D, et al. Evaluation of the relationship between maxillary posterior teeth and the maxillary sinus floor using cone-beam computed tomography. BMC Oral Health 2018; 18: 164. DOI: 10.1186/s12903-018-0626-z.

4. Hamdy RM, Abdel-Wahed N. Three-dimensional linear and volumetric analysis of maxillary sinus pneumatization. J Adv Res 2014; 5:387-95 https://doi.org/10.1016/j.jare.2013.06.006.

5. Hameed S, Bakhshalian N, Alwazan E, et al. Maxillary sinus floor and alveolar crest alterations following extraction of single maxillary molars: a retrospective CBCTanalysis. Int J Periodontics Restorative Dent 2019; 39: 545–551. DOI: 10.11607/prd.3865.

6. Hu, X., Lei, L., Cui, M., Huang, Z., & Zhang, X. (2019). Anatomical analysis of periapical bone of maxillary posterior teeth: A cone beam computed tomography study. The Journal

of International Medical Research, 47 (10), 4701–4710. https://doi.org/10.1177/0300060519860960.

7. Jun Pei*, Jiyuan Liu*, Yafei Chen, Yuanyuan Liu, Xuejuan Liao and Jian Pan, Relationship between maxillary posterior molar roots and the maxillary sinus floor: Cone-beam computed tomography analysis of a western Chinese population, Journal of International Medical Research, 48(6) 1–17, 2020.

8. Junqueira, R. B., Souza-Nunes, L. A., Scalioni, F. A. R., Damasceno, N. N. L., Verner, F. S., Carvalho, A. C. P., Devito, K. L. (2020). Anatomical evaluation of the relationship between the maxillary posterior teeth and maxillary sinus. General Dentistry, 68(1), 66–7.

9. Kwak HH, Park HD, Yoon HR, Kang MK, Koh KS, Kim HJ, et al. Topographic anatomy of the inferior wall of the maxillary sinus in Koreans. Int J Oral Maxillofac Surg 2004; 33:382-8.

10. Lu Y, Liu Z, Zhang L, Zhou X, Zheng Q, Duan X, et al. Associations between maxillary sinus mucosal thickening and apical periodontitis using cone-beam computed tomography scanning: a retrospective study. J Endod 2012;38: 1069-74.DOI: 10.1016/j.joen.2012.04.027.

11. Mehra, P., & Murad, H. (2004). Maxillary sinus disease of odontogenic origin. Otolaryngologic Clinics of North America, 37(2), 347–364. https:// doi.org/10.1016/S0030-6665(03)00171-3.

12. Misch CE. Contemporary implant dentistry. 3rd ed. St Louis: Mosby; 2008.

13. Nunes, C. A., Guedes, O. A., Alencar, A. H., Peters, O. A., Estrela, C. R., & Estrela, C. (2016). Evaluation of Periapical lesions and their association with maxillary sinus abnormalities on cone-beam computed tomographic images. Journal of Endodontia, 42(1), 42–46. https://doi.org/ 10.1016/j.joen.2015.09.014

14. Oberli K, Bornstein MM, von Arx T. Periapical surgery and the maxillary sinus: radiographic parameters for clinical outcome. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007 Jun;103(6):848-853.

15. Rakhi Issrani, Namdeo Prabhu, Mohammed Sghaireen, Hasna Rasheed Alshubrmi, Amal Mohamed Alanazi, Zainab Ali Alkhalaf, Mohammed Odhayd Alnusayri, Fahad Muqbil Aljohani, and Zafar A. Khan. Comparison of Digital OPG and CBCT in Assessment of Risk Factors Associated with Inferior Nerve Injury during Mandibular Third Molar Surgery. Diagnostics (Basel). 2021 Dec; 11(12): 2282.doi: 10.3390/diagnostics11122282

16. Shokri A, Lari S, Yousefi F, Hashemi L. Assessment of the Relationship between the Maxillary Sinus Floor and Maxillary Posterior Teeth Roots using Cone Beam Computed Tomography. J Contemp Dent Pract 2014;15(5):618-622.

17. Suresh K. Sharma, Massarat Jehan, Anil Kumar. Measurements of Maxillary sinus volume and dimensions by computed tomography scan for gender determination. J journal of anatomical society of india2014; 63:36-42.

18. Talo-Yildirim T. Oztekin F. Tozum M. D. Topographic relationship between maxillary sinus and roots of posterior teeth: a cone beam tomographic analysis. Eur Oral Res 2021; 55(1): 39-44.

19. Tsiklakis K, Donta C, Gavala S, Karayianni K, Kamenopoulou V, Hourdakis CJ. Dose reduction in maxillofacial imaging using low dose Cone Beam CT. Eur J Radiol 2005 Dec;56(3): 413-417.doi: 10.1016/j.ejrad.2005.05.011

20. Vestin Fredriksson, M., Öhman, A., Flygare, L., & Tano, K. (2017). When maxillary sinusitis does not heal: Findings on CBCT scans of the sinuses with a particular focus on the occurrence of odontogenic causes of maxillary sinusitis. Laryngoscope Investig Otolaryngol, 2(6), 442–446. https://doi.org/10.1002/lio2.130