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POSTERIOR SUPERIOR ALVEOLAR ARTERY LOCATION USING CONE-BEAM COMPUTED TOMOGRAPHY AMONG THE IRAQI POPULATION

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ABSTRACT

The blood supply to the lateral sinus walls and the sinus floor membrane is provided by maxillary artery through a branch named posterior superior alveolar artery (PSAA). [1] preoperative radiological evaluation to detect and locate the exact position of the artery to avoid traumatizing these arteries and subsequent perioperative bleeding, during any surgical intervention [2]. Cone beam computed tomography (CBCT) is appropriate for craniofacial area imaging. It shows precise images of well-contrasted structures; it is also suitable for bone imaging [3], [4]. In addition, the usage of the CBCT technique in the clinical application offers several impending benefits for "maxillofacial imaging including: X-ray beam restriction", image precision, dose reduction and rapid scan time [5].

1. Introduction

In order to increasing the amount of bone in vertical dimension for placement of dental implant, sinus floor elevation can be consider as a surgical procedure modality [6]. However, care should be taken from the complication during the surgery and postoperative during elevation of sinus floor. From these complication is disturbance to a blood vessel, that may cause severe bleeding [7].

Maxillary sinuses vascular supply is from posterior superior alveolar artery, shenopalatine artery, greater palatine artery and infraorbital artery. The infraorbital artery and PSAA are branches of maxillary artery that supply the schneiderian membrane and lateral wall of sinus. The PSAA and infraorbital artery have extraosseous and intraosseous branches, which may anastomose. The PSA artery runs laterally to the convexity of the maxillary tuberosity, outside of the maxillary bone, and lies in close proximity to the bone and the periosteum [8], [9].

Information about the anatomy of of the maxillary sinus is necessary to avoid any unpredictable

complication that may occur because of the close relationship between the maxillary sinus and PSAA [10], [11]. Imaging procedure that expose the patient to ionizing radiation must yield as much relevant information as possible, and it is necessary that the physician obtain all the beneficial information possible. Cone beam computed tomography (CBCT) is useful with the option of low dose when we compare it with standard medical computed tomography (MDCT) scans in imaging of maxillofacial area [12]. The effective dose (International Commission on Radiological Protection - ICRP 2007) from a standard dental protocol scan with MDCT is 1.5 to 12.3 times greater than from comparable medium–field of view dental CBCT scans [13], [14]. Thus, the using of CBCT befor any procedures in alveolar ridge and maxillary sinus in patient need for dental implant.

The aim of the present study was to evaluate the relationship and location of posterior superior alveolar artery in relation to the alveolar ridge and the flour of maxillary sinus, using CBCT imaging technique.

2. MATERIALS AND METHODS

For this prospective study, a total of 95 Iraqi adults patients (53 females, 42 males; age range 20-49 years). From October 2020 to February 2021, visited a second specialized dentistry centre in Baquba city to examined by CBCT scanning for various diagnostic reasons.

The same radiography equipment was used for all projections “Tomographic images were acquired with a CBCT scanner (NewTom VGi)^{TM}”.

These were some of the scanning parameters:
“Volt =110 kiloVolt, Exposure time =24 second, Electrical current = 5.7 mA, voxel size =0.5 mm, field of view =16 cm× 14 cm”
The measurements and the analyses were done by oral and maxillofacial radiologists.

Excluded criteria:
- Patients with systemic diseases affecting growth and development
- The presence of any deciduous teeth in the target area.
- The presence of pathological change was detected radiographically in the target area.
- Previous history of surgery and/or trauma involving the target area.

Included criteria:
All teeth should be present and permanent in the target area.
Cross-section views were used to assess the position of the posterior superior alveolar artery as shown in figures 1,2 and 3

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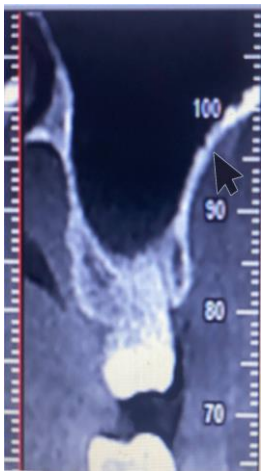

FIG. 1 CBCT (Cross-Section Views) Show the Position of Posterior Superior Alveolar Artery (Intramembranous)

FIG. 2 CBCT (Cross-Section Views) Show the Position of Posterior Superior Alveolar Artery (Intraosseous)

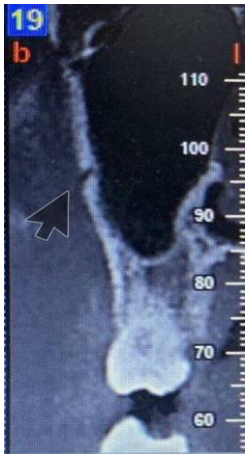

FIG. 3 CBCT (Cross-Section Views) Show the Position of Posterior Superior Alveolar Artery (Extraosseous)

The test was performed on ten randomly selected Iraqi residents to assess the reliability and reproducibility of the relationship between the roots of mandibular premolars and molars and "the surrounding cortical

plates and mental foramen using cone beam computed tomography".

-Inter examiner calibration:
This calibration has been done by comparing the researcher's measurement of a randomly chosen Ten sample to another well-practiced oral and maxillofacial radiologist's measurement. When the paired t-test was used to compare the two measurements, there was no significant difference ($p>0.05$).

- Intra examiner calibration:
The calibration was done by the researcher repeating the measurement of a randomly selected 10 CBCT picture two weeks following the first reading. When a paired t-test was used to compare the two readings, there was no significant difference ($p>0.05$).

Statistical analysis using Statistical Package for social Science (SPSS version -22, Chicago, Illionis, USA), minimum, Maximum, mean, Standard deviation(SD) and standard error (SE), cluster chart bars, frequency and percentage, inferential statistics are: Shapiro Wilk test, Levene test, Two independent Sample T test, One Way Analysis Of Variance (ANOVA) with Games-Howell posthoc test and Pearson Chi square. Accepted level of significance is at 0.05.

3. RESULTS

Table 1 association between artery and tooth presence

Side			Tooth						Total	
			dentuolous		edentulous					
			N.	%	N.	%	Chi square	P value	N.	%
R	Presence	with	51	80.95	27	84.38	0.169	0.681 NS	78	82.11
		free	12	19.05	5	15.63			17	17.89
	Total		63	100.00	32	100.00			95	100.00
L	Presence	with	58	82.86	23	92.00	1.225	0.268 NS	81	85.26
		free	12	17.14	2	8.00			14	14.74
	Total		70	100.00	25	100.00			95	100.00
Total	Presence	with	109	81.95	50	87.72	0.971	0.324 NS	159	83.68
		free	24	18.05	7	12.28			31	16.32
	Total		133	100.00	57	100.00			190	100.00

Results in table 1 show 95 subjects that 190 sides (95 right and 95 left) participated in this study, 159 (83.68%) artery is present in this study with 31 (16.32%) artery not present and the left side has more artery present than the right one, although the presence of teeth has more artery than that absent of teeth to presence the artery in each side and in the total sample but the result is not significant association.

Table 2 descriptive and statistical test of Alveolar crest among locations

Sides	Location	N	%	Mean	SD	SE	Min.	Max.	F	P value
R	Intra.Oss	28	35.90	9.461	4.455	0.842	3.900	16.500	0.367	0.69389

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	Extra.Oss	15	19.23	10.773	1.350	0.347	8.700	13.100		
	Intra.mem	35	44.87	9.637	6.215	1.051	4.200	19.900		
L	Intra.Oss	21	25.93	7.936	3.833	0.837	3.290	14.100	0.982	0.37907
	Extra.Oss	18	22.22	9.667	2.543	0.600	8.100	18.000		
	Intra.mem	42	51.85	9.673	5.957	0.919	4.800	21.600		

Results in table 2 show that distance from artery to alveolar crest in the right side is higher in the extraosseous from other locations while in the left side this distance is higher in the intraosseous membrane but with no significant difference.

Table 3 descriptive and statistical test of Sinus floor among location

Sides	Location	Mean	SD	SE	Min.	Max.	F	P value
R	Intra.Oss	18.986	4.338	.820	13.600	25.500	16.541	**0.00000***
	Extra.Oss	20.510	2.372	.612	16.000	22.500		
	Intra.mem	15.543	2.139	.362	12.900	19.000		
L	Intra.Oss	17.414	4.864	1.061	10.750	23.700	3.552	**0.03338 ***
	Extra.Oss	17.928	2.811	.663	14.700	25.200		
	Intra.mem	15.860	1.803	.278	13.000	19.800		

*=significant at p<0.05

Findings in table 3 show that distance from artery to sinus floor is higher in extraosseous from other two locations in each side with significant difference between locations.

Table 4 multiple Comparisons of sinus floor distance among locations using Games-Howell

Side			(I) Location	(J) Location	Mean difference	p value
R			Intra.Oss	Extra.OSS	-1.52429	**0.30639***
				Intra.mem	3.44286	**0.00130***
			Extra.OSS	Intra.mem	4.96714	**0.00000***
L			Intra.Oss	Extra.OSS	-0.51349	0.91161
				Intra.mem	1.55476	0.34915
			Extra.OSS	Intra.mem	2.06825	**0.02216***

*=significant at p<0.05.

Findings in table 4 show that in the right side each result is significant from each location to other while in the left side only when compare extraosseous to Intramembranous, this result is only significant while other results are not significant.

Table 5 descriptive and statistical test of Alveolar crest and sinus floor among gender.

Side		Gender									
		M				F					
		N	Mean	SD	SE	N	Mean	SD	SE	T test	P value
R	Alveolar crest	38	19.358	3.901	.633	40	16.191	2.826	.447	4.088	**0.00012**
	Sinus floor	38	9.316	4.201	.682	40	10.245	5.600	.885	0.832	0.40837
L	Alveolar crest	40	17.315	2.703	.427	41	16.144	3.520	.550	1.682	0.09676
	Sinus floor	40	8.066	2.843	.450	41	10.348	6.092	.951	2.168	**0.03435**

Results in table 5 show that distance of artery to alveolar crest and distance of artery to sinus floor in each

side is higher in males than that in females with significant difference in distance of artery to alveolar crest in right side and significant difference in distance of artery to sinus floor in left side while other results are not significant.

Table 6 association between artery and gender.

Side			Presence						Total	
			With		Without					
			N.	%	N.	%	Chi square	P value	N.	%
R	Gender	M	38	48.72	4	23.53	3.590	0.058 NS	42	44.21
		F	40	51.28	13	76.47			53	55.79
	Total		78	100.00	17	100.00			95	100.00
L	Gender	M	40	49.38	2	14.29	5.961	**0.015 ***	42	44.21
		F	41	50.62	12	85.71			53	55.79
	Total		81	100.00	14	100.00			95	100.00
Total	Gender	M	78	49.06	6	19.35	9.279	**0.002 ***	84	44.21
		F	81	50.94	25	80.65			106	55.79
	Total		159	100.00	31	100.00			190	100.00

Results in table 6 show that females represent with more artery presence than males in each side and in the total with significant result in the left side and in the total while not significant in the right side.

Table 7 association between location and gender.

Side			Gender						Total	
			M		F					
			N.	%	N.	%	Chi square	P value	N.	%
R	Location	Intra.OSS.	18	47.37	10	25.00	5.672	0.056 NS	28	35.90
		Extra.OSS.	8	21.05	7	17.50			15	19.23
		Intra.Mem.	12	31.58	23	57.50			35	44.87
	Total		38	100.00	40	100.00			78	100.00
L	Location	Intra.OSS.	10	25.00	11	26.83	1.305	0.521 NS	21	25.93
		Extra.OSS.	11	27.50	7	17.07			18	22.22
		Intra.Mem.	19	47.50	23	56.10			42	51.85
	Total		40	100.00	41	100.00			81	100.00
Total	Location	Intra.OSS.	28	35.90	21	25.93	4.625	0.099 NS	49	30.82
		Extra.OSS.	19	24.36	14	17.28			33	20.75
		Intra.Mem.	31	39.74	46	56.79			77	48.43
	Total		78	100.00	81	100.00			159	100.00

Findings in table 7 show that presence of artery in each side and in the total in the intramembranous find in females more than that in males while in the extra osseous, artery find to be higher in males than that in females, in the intra osseous, artery find to be higher in males more than that of females in the right side and in the total while in the left side, this result is higher in females more than that in males, but all these results are not significant.

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4. DISCUSSION

Cone Beam Computed Tomography is well appropriate for craniofacial area imaging. It shows precise images of well-contrasted structures; it is also suitable for bone imaging [15], [16]. In addition, the usage of the CBCT technique in the clinical application offers several impending benefits for "maxillofacial imaging including: X-ray beam restriction", image precision, dose reduction and rapid scan time [17].

The purpose of this study was to evaluate the relationship and location of posterior superior alveolar artery in relation to the alveolar ridge and the flour of maxillary sinus. The proper identification of position PSAA is an essential element. However, because there is no research within the Iraqi population, only similar research in other populations can compare the parameter PSAA position differs by racial group.

A research conducted on the Turkish population, The artery was observed in 89.3% of the sinuses and was mostly intraosseous (71.1%) [18]. While in this research we observed the artery in (83.68%) The ability of detection of the artery was higher than that reported by [19] (64.5%), [20] (52.9%), [21] (55%), and [22] (52%).While a study done by [26], on a Chinese population show the precence (87.6%) [23] and similar study done by [27] on a Mexican population show (90%) [24]. The difference in percentage of detection of PSAA may be related to the methods and racial variations, because of these study were carried out in different parts of the world.

Our study demonstrated that females represent with more PSAA presence than males in each side and in the total the difference was significant, this agree with [22], but disagree with [25], [26], this differences may be difference in male to female ratio in sample size.

Also the prescent study show that presence of artery in each side and in the total in the intramembranous find in females more than that in males, this may indicate that the likelihood of Hemorrhages and other complications is more in males, and this should be considered when excising bone for surgical intervention in this area, because of the more prescence of artery in the intramembranous location in female will decrease the risk of traumatic injury during any surgical intervention.

The distance of artery to alveolar crest and distance of artery to sinus floor in each side is higher in males than that in females, a similar result seen in study done by [27- 29], but disagree with similar study done by [30]. This difference may be due to difference in sample size or methodology.

5. CONCLUSION

This study give us an information about the accurate position of PSAA in Iraqi population by using CBCT, this information may be useful in minimizing the risk of bleeding and other complication that may be occur during any surgical intervention including dental implant insertion, ridge augmentation and other surgical procedures in this area.

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