Prevalence and localization of the posterior superior alveolar artery in relation to the floor of the maxillary sinus and alveolar crest among sample of Iraqis using computed tomography

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ABSTRACT
Background: Posterior superior alveolar artery (PSAA) is branch of the maxillary artery, it usually supplies the lateral wall of the sinus and overlying membrane. Evaluation and awareness of the anatomy of maxillary sinus before surgery is crucial to avoid surgical complications. The aim of this study is to examine the prevalence, location of the PSAA in relation to the floor of the maxillary sinus and alveolar crest using computerized tomography (CT) scans.

Materials and Methods: This study included 180 Iraqi subjects (99 males and 81 females) with age more than 16 years old. CT scans for (right and left) Maxillary sinuses were done for each patient. The information obtained was assessed in a coronal multi planar reconstructions images (MPRs) in order to obtain the following parameters: prevalence rate of PSAA, distance from the lower border of the artery to the: alveolar crest, the floor of the sinus and the medial sinus wall.

Results: The prevalence of PSAA on CT images was 73.61% among total sample. Distance from the lower border of the artery to the alveolar crest was (18.42± 4.07) mm, and to the sinus floor was (8.99 ±3.86) mm and to the medial sinus wall was (12.68 ± 2.81) mm.

Conclusions: CT scan is valuable tool in evaluation and localization of the PSAA before maxillary sinus surgery.

Keywords: PSAA, Maxillary sinus, Maxillary artery, Computed tomography. (J Bagh Coll Dentistry 2017; 29(3):54-58)

INTRODUCTION
The posterior superior alveolar artery and infraorbital artery (IOA) are branches of the maxillary artery. They supply the lateral wall of the maxillary sinus and the Schneiderian membrane (1,2). These arteries should be taken into concern during sinus augmentation procedures because of the possibility of bleeding during the surgery due to injure to the vascular supply of the lateral sinus wall (3).

Surgical intervention in the maxillary sinus needs a good knowing of its anatomy. The maxillary sinus is the largest sinus of the paranasal sinuses (4). Placing dental implants required the presence of enough thickness of the bone. In the posterior maxillary areas, where there is atrophy of the bone and pneumatization of maxillary sinuses which occur as a results of teeth extraction in this area. As any other surgical intervention, a large number of complications whether it was intraoperative or postoperative may occur during the surgery of sinus floor elevation. One common complication is the blood vessel trauma (5,6).

Computerized tomography (CT) is a digital imaging tool that allows the quantification and differentiation of hard and soft tissues. CT can examine the arteries, anatomical structures, is also can calculate bone dimension, identify specific anatomical landmarks and detect sinus pathologies (7). Hence, this study was undertaken in order to show variations in the vascular morphology of the posterior superior alveolar artery in a sample of Iraqi subjects using CT scans.

MATERIALS AND METHODS
The sample
The sample in this study composed of 180 Iraqi patients (99 males and 81 females) with an age not less than 16 years old.

They attended the Radiology Department at Neuro Science Hospital in Baghdad to take Spiral CT scan of the brain and paranasal sinuses from November 2015 till February 2016.

All participants were informed well about the aim and the method of the study and asked them if they agree to participate and they were free to withdrawal at any time they decide. A special consent form was to be signed by each one.

The patients were divided according to dental status into dentate partially edentulous patients and then CT scans for (right and left) maxillary sinuses were taken for each patient using Siemens Somatom definition AS (Germany). The parameters of the acquisition were 1 mm thickness slice, kV=120, mAs=370 and exposure time was 20 seconds. The patients were...
positioned in supine on the CT examination table with the head on the head rest.

The information obtained was the measurements parameters which were done using the calibration function of the syngo software program on syngo acquisition workplace in coronal multi planar reconstructions (MPRs), axial and coronal images were evaluated to reconfirm that the examined area contain artery canal.

These CT scan images were used to identify the PSAA in order to obtain the following parameters:

1. Prevalence rate of the PSAA (Figure 1).
2. Distance from the lower border of the artery to the alveolar crest (the vertical line from the artery to the crest) \(^8\) (Figure 2).
3. Distance from the lower border of the artery to the sinus floor (the vertical line from the artery to the floor) (Figure 3).
4. Distance from the lower border of the artery to the medial sinus wall \(^9\) (Figure 4).

Statistical analyses
Data were analyzed using SPSS (statistical package of social science) software version 19. In this study the following statistics were used:

1. Descriptive statistics: including means, standard deviations, frequency (No.), percentages, and statistical tables and figures.
2. Inferential statistics: including: Independent sample t-test: to verify the gender difference for the measured variables.
RESULTS
Radiographical Prevalence rate of the Posterior superior alveolar artery (PSAA) on CT images

![Diagram showing prevalence rates for PSAA based on gender]

Figure 5: Radiographic prevalence of PSAA in relation to the gender. (A) for females, (B) for males and (C) for total sample.

PSAA measurement parameters (Table 1)
1. The mean distance from the lower border of the artery to the alveolar crest was 18.42± 4.07 mm for the total sample in which it was 18.18 ± 3.70 mm in females and 18.57± 4.29 in males. Statistically there no significant correlation between genders and this distance since the P-value=0.447.
2. The mean distance from the lower border of the artery to the sinus floor was 8.99 ± 3.86 mm for the total sample in which it was 8.41 ± 3.16 mm in females and 9.35 ± 4.21 in males. Statistically there no significant correlation between genders and this distance since the P-value=0.053.
3. The mean distance from the lower border of the artery to the medial sinus wall was 12.68 ± 2.81 mm for the total sample in which it was 13.10 ± 2.61 mm in females and 12.41 ± 2.90 in males. Statistically there no significant correlation between genders and this distance since the P-value=0.053.

Table 1: Descriptive statistics and genders difference of PSAA measurement parameters

| Distance from the artery | Genders   | Descriptive statistics | Genders difference (d.f.=263) |
|--------------------------|-----------|------------------------|-------------------------------|
|                          |           | N   | Mean  | S.D. | t-test | p-value |
| To the alveolar crest    | Total     | 265 | 18.42| 4.07 | -0.762 | 0.447 (NS) |
|                          | Females   | 102 | 18.18| 3.70 |         |         |
|                          | Males     | 163 | 18.57| 4.29 |         |         |
| To the sinus floor       | Total     | 265 | 8.99 | 3.86 | -1.944 | 0.053 (NS) |
|                          | Females   | 102 | 8.41 | 3.16 |         |         |
|                          | Males     | 163 | 9.35 | 4.21 |         |         |
| To the medial sinus wall | Total     | 265 | 12.68| 2.81 | 1.944  | 0.053 (NS) |
|                          | Females   | 102 | 13.10| 2.61 |         |         |
|                          | Males     | 163 | 12.41| 2.90 |         |         |
DISCUSSION

The importance of considering the vascular system of the maxillary sinus when employing sinus surgery, particularly lateral approach sinus floor augmentation relates to potential intraoperative complications (1,2,10).

Sinus augmentation is a method with high predictability for placing successful dental implants into atrophic posterior maxilla (11,12). Blood vessels distribution in this area changes when the alveolar bone is severely atrophied because of increased age and loss of dentition. Moreover, the number and diameter of the blood vessels may decrease in elderly edentulous patients (13), so knowledge of the anatomic structure of the area is important for this procedure.

The prevalence of the PSAA from the examined sinuses using MPR-CT images was found to be 73.6% for the total sample. The success rate for identifying the artery was slightly higher than that reported by Fontana et al. (14) for African-Americans (72.2%) and in the Caucasians (43.2%).

Guncu et al. (7) reported a prevalence of 64.5%, Elian et al. (8) 52.9%, Mardinger et al. (9) 55% and Kim et al. (13) 52%. This variation may be related to the methods the other groups used to detect and describe the artery.

PSAA measurements parameters

In the present study, comparison between right and left sides in the same patient was not done but only gender difference was performed due to the anatomical difference in addition to the dental condition on both sides that were not always the same.

Distance from the lower border of the artery to the alveolar crest

The mean distance from the lower border of the artery to the alveolar crest and it was 18.57 ± 4.29 mm for males and 18.18 ± 3.70 mm for females and for the total sample it was 18.42 ± 4.07 mm. This finding is close to that of Guncu et al. (7) and Kim et al. (13) and higher than Elian et al. (8) (16.4 mm) and Mardinger et al. (9) (16.9 mm).

Distance from the lower border of the artery to the sinus floor

The second measurement was the mean distance from the lower border of the artery to the sinus floor which was 8.99 ± 3.86 mm for the total sample (9.35 ± 4.21 mm in males and 8.41 ± 3.16 mm in females). This distance was reported by Guncu et al. (7) as 7.8 ± 0.3 mm and by Mardinger et al. (8) as 7–8 mm.

Distance from the lower border of the artery to the medial sinus wall

The third measurement was the mean distance from the lower border of the artery to the medial sinus wall which was 12.68 ± 2.81 mm for the total sample (12.41 ± 2.90 mm in males and 13.10 ± 2.61 mm in females). It is near to that reported by Guncu et al. (7) which was 11 ± 3.8 mm.

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الخلاصة: معرفة وتقييم تشريح الجيب الفكي قبل رفع الجيب ضرورية لتجنب المضاعفات الجراحية. الشريان السنوي العليا.

الهدف من الدراسة: هو معرفة احتمالية وجود و موقع الشريان السنوي العليا الخلفي وعلاقته بأرضية الجيب الفكي والعظم السنخي باستخدام التصوير بالمقطعية.

طرق البحث و المواد المستخدمة: شملت هذه الدراسة (180) فردًا (99 من الذكور و 81 من الإناث) الذين كانت عشراهم أكثر من 16 عاما، و تم إجراء الدراسة في مستشفى العلوم المعمية في بغداد للقرة من تشرين الثاني 2015 إلى شباط 2016. تم إجراء الأشعة المقطعية للجيف الفكي (اليمين واليسار) لكل مريض. المعلومات التي تم الحصول عليها تم تقييمها بواسطة صور مركبة متعلقة باستخدام التصوير بالمقطعية للجيف الفكي. القائمة أدناه: معدل احتمالية وجود الشريان السني العليا الخلفي والمسافة من الحد السفلي إلى الشريان السنخي العلوي الخلفي إلى قمة العظم السنخي و إلى أرضية الجيب الفكي و إلى الجدار الوسطي للجيف الفكي.

النتائج: وكان معدل احتمالية وجود الشريان السنوي العليا الخلفي عند حسب 360 جيب فكي لكل الأفراد ضمن الدراسة هو (73.6%)، وكانت نسبة أعلى عند الذكور من الإناث. وكانت المسافة من الحد السفلي إلى الشريان إلى قمة العظم السنخي (8.42 ± 4.07) ملم إلى أرضية الجيب الفكي (8.99 ± 3.86) ملم و إلى الجدار الوسطي للجيف الفكي (12.68 ± 2.81) ملم.

الاستنتاجات: تشير الدراسة إلى أن التصوير بالمقطعية هو أداة قيمية في اتخاذ و تحديد موقع الشريان السنوي العلوي الخلفي قبل جراحة الجيوب الأنفية العلوية.