The distance between maxillary second molar and the base of the maxillary sinus by aging using CT scan

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المسافة بين الرحى الثانية وارضية الجيب الانفي خلال فئات عمرية باستخدام المفراس الحلزوني

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المستخلص

قاع الجيب الفكي يوجد ضمن عظام الفك العلوي . إذا كان الجيب الانفي هو من الحجم المتوسط ، كان على مستوى مع قاع الأنف ، وإذا كان الجيب الانفي هو كبير ، يصل ما دون هذا المستوى . البروز في قاع الجيب الانفي هو متعدد ، مقابل لجذور الرحى الأولى والثانية ، وفي بعض الحالات، جذور الاسنان تخترق قاع الجيب الانفي . العلاقة التشريحية الوثيقة بين الجيب الفكي مع جذور الأضراس و الضواحك للفك العلوي يجعل هذه المنطقة عرضة لحالات مرضية الناتجة عن الأضرار التي لحقت ، و التدخل العلاجي في الاسنان . معرفة العلاقة بين قمة الجذر والجدار السفلي للجيب الفكي هو أمر حاسم لتشخيص و علاج حالة مرضية للجيوب الأنفية وكذلك في مساعدة غرس الأسنان ، وحشوات الجذور و المعالجة التقويمية . تهدف هذه الدراسة إلى تقدير مسافات مختلفة بين قاعدة الجيب الفكي و قمم جذور للأضراس الثانية العلوية يقاس بواسطة المفراس الحلزوني لتحديد الاختلافات في المسافة خلال الاعمار . وقد تم اختيار ستين مريض الذين يراجعون مركز الأشعة في مستشفى الزهراء في مدينة الكوت الذين يعانون من مشاكل في منطقة الوجه والفكين وفقا لمعايير خاصة . تم تقسيم العينات إلى أربع مجموعات متساوية وفقا لسنهم .وذلك بواسطة الخط الموضوع على الصورذات المقطع الجانبي بين أعمق نقطة لقاعدة الجيب الفكي و قمم الجذر للضرس الثاني للفك العلوي وتم قياس المسافات باستخدام أدوات القياس للحصول على النتائج للجانبين الأيمن والأيسر من هذه المجموعات الأربع . نتائج هذه الدراسة بينت انه لا يوجد فرق معنوي في المسافة بين جذور الرحى الثانية و أرضية الجيب الفكي في الفئات العمرية الأربع ، عدم وجود فروق ذات دلالة إحصائية بين الجانبين الأيمن و الأيسر . إلا في الجذورالحنكية في الاعمار فئة الخمسين عام كانت المسافة في الجانب الأيمن أكبر من في الجانب الأيسر.

Abstract

The alveolar process of the maxilla forms the maxillary sinus floor. If the sinus is of an average size, it is on a level with the floor of the nose; if the sinus is large, it reaches below this level. Projecting into the floor of the antrum are several conical processes, corresponding to the roots of the first and second molar teeth; in some cases, the fangs of the teeth perforate the floor .The close anatomical relationship of the maxillary sinus with the roots of maxillary molars and premolars renders this anatomical region susceptible to morbid situations resulting from damage to, and therapeutic intervention in the dentoalveolar environment. Knowledge of the relationship between the root apex and the inferior wall of the maxillary sinus is crucial for diagnosis and treating a sinus pathosis as well as in assisting dental

implantation, endodontic procedures and orthodontic treatment. This study aimed to estimate different distances between the maxillary sinus base and the root apices of maxillary second molars measured on computed tomography (CT) to determine the differences through aging. Sixty patients attending the radiology center of AL-Zahraa Teaching Hospital in AL-Kut city for any maxillofacial complaints were selected in this study according to special criteria. The samples were divided into four equal groups according to their age. Lines were drawn on the sagittal reconstructed images between the deepest point of the maxillary sinus floor and the root apices of the maxillary second molar and the distances were measured using built-in measurement tools for right and left sides of these four groups. Results of this study found that there was no significant difference in the distance between apices of maxillary second molar roots and the floor of maxillary sinus in the four age groups and there was no significant differences between the right and left sides of the 2^{nd} molar roots apices and their relations to the floor of the maxillary sinus in these groups except in P roots of 50 age group the distance in right side was larger than in the left side.

Keywords: Maxillary second molar, CT scan , maxillary sinus

Introduction

The maxillary sinus are pyramidal shaped cavities in the mid-facial aspect of the skull; they are bilateral structures, located beside each nasal fossa. Each sinus extend posteriorly near the roots of maxillary posterior teeth and for this reason, parts of the floor of the maxillary sinuses may appear in many of the maxillary periapical projections (1).

Identifying the proximity between the root apex and the inferior wall of the sinus and clarifying the cortical thickness of the inferior wall of the sinus is essential for determining the topography of a spreading dental infection into the maxillary sinus. Accordingly, knowledge of the topography between the root apex and the inferior wall of maxillary sinus is important for diagnosing and planning dental implantation, endodontic procedures, and orthodontic treatment. The topography of the inferior wall with the maxillary root apices varies according to an individural's age, size and the degree of pneumatization of the maxillary sinus and the state of dental retention (2). A periapical or periodontal infection of the upper premolars and molars may spread beyond the confines of the supporting dental tissue into the maxillary sinus, causing sinusitis (3). The use of computed tomography (CT) instead of plain radiography in the work-up of paranasal sinus pathology was recommended in the beginning of the 1990's (4). Normally tooth apices and the maxillary floor are separated by cortical bone, but some teeth (such as the first and second maxillary molar) are only separated from the maxillary sinus floor by a thin mucosal layer (5, 6). The CT solves the limitations of the panoramic radiograph by providing multiplanar views with low magnification. The volume of the maxillary sinus has a natural tendency to increase during life. Tooth loss in the posterior maxilla can result a rapid alveolar bone resorption caused by inherent bone remodelling of the alveolar bone. In addition the

maxillary sinus extends further by osteoclast activity in the Schneiderian membrane, causing pneumatisation of the sinus by resorbing bone within a few months (7, 8). CT also provides an accurate assessment of the paranasal sinuses, craniofacial bones, as well as the extent of pneumatization of the paranasal sinuses (9).

The morphological evaluation of maxillary sinus is necessary to deal with problems such as injury to the tooth root and perforation of the sinus (10). The roots of the maxillary first and second molars have been shown to be in an intimate relationship with the maxillary sinus floor in 40 percent of cases. The palatine roots have been shown to be closer to the antral floor than to the palate and in close proximity to the maxillary sinus (11) **.**This location complicates a surgical approach through the sinus, so that palatinal access is usually required.
The distance from the root apex to the inferior wall of the sinus was the shortest in the second molar area and the longest in the first premolar area (2). Most of researches study the relationship between maxillary sinus floor and the apices of maxillary molars in general and only few of these researches deals with the relation of individual tooth roots to the floor of the maxillary sinus. So the aim of the present study is to determine the relationship between the root apices of the permanent maxillary second molar and floor of the maxillary sinus and its relation to age.

Materials and methods

The sample of the present study is a total of 60 Iraqi subjects,aged (20-59) years old attending the radiology center of AL-Zahraa Teaching Hospital in AL-Kut city for any maxillofacial complaints.

Patients were selected that fulfilled the following selection criteria:

- Normally erupted bilateral maxillary molars.
- No periapical or periodontal lesion involved maxillary molars.
- The maxillary sinuses included in this study should be asymptomatic and clearly free of any pathology such as fractures, inflammation, cysts or tumors that are being examined with the assistance of Radiologist.
- Images of good quality, which had the clearest reproduction of the maxillary sinus floor for exact measurement in CTscan include 0.6 mm thickness of slice.

The samples were divided into four equal groups according to their age:

1st age group range between (20 –29) years
2nd age group range between (30–39) years.
3rd age group range between (40 –49) years
4th age group rang between (51-59) years.

Spiral CT scanner, (TOSHIBA ,Aquillion 64) was the X-ray Machine used in the present study. kVp = 120, mA = 500 Slice thickness 0.6 mm and- Pixel size 512x512.

All patients were exposed by spiral CT scan without using sedation or contrast medium and all scans were performed in axial plan and sagittal reconstructed images. Lines were drawn on the sagittal reconstructed images between the deepest point of the maxillary sinus floor and the root apices of the maxillary second molar and the distances were measured using built-in measurement tools as in the figure (1).

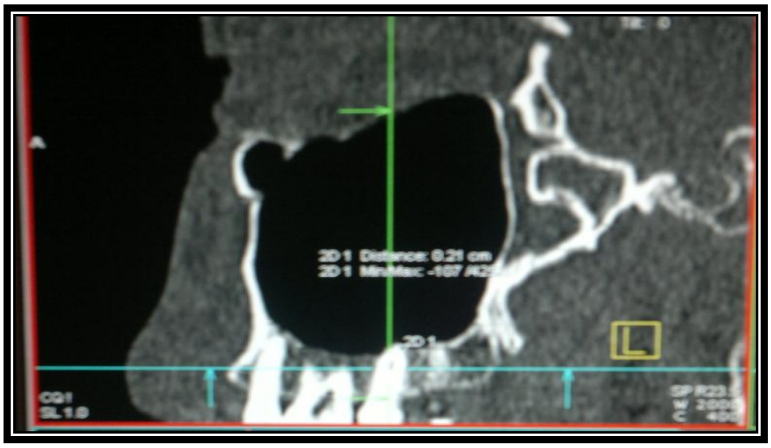

Figure (1): Palatal root of left second molar penetrates or inside the maxillary sinus

The resultant measurements were arranged into tables and statistical analysis has been applied for these results then comparative significance were detected by using t- test.

Results

The total studied samples composed of 60 patients with aged (20-59) years,1st group aged between (20 –29) years ,2nd group aged between (30–39) years ,3rd group aged between (40 –49) years and 4th aged between (51-59)years.

For the right and left second molar there was no significant difference in the distances between the root apices and the inner wall of the maxillary sinus in the four age group as that showing in the table 1. Means, standard deviations and minimum and maximum values obtained from right and left side as showing in the table (1).

Table (1): Descriptive statistics and age groups' differences

Side	Tooth	Root	Age group	Descriptive statistics					Age groups' comparison	
				Mean	S.D.	S.E.	Min.	Max.	F-test	p-value
Right	2nd molar	MB	20-29	0.07	1.50	0.39	-3	2.1	1.48	0.229 (NS)
			30-39	0.13	1.00	0.26	-2	1.2		
			40-49	0.31	1.05	0.27	-1	1.8		
			50-59	-0.62	1.54	0.40	-3	2.2		
		DB	20-29	1.62	1.40	0.36	0	4	0.52	0.669 (NS)
			30-39	1.11	1.33	0.34	0	3		
			40-49	1.29	1.31	0.34	0	4.2		
			50-59	0.99	1.79	0.46	-1	4.6		
		P	20-29	0.41	1.43	0.37	-2	4.5	0.38	0.767 (NS)
			30-39	0.77	1.68	0.43	-1	4		
			40-49	0.77	1.40	0.36	-1	4		
			50-59	0.97	1.32	0.34	-1	3		
Left	2nd molar	MB	20-29	0.10	1.73	0.45	-2.3	3.5	1.46	0.234 (NS)
			30-39	-0.52	1.91	0.49	-4	4		
			40-49	-0.28	1.34	0.35	-3	3.5		
			50-59	-1.07	1.16	0.30	-3	1		
		DB	20-29	1.29	1.88	0.49	-1	5.3	2.06	0.117 (NS)
			30-39	1.49	1.96	0.51	-3	4.6		
			40-49	1.07	1.34	0.35	-1	4.3		
			50-59	0.13	1.19	0.31	-2	3		
		P	20-29	0.97	1.99	0.51	-2	5.3	1.67	0.184 (NS)
			30-39	0.33	1.64	0.42	-2	4.5		
			40-49	0.47	1.06	0.27	-2	2		
			50-59	-0.20	0.77	0.20	-3	0		

IN 20 ,30 and 40 age group there was no significant differences between the right and left sides of the t 2nd molar roots apices and their relations to the floor of the maxillary sinus as show in the table 2 , 3 and 4 while in 50 age group the Sides' difference was highly significant for P root of second molar as showing in the table 5.

Table (2): Side difference in 20 age group

Tooth	Root	Side	Descriptive statistics			Sides' difference	
			Mean	S.D.	S.E.	t-test	p-value
2nd Molar	MB	Right	0.07	1.50	0.39	-0.044	0.966 (NS)
		Left	0.10	1.73	0.45		
	DB	Right	1.62	1.40	0.36	0.733	0.476 (NS)
		Left	1.29	1.88	0.49		
	P	Right	0.41	1.43	0.37	-1.165	0.263 (NS)
		Left	0.97	1.99	0.51		

Table (3): Side difference in 30 age group

Tooth	Root	Side	Descriptive statistics			Sides' difference	
			Mean	S.D.	S.E.	t-test	p-value
2nd Molar	MB	Right	0.13	1.00	0.26	1.406	0.181 (NS)
		Left	-0.52	1.91	0.49		
	DB	Right	1.11	1.33	0.34	-0.859	0.405 (NS)
		Left	1.49	1.96	0.51		
	P	Right	0.77	1.68	0.43	0.801	0.436 (NS)
		Left	0.33	1.64	0.42		

Table (4): Side difference in 40 age group

Tooth	Root	Side	Descriptive statistics			Sides' difference	
			Mean	S.D.	S.E.	t-test	p-value
2nd Molar	MB	Right	0.31	1.05	0.27	1.877	0.082 (NS)
		Left	-0.28	1.34	0.35		
	DB	Right	1.29	1.31	0.34	0.487	0.634 (NS)
		Left	1.07	1.34	0.35		
	P	Right	0.77	1.40	0.36	0.891	0.388 (NS)
		Left	0.47	1.06	0.27		

Table (5): Side difference in 50 age group

Tooth	Root	Side	Descriptive statistics			Sides' difference	
			Mean	S.D.	S.E.	t-test	p-value
2nd Molar	MB	Right	-0.62	1.54	0.40	1.102	0.289 (NS)
		Left	-1.07	1.16	0.30		
	DB	Right	0.99	1.79	0.46	2.613	0.020 (S)
		Left	0.13	1.19	0.31		
	P	Right	0.97	1.32	0.34	3.676	0.002 (HS)
		Left	-0.20	0.77	0.20		

NS: Non-Significant, $P > 0.05$
S: Significant, $0.05 \geq P > 0.01$
HS: Highly Significant, $0.01 \geq P > 0.001$

Discussion

The relations between the dental roots apices and the sinus floor are critical elements for the diagnosis and surgical treatment of antral pathology. The results obtained in this study are useful both in endodontics and in oral surgery. In what concerns the latter field, the antrum–teeth relations interfere with teeth removal and immediate placement of dental implants in the lateral maxillary region. The close relationship of the maxillary sinus and the roots of the maxillary molars can lead to accidental oroantral communication (6).

Clinicians conducting immediate placement of implants in posterior teeth, particularly should take into consideration the amount of protrusion of teeth roots into the sinus. Large number of studies regarding this vital relationship was carried out utilizing different radiographic techniques including conventional, computed tomography and digital radiography (12, 13). In a review study in 2000, the distance from the apices of the roots of the first molar tooth to the sinus floor was found to be 0.5mm or even less in one third of all cases, and sometimes there is no bone between the root apex and the sinus. A periapical or periodontal infection of the upper premolars and molars may spread beyond the confines of the supporting dental tissue into the maxillary sinus, causing sinusitis (14). The study aimed to assess the age-related changes of the measurements of the distances between the apices of the second molar roots and the floor of the maxillary sinus.

The roots of the second molars (especially the mesio-buccal roots), followed by the first molars (especially the buccal roots), third molars, second premolars and first premolars have the closest proximity to the sinus floor (15).

The present study was found that there is no significant difference of the distance between the root apices of second molar and the sinus floor between the different age groups .This results agree with more detailed study that found there was no significant difference in the maxillary sinus volume between different age group (16) and disagree with previous reports suggested that the mean distances between the root apices and sinus floor increased with age. Regarding the volume of the maxillary sinus, it had been demonstrated that this increases up to the age of 20 years, but then it starts decreasing (17) **.**Another study revealed that the growth of the maxillary sinus continues until the 3rd decade in males (18) .The present study also showed that there was no significant differences between the right and left sides of the 2^{nd} molar roots apices and their relations to the floor of the maxillary sinus in 20,30 40 age groups. Regarding the volume of the maxillary sinus, it had been demonstrated that there was no significant difference between the left and right side (17) , except the P root show highly significant difference between the right and left side that the distance in right side was larger than in the left side this result came in agreement with many studies in the literature (19) . Unfortunately, this difference was found to be unexplainable, but it may be related to the habit of chewing on one side that may lead to some differences between both sides.

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