RESEARCH

Cone Beam CT Evaluation of Maxillary Sinus and Posterior Superior Alveolar Artery

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Selcuk Dent J, 2022; 9: 191-199 (Doi: 10.15311/selcukdentj.846996)

Başvuru Tarihi: 25 Aralık 2020
Yayına Kabul Tarihi: 11 Ağustos 2021

ABSTRACT

Cone Beam CT Evaluation of Maxillary Sinus and Posterior Superior Alveolar Artery

Background: The aim of this study was to investigate the diameter, location, and appearance frequency of the posterior superior alveolar artery (PSAA), and the presence of septa and pathology within the maxillary sinus using cone-beam computed tomography (CBCT) cross sections.

Methods: Two hundred CBCT records were included in the study. The patients were divided into dentate, partially dentate, and edentulous groups. The type of PSAA (intrasinus-intraosseous-superficial) and its diameter, the distance between the inferior border of the PSAA and alveolar crest, bone height measured from the floor of the sinus to the crest of the alveolar ridge, the distance between the lateral wall of the PSAA and the medial wall of the maxillary sinus, presence of septa and pathology were evaluated.

Results: PSAA was detected 86.5% in the right, and 84.5% in the left side. Intraosseous PSAA was the most common variant (50% on the right, and 51.5% on the left). The mean distances between the PSAA and the alveolar crest were 17.80±3.59 mm on the right and 17.83±3.61 mm on the left side. No significant correlation was found between age and the diameter of the PSAA. (r=0.09, p=0.213 on right side, r=0.08, p=0.294 on left side).

Conclusion: CBCT cross-sectional analysis shows a high prevalence of PSAA. Through careful examination on available CBCT images, potential vascular damage around the maxillary sinus can be prevented.

KEYWORDS

Posterior Superior Alveolar Artery; Cone-Beam Computed Tomography; Maxillary Sinus; Pathology; Septa.

ÖZ

Maksiller Sinüs ve Posterior Superior Alveolar Arterin Konik Işınlı Bilgisayarlı Tomografi Değerlendirmesi

Amaç: Bu çalışmanın amacı, konik ışınlı bilgisayarlı tomografi (KIBT) kesitlerinde posterior superior alveolar arter (PSAA) görülme sıklığı, çapı ve konumunu, maksiller sinüste septa ve patoloji varlığını araştırmak ve bu parametrelerin yaş, cinsiyet ve dişlenme durumu ile olası ilişkisini ortaya çıkarmaktır.

Gereç ve Yöntemler: Çalışmaya 200 KIBT kaydı dahil edildi. Hastalar dişli, kısmi dişli ve dişsiz olmak üzere üçe ayrıldı. PSAA'nın çapı ve tipi (intrasinus-intraosseöz-yüzeysel), PSAA'nın alt sınırı ile alveolar kret arasındaki mesafe; sinüs tabanından sırtın tepesine kadar ölçülen kemik yüksekliği; PSAA'nın lateral duvarından maksiller sinüs medial duvarına olan mesafe, septa varlığı ve patoloji değerlendirildi.

Bulgular: Sağ tarafta% 86,5 ve solda% 84,5 PSAA tespit edildi. Sağda (% 50) ve solda (% 51.5) en sık görülen PSAA tipi intraosseöz idi. PSAA ile alveolar krest arasındaki ortalama uzaklıklar sağda 17.80 ± 3.59 mm ve solda 17.83 ± 3.61 mm idi. Yaş ile PSAA çapı arasında anlamlı bir ilişki yoktu (p> 0.05).

Sonuç: KIBT kesitlerinde PSAA gözlenmesi sıktır. Preoperatif KIBT görüntüleme, maksiller sinüs çevresindeki potansiyel vasküler hasarları önleyebilir.

ANAHTAR KELİMELER

Posterior Superior Alveolar Arter, Konik Işınlı Bilgisayarlı Tomografi, Maksiller Sinüs, Patoloji, Septa

The posterior superior alveolar artery (PSAA) is located on the lateral wall of the maxillary sinus[1,2] and is a branch of the maxillary artery.[2-8] The maxillary artery is a branch of the external carotid artery, and divides into five segments inside the pterygopalatine fossa. The PSAA and inferior orbital artery (IOA) are two branches of the maxillary artery which supply the Schneiderian membrane and maxillary sinus.[3-9] Because the integrity of the PSAA is at risk during augmentation procedures, clinicians must have adept knowledge surrounding the vascular system of the maxillary sinus in order to prevent surgical complications such as large-scale hemorrhage.[10]

Following the loss of posterior teeth,[1] changes occur to the properties of the blood vessels,[1] and the quantity and quality of existing alveolar bone in the posterior maxilla may decrease through the resorption of the alveolar bone and maxillary sinus pneumatization.[3] The volume of the maxillary sinus increases as a result of pneumatization due to tooth loss, which leads to positional changes to the main vessels in respect to other anatomical structures.[1] This situation carries significant important in patients who require posterior dental implants.[3] Sinus floor lifting (sinus augmentation[3]) can be executed through a lateral or crestal approach.[1,10] Results become more predictable in patients with minimum alveolar bone height[10]

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which include the risk of damaging blood vessels in the surrounding area, especially PSAA.[1] Mish and Judy[11] reported the necessity of sinus augmentation when the bone height is less than 10 mm. In addition to sinus augmentation, Caldwell-Luc surgery and Le Fort I osteotomy are performed through the lateral sinus wall.[2] Every surgical procedure surrounding this artery consists of risks of vascular complications.[2] Although the maximum diameter of the PSAA is around 3 mm, hemorrhage risk during surgical procedures increases in conjunction with the diameter.[3,8,9]

Oral and maxillofacial anatomy becomes tough to identify in detail with two-dimensional imaging methods because of superimpositions.[2] Cone beam computed tomography (CBCT) provides reliable and accurate three-dimensional measurements[3] of maxillofacial structures[13] with a lower dose of radiation in comparison to conventional medical CT.[2,12] Because the effective dose of medical CT is 1.5 to 12.3 times greater than CBCT, clinicians prefer the use of CBCT while planning dental implants.[7] In a previous meta-analysis study,[14] prevalence of PSAA was reported to be 62.02%. The study also showed that CT images are only effective in the imaging of thicker arteries and CBCT was more effective for in the overall detection of the PSAA.[14] The aim of this study was to investigate the diameter, location, and appearance frequency of the posterior superior alveolar artery (PSAA), and the presence of septa and pathology within the maxillary sinus using cone-beam computed tomography (CBCT) cross sections. The null hypothesis was that there is no association between age, sex and dentition status in the anatomy and prevalence of PSAA.

MATERIAL AND METHODS

Sample and Study Design

This retrospective study was performed with the approval of the Necmettin Erbakan University Faculty of Dentistry Research Ethics Committee (decision no: 2017/12). Furthermore, the analysis was performed according to the stipulations laid out by the Declaration of Helsinki. The CBCT records were retrieved from the Department of Oral and Maxillofacial Radiology of the Faculty of Dentistry at Necmettin Erbakan University. Two hundred patients with a mean age of 37.03±18.58 years were included in the study. Of the 200 patients aged between 10 and 83 years, who underwent CBCT examination for diagnostic reasons between 2013 and 2017, 112 were females and 88 were males. Patients that were excluded demonstrated trauma or tumors/diseases which influenced the boundary of the maxillary sinus, had previous mentions of sinus surgery and bone grafting in the region. The CBCT scans were acquired using a 3D Accuitomo 170® machine (Morita, Kyoto, Japan).

The patients were divided into dentate, partially dentate, and edentulous groups. Partially edentulous patients were defined as an individual missing any hemi-maxillary tooth, with the exemption of the third molar.[1] All of the CBCT images were analyzed for the following criteria:

-Diameter of the PSAA

-Distance between the PSAA and the floor of the maxillary sinus (Figure 1, a).

-Distance between the lower border of the PSAA and the alveolar crest (Figure 1, b).

-Bone height measured from the floor of the sinus to the crest of the alveolar ridge (Figure 1, c).

-Distance between the lateral wall of the PSAA and the medial wall of the maxillary sinus (Figure 1, d).

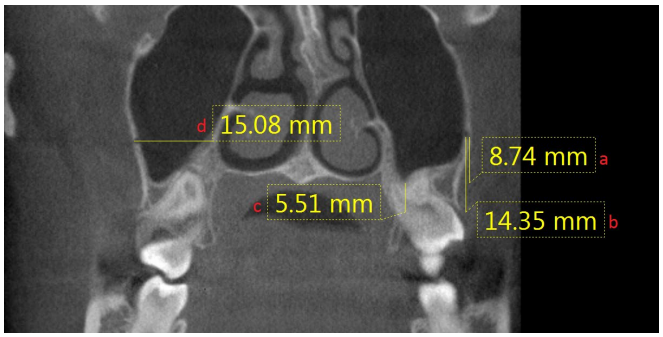

Figure 1

Scheme of CBCT evaluation. (a) Distance between PSAA and the floor of the maxillary sinus. (b) Distance between the lower border of PSAA and the alveolar crest. (c) Bone height measured from the floor of the maxillary sinus to the crest of the ridge (d) Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus.

-Types of PSAA (intrasinus, intraosseous, superficial)[3,6,7,9,12] (Figure 2, a, b, c).

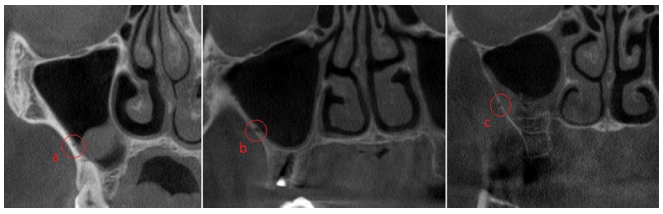

Figure 2

Types of PSAA [(intrasinus (a), intraosseos (b), superficial (c), respectively)]

-Presence of septa (Figure 3).

-Presence of pathology in the maxillary sinus including thickening of the membrane, chronic sinusitis, and pseudocysts (Figure 3).

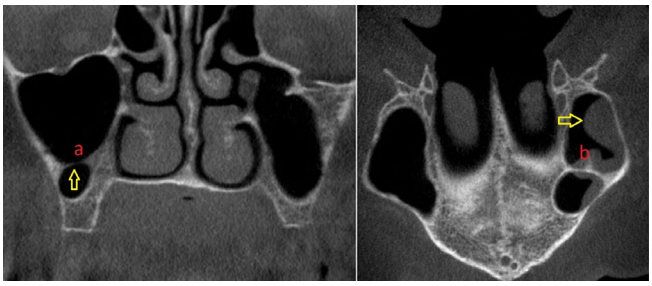

Figure 3

Maxillary sinus septa (a, yellow arrow) on coronal and pseudocyst (b, yellow arrow) on axial CBCT cross-sections.

The measurements were performed in the first molar region on coronal CBCT cross-sections.15 The aforementioned parameters were assessed in relation to age, sex, and dentition status by the same observer, two times within a two-week interval.

Statistical analysis

All the statistical analysis was performed using SPSS software (ver. 21; SPSS, Inc., Chicago, IL, USA). The data were tested for normality using the Shapiro-Wilk test. Mean and standard deviation values were calculated. The deviation of normality was analyzed using the Wilcoxon, Mann-Whitney U test and the Kruskal-Wallis H test. Spearman's rho correlation coefficient was used to determine the correla¬tion between age and the diameter of the artery. Intra-examiner reliability was tested with Intra-class correlation coefficient (ICC) and the Kappa Cohen test. Statistical significance was assumed for $p < 0.05$.

RESULTS

A total of 400 maxillary sinuses from 200 patients were assessed. The measurements were repeated and showed good intra-examiner unity. The ICC values of five measurements were 0.82, 0.84, 0.88, 0.91 and 0.94, respectively. Kappa values PSAA type, and presence of septa and pathology were 88%, 94% and 96, respectively.

The PSAA was detected on 86.5% (173/200) of the right and 84.5% (169/200) on the left maxillary sinuses. Minimum and maximum diameters of the PSAA were 0.16 mm and 2.18 mm. Mean values of all the parameters analyzed are given in Table 1.

Table 1.

Mean values of all studied parameters

Measured parameters	Right side (mm)	Left side (mm)	P values
Diameter of PSAA	0.90±0.39	0.89±0.38	0.689
Distance between PSAA and the floor of the maxillary sinus	9.25±3.74	8.83±3.79	0.172
Distance between the lower border of PSAA and the alveolar crest	17.80±3.59	17.83±3.61	0.712
Bone height measured from the floor of the maxillary sinus to the crest of the ridge	10.12±3.47	10.05±3.70	0.557
Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus	14.35±2.45	14.54±2.67	0.144

**The significance level is p<0.05.*

The measurements between the right and left side did not show any statistically significant differences.

The 112 females had a mean age of 38.47±17.97 (range, 10-83) years, while the 88 males were of 35.18±19.26 (range, 10-81) years. Age was found to be positively correlated with the distance between the PSAA and the alveolar crest ($r=0.2$, $p=0.001$ for the right, $r=0.1$, $p=0.022$ for the left) and the distance between the PSAA and the floor of the maxillary sinus ($r=0.3$, $p=0.000$ for right and left). These distances showed an increase within the 40-49 age group and a decrease in the older groups. However, age was negatively correlated with the distance between the floor of the maxillary sinus and the alveolar crest ($r=-0.1$, $p=0.023$ on right, $r=-0.2$, $p=0.000$ on left) (Table 2).

Table 2.

All studied parameters according to age groups

Measured parameters (mm)	Diameter of PSAA (Right)	Distance between PSAA and the floor of the maxillary sinus (Right)	Distance between the lower border of PSAA and the alveolar crest (Right)	Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Right)	Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Right)	Diameter of PSAA (Left)	Distance between PSAA and the floor of the maxillary sinus (Left)	Distance between the lower border of PSAA and the alveolar crest (Left)	Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Left)	Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Left)
10-19 years (n=68)	0.91±0.37	7.38±3.42	16.43±3.14	11.07±3.06	14.80±2.40	0.84±0.36	6.56±3.13	16.37±3.23	11.29±3.22	14.23±3.25
20-29 years (n=16)	0.76±0.41	8.61±3.08	17.15±3.80	10.43±3.39	13.54±2.86	0.96±0.34	9.48±2.00	18.76±2.65	10.01±2.95	15.36±1.66
30-39 years (n=16)	0.92±0.39	10.49±5.04	18.15±4.11	9.86±3.22	14.70±2.64	0.95±0.52	10.83±4.76	19.50±3.49	9.95±3.92	15.55±3.56
40-49 years (n=39)	0.85±0.35	11.21±3.67	19.31±3.69	9.60±3.61	14.35±2.50	0.88±0.33	10.30±4.13	19.10±3.74	9.84±3.43	14.92±2.06
50-59 years (n=33)	0.86±0.48	9.53±2.94	18.18±3.34	9.42±3.26	14.35±2.30	0.81±0.45	9.66±3.09	18.01±2.89	9.00±3.48	14.07±2.26
≥60 years (n=28)	1.03±0.37	9.90±3.08	18.39±3.47	9.59±4.26	13.61±2.25	1.04±0.34	9.36±3.20	17.67±4.41	8.91±4.82	14.28±2.09
P values	0.146	0.000**	0.006*	0.292	0.312	0.254	0.000**	0.002**	0.017*	0.215

*The significance level is p<0.05. ** The significance level is p<0.01

There were statistically significant differences between the correlation of the diameter of the PSAA (right and left), distance between the lower border of the PSAA and the alveolar crest (right) measurements between the male and female groups (p<0.01, p=0.004, respectively) (Table 3).

Table 3.

Mean values of all studied parameters according to gender

Measured parameters	Males (mm)	Females (mm)	P values
Diameter of PSAA (Right)	1.02±0.39	0.80±0.37	0.001**
Distance between PSAA and the floor of the maxillary sinus (Right)	9.79±4.24	8.82±3.25	0.270
Distance between the lower border of PSAA and the alveolar crest (Right)	18.65±3.69	17.13±3.38	0.004*
Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Right)	10.36±3.58	9.92±3.38	0.432
Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Right)	14.74±2.57	14.05±2.31	0.052
Diameter of PSAA (Left)	0.98±0.40	0.82±0.36	0.015*
Distance between PSAA and the floor of the maxillary sinus (Left)	9.13±4.00	8.60±3.63	0.443
Distance between the lower border of PSAA and the alveolar crest (Left)	18.28±3.59	17.49±3.61	0.124
Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Left)	10.49±3.77	9.72±3.63	0.113
Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Left)	14.89±2.90	14.28±2.47	0.157

*The significance level is p<0.05. ** The significance level is p<0.01

Males showed greater values regarding these parameters. There was no correlation between age and the size of the PSAA (r=0.09, p=0.213 on right side, r=0.08, p=0.294 on left side).

The hemi-maxillary dentition status of the right side consisted of 130 dentate, 41 partially dentate and 29 edentulous while the left side consisted of 132 dentate, 42 partially dentate and 26 edentulous. All the studied parameters are given in Table 4 in accordance to dentition status.

Table 4.

Mean values of all studied parameters according to dentition status

Measured parameters	Dentate (mm)	Partially dentate (mm)	Edentulous (mm)	P values
Diameter of PSAA (Right)	0.90±0.41	0.89±0.34	0.89±0.42	0.827
Distance between PSAA and the floor of the maxillary sinus (Right)	8.58±3.85	10.10±3.19	10.74±3.37	0.003**
Distance between the lower border of PSAA and the alveolar crest (Right)	17.29±3.47	18.61±3.77	18.72±3.57	0.042*
Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Right)	10.69±3.32	9.65±3.15	8.45±3.91	0.005**
Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Right)	14.57±2.45	13.60±2.59	14.51±2.08	0.056
Diameter of PSAA (Left)	0.87±0.39	0.96±0.35	0.87±0.39	0.202
Distance between PSAA and the floor of the maxillary sinus (Left)	8.32±3.95	9.78±3.73	9.52±2.81	0.023*
Distance between the lower border of PSAA and the alveolar crest (Left)	17.60±3.61	18.62±3.79	17.63±3.31	0.717
Bone height measured from the floor of the maxillary sinus to the crest of the ridge (Left)	10.54±3.56	9.62±3.85	8.66±3.74	0.011*
Distance from the lateral wall of PSAA to the medial wall of the maxillary sinus (Left)	14.71±2.86	14.01±2.31	14.60±2.33	0.409

*The significance level is p<0.05. ** The significance level is p<0.01

The most common type of PSAA was intraosseous on both sides (50% for the right and 51.5% for the left). The distribution of the types of PSAA are shown in Table 5. No correlation between sex and the type of PSAA was found ($p>0.05$). Likewise, no relationship was found between the diameter and types of PSAA.

Table 5.

The distribution of the types of PSAA according to gender

Gender	Type of PSAA (Right)				Total	P values
	Absent	Intrasinus	Superficial	Intraosseos		
Females	15 (13%)	40 (35%)	3 (2%)	54 (50%)	112 (56%)	$X^2=0.859$ $p=0.835$
Males	12 (13%)	29 (32%)	1 (1%)	46 (54%)	88 (44%)	
Total	27 (13.5%)	69 (34.5%)	4 (2%)	100 (50%)	200 (100%)	
Type of PSAA (Left)						
Females	15 (13%)	37 (33%)	0 (0%)	60 (54%)	112 (56%)	$X^2=3.572$ $p=0.312$
Males	16 (18%)	27 (30%)	2 (2%)	43 (50%)	88 (44%)	
Total	31 (16%)	64 (32%)	2 (1%)	103 (51%)	200 (100%)	

**The significance level is $p<0.05$.*

Of the 400 maxillary sinuses, 82 (20.5%) showed septa variation. A statistically significant connection was found between septa and the presence of maxillary sinus pathology on the right side ($p<0.01$, $p=0.006$, respectively) side (Table 6). The presence of septa and pathology was not attributed to sex ($p>0.05$).

Table 6.

The distribution of maxillary sinus septa and pathology

	Absence of Septa (right)	Presence of Septa (right)	Total	P values
Presence of sinus pathology (right)	38 (66%)	19 (34%)	57 (28.5%)	$X^2=8.056$ $p=0.006$*
Absence of sinus pathology (right)	121 (85%)	22 (15%)	143 (71.5%)	
Total	159 (79.5%)	41 (20.5%)	200 (100%)	
	Absence of Septa (left)	Presence of Septa (left)		
Presence of sinus pathology (left)	33 (74%)	12 (26%)	45 (22.5 %)	$X^2=1.355$ $p=0.294$
Absence of sinus pathology (left)	126 (81%)	29 (19%)	155 (77.5%)	
Total	159 (79.5%)	41 (20.5%)	200 (100%)	

Significance level is $p<0.01$.

DISCUSSION

The null hypothesis of this study was there is no association between age, sex, and dentition status regarding the anatomy and prevalence of the PSAA. This hypothesis was rejected which was confirmed by the results of this study which showed that the position of the PSAA varied with age, in conjunction with previous studies.[3] The diameter of the PSAA was not correlated with age, similar to the findings of Guncu et al.[9] and Danesh-Sani et al.[10] The mean diameter of the PSAA was over 1 mm in individuals over 60 years of age, which was explained with two perspectives. The first being PSAA is easier to detect in the osteoporotic bones of the elderly.[16] The other view stating a higher blood flow is required to ensure proper function with aging. It has been suggested that PSAA with a diameter smaller than 1 mm does not carry the risk of prolonged bleeding[17] and therefore, it can be said that individuals over the age of 60 are at a risk of prolonged hemorrhage.

Prevalence of PSAA was reported within a wide range of 36.5%18 and 100%,[19-21] and by other studies in the literature which reported different findings[19-21,23,24] (Table 7).

Table 7.

PSAA studies in the literature.

Author	Type of study	Population	Number of patients (Number of maxillary sinus)	Prevalence (%)
Solar et al.[19]	Cadaveric	Austrian	18 (18)	100
Hur et al.[23]	Cadaveric	Korean	42 (42)	100
Rosano et al.[24]	Cadaveric	French	15 (30)	100
Sato et al.[20]	Cadaveric	Japanese	19 (34)	100
Kqiku et al.[21]	Cadaveric	Croatian	10 (20)	100
Yang and Kye[18]	CT	Korean	283 (566)	36.5
Elian et al.[32]	CT	American	50 (100)	52.9
Mardinger et al.[26]	CT	Israeli	104 (208)	55
Guncu et al.[9]	CT	Turkish	121 (242)	64.5
Jung et al.[33]	CBCT	Korean	250 (250)	52.8
Ilguy et al.[7]	CBCT	Turkish	135 (116)	75.9
Kang et al.[25]	CBCT	Korean	150 (150)	90
Anamali et al.[8]	CBCT	American	254 (254)	94.4
Present study	CBCT	Turkish	200 (400)	86.5 (right side) 84.5 (left side)

The variability in these findings could be attributed to the use of different methodology[3,6,7,12] and variance between sample sizes[6]. Some studies were conducted with radiological imaging such as CT and CBCT, while others obtained their results through cadaveric analysis, which provides precise measurements because of direct observation.[22] CBCT cross-sectional analysis was used in this study as the supply of cadavers are very limited.

CBCT provides accurate and reliable linear measurements for maxillofacial imaging, with a lower exposure to radiation in comparison to CT.[3] CBCT studies reported a higher prevalence of PSAA (52.8% 14 to 94.4% 8) when compared to CT studies (36.5% 18 to 64.5% 9). The detection rate of the PSAA less than 1 mm in diameter is higher in CBCT studies[18,25]

in comparison to CT studies,[27] which can be attributed to a higher spatial resolution in CBCT technology.[27] The identification of fine structures such as PSAA is related to the spatial resolution of the imaging method,[4] which is defined as the capability of an imaging system to resolve fine details.[27] However, there is no study in the literature evaluating the diagnostic value of CT and CBCT in the detection of the PSAA, and additional comparative studies are needed.

If the PSAA runs adjacent to the maxilla rather than within it, detection through radiological techniques becomes increasingly difficult.[4] As a result, the absence of the PSAA in a CBCT scan does not exclude the complication of a hemorrhage episode.[15] In this study, the PSAA was detected in 86.5% of right and 84.5% of the left sinuses, which is in conjunction to the results of Ilguy et al.[7](89.3% left and right), Tehranchi et al.[6] (87% of patients) and Velasco-Torres et al.1 (83% of right and 86% of the left sinuses).

It is essential for the surgeon to identify the vascular structure accurately before an operation. The arterial supply of the maxillary sinus is delivered by the PSAA and IOA. In a cadaveric study by Traxler et al.[28] intraosseous anastomosis between these two arteries were observed in all their cases while extraosseous anastomosis was detected in 44% of their sample size. If the lateral approach is preferred for sinus lifting, knowledge of the location of the PSAA becomes indispensable.[4] The use of CT is discouraged in this situation because of its relatively unreliable detection of the PSAA in many patients.[14] The assessments made in this study were performed in the first molar region on coronal CBCT cross-sections, since this region was reported to be the most common site for sinus lifting and dental implant placement.[29]

All of the parameters measured (diameter of PSAA, bone height, and distance) showed a greater value in males than in females, which can be attributed to larger skeletal features within the male anatomy.[3] Since the maxillary sinus volumes are larger in men, the location of the arteries may differ according to sex. No correlation was found between sex and the presence of PSAA, which is consistent with previous studies.[3,7] The mean distance between the PSAA and the alveolar was found to be 18.65±3.69 mm in males and 17.13±3.38 mm in females. In another Turkish population study, similar results were obtained (18±4.9 mm),[9] whereas a Spanish study1 reported lower results (13.40±3.72 mm). Genetic variance and racial differences could have an impact on PSAA measurements.30 Slightly greater values were found in anatomical studies[19,28] (18.9-19.6 mm).

PSAA injury during a surgical operation does not lead to life-threatening hemorrhage, rather makes visualization and insertion of biomaterials difficult, increases the chance of membrane rupture and pioneers the formation of hematoma.[15] The results of this study indicated that clinicians could possibly avoid bleeding complications for the lateral approach of sinus lifting in the presence of PSAA, by taking into consideration the distance of the PSAA from the alveolar crest (17.80±3.59 mm on the right and 17.83±3.61 on the left), and make vertical incisions with respect to these measurements (Table 1). On the other hand, hemostasis is difficult to maintain because of the intraosseous nature.[15] In accordance with Guncu et al.[9] the mean diameter of the PSAA was found to be greater in males than in females, therefore males have a greater risk of hemorrhage during operations.[15] Mardinger et al.,[26] however, did not find a difference between either sex.

According to its position, the PSAA was divided into 3 separate categories: (1) intraosseous, (2) intrasinus (or sub membranous), and (3) superficial (or over the outer cortex of the lateral sinus wall) (Figure 2). In the maxillary tuberosity level, the PSAA can run entirely as intraosseous or show variation. The course of this artery and its variation can be in accordance to where the artery is first and last seen.[5] In this study, the intraosseous type of PSAA continued as intraosseous throughout the path of the artery 100% of the time. Intrasinus and superficial types demonstrated variance in their pathways, from the second premolar and the second molar points, and were classified according to their coronal CBCT images at the first molar level. Consistent with the results of Ilguy et al.,[7] Chitsazi et al.[12] and Guncu et al.,[9] intraosseous was the most common type of PSAA in this study (50% on the right and 51.5% on the left). However, intrasinus was the most common type of PSAA in Khojastehpour et al.[3] which may be attributed to genetic and racial differences.

Of the 400 maxillary sinuses, 25% showed pathology, and 20% showed presence of septa, similar to the results of Guncu et al.[9] (24.8% pathology) and Chitsazi et al.[12] (26% septa)(Table 6). Sinus septas may increase the difficulty of lifting procedures, therefore clinicians should take the presence of septas into consideration while planning surgical operations.[2,23]

Parallel to the results of Velasco-Torres et al.,[1] the results of this study showed that dentition status influenced the location of PSAA. Edentulous and partially dentate patients showed lower distances between the PSAA and maxillary sinus compared to dentate individuals. The distance between the maxillary sinus and the floor of the alveolar crest decreases with the loss of teeth, which was expected because of previous studies.[1] This result was also consistent with Hayek et al.[34] which showed a significant difference between dentate and edentulous individuals regarding distance measurements. The authors attributed this result to the progressive atrophy of the alveolar bone.

CONCLUSIONS

CBCT cross sectional analysis showed the prevalence of PSAA to be high (86.5% on the right and 84.5% on the left side). The mean diameter of the PSAA was over 1 mm in individuals over the age of 60, which demands great care and precautionary measurements during their operations. Tooth loss causes vertical collapse and reduction in the distance between the PSAA, which increases complications during sinus lifting procedures. Careful examination of the PSAA on available CBCT images can help prevent potential vascular damage around the maxillary sinus and membrane perforation.

Acknowledgemens : None.

Funding : None.

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