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Investigation of the relationship of the maxillary sinus floor with maxillary posterior teeth using cone beam CT

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Background: *Any intervention to the maxillary posterior teeth (MPT) and alveola pose a risk of sinus perforation. Given the proximity of these structures, this study aimed to investigate the relationship between the maxillary sinus (MS) and MPT.*
Materials and methods: *CBCT images obtained from 207 patients (mean age, 45 ± ± 17 years; age range: 18–92 years) including 99 females and 108 males were examined retrospectively. Patients with sinus pathologies affecting the structure of MS and a history of oral and maxillofacial surgery were excluded from the study. On these images, the relationship of maxillary sinus floor (MSF) with 2 premolars and 3 molars was examined bilaterally for each patient using Kwak et al.'s classification. The presence, number, frequency and location of septa within the MSF were investigated.*
Results: *Examination of a total of 410 maxillary sinuses on the images of 207 patients with no sinus perforation or pathology revealed that septa were most commonly (48.7%) located in the middle segment (second molars). When the relationship between the MSF and MPT was evaluated, molar teeth were found to have a closer relationship with the MSF than premolars.*
Conclusions: *It is believed that the findings of this study may provide further guidance to the dental practitioners and other clinicians for future studies.* (Folia Morphol 2024; 83, 4: 858–867)

Keywords: maxillary sinus, maxillary sinus septa, maxillary posterior teeth, cone beam computed tomography, morphometry

INTRODUCTION

Because of its implications for surgical procedures, it is important for clinicians to be aware of the exact relationship between the apical roots of the maxillary teeth and maxillary sinus floor [3, 5, 12, 18, 21]. The relationship of the inferior wall of the sinus with the root apices of maxillary teeth varies according to the sinus topography, the age of the individual, the size of the maxillary sinus and its extent of pneumatization and tooth retention [7]. The roots of the first and second molars (teeth numbered 2, 3, 14 and 15 according to the international numbering system) are most closely related to the inferior wall of the maxillary sinus and in some individuals, maxillary canine roots penetrate the sinus [7, 21]. A periodontal or periapical infection of the upper premolar and molar teeth may

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extend into the maxillary sinus. The close anatomical proximity of the root apices of the maxillary posterior teeth (MPT) to the maxillary sinus floor (MSF) may lead to the development of inflammatory, infectious and/or traumatic changes in the maxillary sinus [1, 7, 8, 27]. Sinus perforations and ultimately, oroantral fistula formation may occur during tooth and/or root extraction, endodontic root canal treatment, periapical surgery and dental implant placement. In addition to the relationship between the maxillary sinus and the maxillary posterior teeth, the topography and variations of the maxillary sinus are also important for surgical procedures. Currently, maxillary sinus augmentation surgery is a procedure that is extensively used during implant placement [11, 21, 23]. The presence of maxillary septa may lead to membrane perforation, and therefore, anatomical factors such as the location and presence of the maxillary septa, the thickness and angles of the maxillary sinus walls and the thickness of the Schneiderian membrane should be carefully identified and examined on three-dimensional radiographic images [10, 23].

In general, the reported prevalence of septa at the sinus level ranges from 16% to 48% [9, 19]. Many studies have been conducted in adult patients to examine the height, location, prevalence and morphology of the maxillary sinus septa using various medical imaging techniques including cone beam computed tomography (CBCT) [1, 17, 20]. Possible risks such as interfering maxillary sinus septa can be identified using the digital implant planning software coupled with CBCT. Such risks can be considered during implant planning and implant placement [1].

The primary aim of this study was to classify the relationship between maxillary sinus and maxillary posterior teeth on CBCT images using the classification described by Kwak et al. [12] and to correlate these classifications with individual factors of the patients. As a secondary aim, this study sought to determine the prevalence and location of sinus septa on CBCT scans and to examine the association of the septa with age, sex and tooth type of the patients.

MATERIALS AND METHODS

Cone beam computed tomography images obtained from 550 patients referred to the Department of Dentomaxillofacial Radiology at Gaziantep University Faculty of Dentistry for any reason between 2017 and 2020 were reviewed retrospectively. Image analysis and measurements were performed by a single assessor (2 years experienced in anatomy) under the supervision of a dentomaxillofacial radiologist (10 years experienced in dentomaxillofacial radiology). Patients over the age of 18 without any pathology affecting the maxillary sinus structure were included in the study. Excluded patients were those with maxillary sinus pathologies and a history of oral and maxillofacial surgery. For 207 patients included in the study, CBCT images (1 mm slice thickness, 0.4 mm^3 voxel) acquired with Planmeca ProMax 3D Mid (Planmeca Oy, Helsinki, Finland) were examined using the Romexis software (Planmeca Oy, Helsinki, Finland). Approval was obtained from the Ethics Committee for Clinical Trials of Gaziantep University prior to initiation of the study (No: 2021/74).

The relationship between maxillary sinus floor and maxillary posterior teeth was examined on the CBCT images according to Kwak et al.'s [12] classification. The parameters were analysed by a single investigator. One month later, a blinded examination by the same investigator was conducted for 10% of the patients who were randomly selected among the study population. No significant difference was observed between the first and second examinations and the p value was the same for all parameters tested ($p = 1.0$).

Vertical relationship of the maxillary sinus floor with the apex radicis dentis of the maxillary posterior teeth was classified as described by Kwak et al. [12] (Fig. 1).

The presence, number and location of septa within the maxillary sinus were examined in three regions: anterior (first molars or teeth numbered 3 and 14), middle (second molars or teeth numbered 2 and 15), posterior (third molars or teeth numbered 1 and 16) (Fig. 2).

Statistical analysis

Data from the study were analysed using SPSS software, version 25.0 (IBM Corp., Armonk, NY, USA). Whether the numerical data followed a normal distribution was checked using Shapiro-Wilk test. For normally distributed variables, student's t-test was used for comparisons between two groups and one-way ANOVA for comparisons among multiple groups. Correlations between numerical variables were tested using Pearson correlation coefficient. Chi-squared test was used to analyse associations between categorical variables. The relations of the premolar and molar teeth with the groups were analysed using chi-squared test. Fisher's exact test was employed when the number of cells in the contingency Table with an expected frequency less than 5 exceeded 20% of the

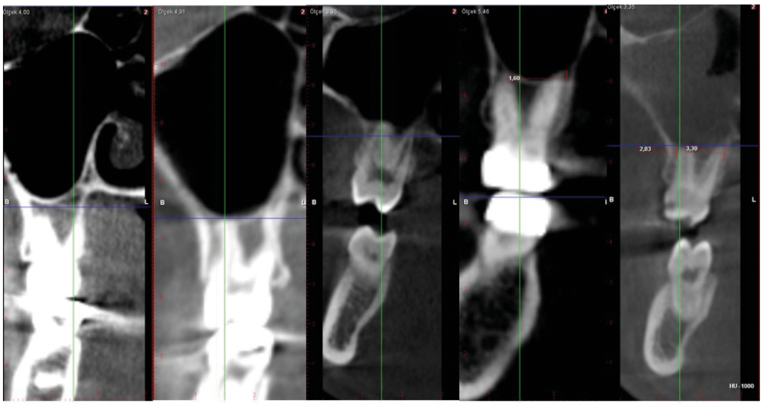

Figure 1. Vertical relationship of the maxillary sinus floor with the apex radicis dentis of the maxillary posterior teeth.

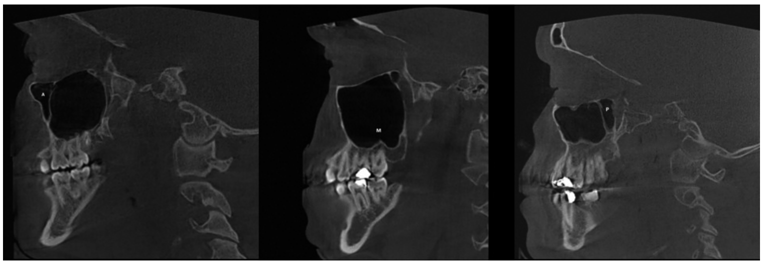

Figure 2. Locations of septa visualized on CBCT image in sagittal plane. **A.** Anterior; **B.** Middle; and **C.** Posterior.

Table 1. Prevalence of tooth types in maxillary posterior teeth.

Teeth	N	Tooth type, n [%]							
		Type I	Type II	Type III	Type IV	Type V	H I	H II	H III
1st Premolar	274	261 (95.3)	12 (4.4)	–	–	1 (0.4)	–	–	–
2nd Premolar	249	197 (79.1)	36 (14.5)	–	–	15 (6)	–	–	1 (0.4)
1st Molar	239	96 (40.2)	86 (36.0)	9 (3.8)	15 (6.3)	32 (13.4)	–	–	1 (0.4)
2nd Molar	239	54 (22.6)	91 (38.1)	7 (2.9)	13 (5.4)	63 (26.4)	5 (2.1)	3 (1.3)	3 (1.3)
3rd Molar	148	31 (21.1)	46 (31.3)	3 (2.0)	1 (0.7)	31 (21.1)	14 (9.5)	17 (11.6)	4 (2.7)

total number of cells in the Table. A p value less than 0.05 was considered statistically significant.

RESULTS

In this study, CBCT images of 207 individuals (age range, 18 to 92 years) were examined. Of these individuals, 99 were female (mean age: 44.70 ± 17.38 years) and 108 were male (mean age: 46.59 ± 16.95 years). There was no significant age and sex difference among the subjects ($p = 0.428$). The subjects were divided into three age groups: young (18–40 years, 41.2%), middle-aged (41–65 years, 45.6%) and elderly (66 years and older, 13.2%). Based on the presence of maxillary teeth, the subjects were divided into 3 groups: fully dentate (20.1%), partially dentate (61.8%) and edentulous (18.1%).

To determine the relationship between the maxillary sinus floor and maxillary posterior teeth, a total of 274 first premolars (teeth numbered 5 and 12), 249 second premolars (teeth numbered 4 and 13), 239 first molars (teeth numbered 3 and 14), 239 second molars (teeth numbered 2 and 15) and 148 third molars (teeth numbered 1 and 16) in 414 maxillae of 207 subjects were examined. The most common tooth type was Type I, with a prevalence of 95.3% in the first premolars, 79.1% in the second premolars and 40.2% in the first molars. 40.2% of the second molars were Type II and 31.3% of the third molars were Type III (Tab. 1).

Table 2. Distribution of tooth types by age, sex and location — premolar teeth.

Teeth		**1[st] premolar**								**2[nd] premolar**							
Groups		**Age n [%]**			**Sex n [%]**		**Right/left n [%]**		**Total n [%]**	**Age n [%]**			**Sex n [%]**		**Right/left n [%]**		**Total n [%]**
		Y	**MA**	**E**	**F**	**M**	**Right**	**Left**		**Y**	**MA**	**E**	**F**	**M**	**Right**	**Left**	
N		**168**	**190**	**56**	**198**	**216**	**207**	**207**	**414**	**168**	**190**	**56**	**198**	**216**	**207**	**207**	**414**
Tooth types, n [%]	None	8 (4.8)	84 (44.2)	47 (83.9)	59 (29.8)	80 (37.0)	70 (33.8)	69 (33.3)	139 (33.7)	11 (6.5)	102 (53.7)	50 (89.3)	71 (35.9)	92 (42.6)	81 (39.1)	82 (39.6)	163 (39.4)
	Type I	150 (89.3)	105 (55.3)	9 (16.1)	132 (66.7)	132 (61.1)	131 (63.3)	133 (64.3)	263 (63.7)	112 (66.7)	80 (42.1)	6 (10.7)	93 (47.0)	105 (48.6)	102 (49.3)	96 (46.4)	198 (47.8)
	Type II	9 (5.4)	1 (0.5)	–	7 (3.5)	3 (1.4)	5 (2.4)	5 (2.4)	10 (2.4)	31 (18.5)	6 (3.2)	–	24 (12.1)	13 (6)	15 (7.2)	22 (10.6)	37 (8.9)
	Type III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Type IV	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Type V	1 (0.6)	–	–	–	–	1 (0.5)	–	1 (0.2)	14 (8.3)	1 (0.5)	–	10 (5.1)	5 (2.3)	8 (3.9)	7 (3.4)	15 (3.6)
	H I	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	H II	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	H III	–	–	–	–	–	–	–	–	–	1 (0.5)	–	–	1 (0.5)	1 (0.5)	–	1 (0.2)
p			0.00*		0.45			0.00*			0.00*		0.072			0.00*	

For all teeth, a significant association was observed between tooth type and age groups (p = = 0.000). A lower frequency of edentulism was found in the young age group, with the most common tooth types (both premolars and molars) being Type I and Type II. In contrast, a higher percentage of edentulism and a higher prevalence of Type I teeth were found in the elderly group (Tab. 2 and 3). There were only 1 subject each with Type II and Type V molar teeth in the elderly group. For the second molars, the tooth type was significantly associated with sex (p = 0.04). However, no such association was found for other teeth (Tab. 3). The tooth types of right and left maxillary posterior teeth were correlated with each other (Tab. 2, 3).

Examination of the maxillary sinus floor in the sagittal plane revealed septa in 132 (63.5%) of 207 (81 ♀, 96 ♂) subjects. A total of 410 sinuses (n = 206 on the right side and n = 204 on the left side) were examined on the images from 207 subjects and septa were detected in 46.8% of the sinuses (Tab. 4, Fig. 3).

Among the subjects with septa, 53.8% had unilateral and 46.2% had bilateral septa. The presence of septa was not significantly associated with sex (p = 0.756). No significant association was found between the age groups (young, middle-aged, elderly) and the presence of septa (p = 0.058). There was a significant difference among the fully dentate, partially dentate and edentulous subjects in terms of the presence of septa (Tab. 5). The partially dentate group showed the highest prevalence of septa (p = 0.041) (Tab. 5).

In the presence of a single septa in the maxillary sinus, 48.4% of the septa were localized in the middle region, 25% in the posterior region and 11.5% in the anterior region. In the subjects with multiple septa, septa were mostly localized anteriorly and medially (Tab. 6).

In the subjects with bilateral septa, the locations of septa in the right and left maxillary sinuses were not correlated. The majority of septa were located in the middle region in both sides (Tab. 7).

DISCUSSION

With respect to the relationship between the maxillary sinus floor and maxillary posterior teeth, sinus pathologies need to be considered when planning a suitable dental implantation, endodontic procedures and periapical surgical interventions [3, 7, 8, 12]. In the current study, the results were partially consistent among the tooth types classified as described by Kwak et al. [12]. Using measurements, Kwak et al. [12] reported that maxillary molar teeth

Table 3. Distribution of tooth types by age, sex and location — molar teeth.

Teeth	Groups		N	Tooth Types, n [%]									p
				None	Type I	Type II	Type III	Type IV	Type V	H I	H II	H III	
1st molar	Age	Y	168	16 (9.5)	52 (31.0)	53 (31.5)	7 (4.2)	12 (7.1)	28 (16.7)	–	–	–	**0.00***
		MA	190	107 (56.3)	40 (21.1)	33 (17.4)	2 (1.1)	3 (1.6)	4 (2.1)	–	–	1 (0.5)	
		E	56	50 (89.3)	6 (10.7)	–	–	–	–	–	–	–	
	Sex	F	198	75 (37.9)	47 (23.7)	44 (22.2)	3 (1.5)	8 (4.0)	21 (10.6)	–	–	–	0.262
		M	216	98 (45.4)	51 (23.6)	42 (19.4)	6 (2.8)	7 (3.2)	11 (5.1)	–	–	1 (0.5)	
	Right/ /left	RIGHT	207	83 (40.1)	53 (25.5)	46 (22.2)	3 (1.4)	8 (3.9)	14 (6.8)	–	–	–	**0.00***
		LEFT	207	90 (43.5)	45 (21.7)	40 (19.3)	6 (2.9)	7 (3.4)	18 (8.7)	–	–	1 (0.5)	
	Total	414	173 (41.8)	98 (23.7)	86 (20.8)	9 (2.2)	15 (3.6)	32 (7.7)	–	–	1 (0.2)		
2nd molar	Age	Y	168	15 (8.9)	20 (11.9)	67 (39.9)	5 (3.0)	10 (6.0)	44 (26.2)	4 (2.4)	3 (1.8)	–	**0.00***
		MA	190	110 (57.9)	29 (15.3)	25 (13.2)	1 (0.5)	3 (1.6)	19 (10.0)	1 (0.5)	–	2 (1.1)	
		E	56	48 (85.7)	5 (8.9)	1 (1.8)	–	–	–	–	–	1 (1.8)	
	Sex	F	198	69 (34.8)	29 (14.6)	51 (25.8)	2 (1.0)	7 (3.5)	39 (19.7)	–	–	1 (0.5)	**0.04***
		M	216	104 (48.1)	25 (11.6)	42 (19.4)	5 (2.3)	6 (2.8)	24 (11.1)	5 (2.3)	3 (1.4)	2 (0.9)	
	Right/ /left	RIGHT	207	89 (43)	24 (11.6)	43 (20.8)	4 (1.9)	12 (5.8)	30 (14.5)	1 (0.5)	3 (1.4)	1 (0.5)	**0.00***
		LEFT	207	84 (40.6)	30 (14.5)	50 (24.2)	3 (1.4)	1 (0.5)	33 (15.9)	4 (1.9)	–	2 (1.0)	
	Total	414	173 (41.8)	54 (13)	93 (22.5)	7 (1.7)	13 (3.1)	63 (15.2)	5 (5.2)	3 (0.7)	3 (0.7)		
3rd molar	Age	Y	168	52 (31.0)	20 (11.9)	37 (22.0)	3 (1.8)	1 (0.6)	24 (14.3)	13 (7.7)	17 (10.1)	1 (0.6)	**0.00***
		M	190	158 (83.2)	12 (6.3)	9 (4.7)	–	–	7 (3.7)	1 (0.5)	–	3 (1.6)	
		E	56	56 (100)	–	–	–	–	–	–	–	–	
	Sex	F	198	120 (60.6)	15 (7.6)	26 (13.1)	2 (1.0)	1 (0.5)	22 (11.1)	6 (3.0)	4 (2.0)	2 (1.0)	0.069
		M	216	146 (67.6)	17 (7.9)	20 (9.3)	1 (0.5)	–	9 (4.2)	8 (3.7)	13 (6)	2 (0.9)	
	Right/ /left	RIGHT	207	130 (62.8)	18 (8.7)	22 (10.6)	1 (0.5)	1 (0.5)	20 (9.7)	4 (1.9)	10 (4.8)	1 (0.5)	**0.00***
		LEFT	207	136 (65.7)	14 (6.8)	24 (11.6)	2 (1.0)	–	11 (5.3)	10 (4.8)	7 (3.4)	3 (1.4)	
	Total		414	266 (64.3)	32 (7.7)	46 (11.1)	3 (0.7)	1 (0.2)	32 (7.5)	14 (3.4)	17 (4.1)	(1.0)	

Table 4. The distribution of maxillary sinus septa.

Prevalence of septa	Number of sinuses	Number of septa n [%]			
		0	1	2	3
Right	206	112 (54.4)	75 (36.4)	16 (7.8)	3 (1.5)
Left	204	106 (52)	87 (42.6)	10 (4.9)	1 (0.5)
Total	410	218 (53.2)	162 (39.5)	26 (6.3)	4 (1.0)

are closer to the sinus floor than the premolar teeth. Likewise, in the present study, the percentage of tooth types closer the sinus floor was higher in molars than in premolars.

In a study by Razumova et al. [18] Type I was the most common tooth type observed in the first and second premolars and Type II was most prevalent in molar teeth. In our study, Type I was the most common tooth type in first and second premolars and first molar and Type II was most commonly observed in the second and third molars. Our results seem to be fairly consistent with the aforementioned findings. Discrepancy between the results may be explained by the difference in the populations studied.

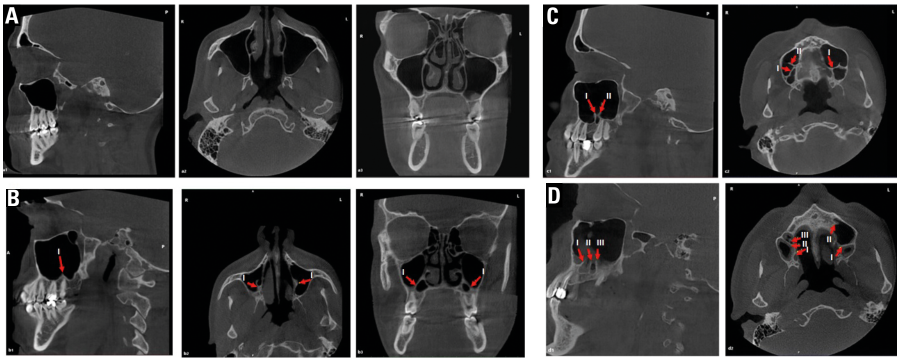

Figure 3. Number of septa detected in the maxillary sinus; **A.** None; **B.** One septa; **C.** Two septa; **D.** Three septa.

Table 5. The prevalence of septa in the maxillary sinus floor by age, sex and tooth presence.

Septa		Tooth presence n [%]			Sex n [%]		Age groups n [%]			Total n [%]
		FD	PD	E	F	M	Y	MA	E	
None		16 (39.0)	37 (29.4)	19 (51.4)	36 (36.4)	36 (34.3)	26 (31.0)	31 (33.3)	15 (55.6)	72 (35.3)
Present	Unilateral	12 (29.3)	50 (39.7)	10 (27.0)	37 (37.4)	35 (33.3)	36 (42.9)	29 (31.2)	7 (25.9)	72 (35.3)
	Bilateral	13 (31.7)	39 (31.0)	8 (21.6)	26 (26.3)	34 (32.4)	22 (26.2)	33 (35.5)	5 (18.5)	60 (29.4)
Total (n)		41 (20.1)	126 (61.8)	37 (18.1)	99 (48.5)	105 (51.5)	84 (41.2)	93 (45.6)	27 (13.2)	204
P			0.041*		0.756			0.058		

*Statistically significant difference ($p < 0.005$). E — elderly; FD — fully dentate; MA — middle–aged; PD — partially dentate; Y — young.

Table 6. Location of septa in subjects with single or multiple septa.

Location of septa		n [%]
Single septa	Middle	93 (48.4)
	Posterior	48 (25.0)
	Anterior	22 (11.5)
Multiple septa	Anterior and middle	12 (6.3)
	Anterior and posterior	8 (4.2)
	Middle and posterior	6 (3.1)
	Anterior, middle and posterior	3 (1.6)

Table 7. Comparison of right- and left-sided septa in subjects with bilateral septa.

	LEFT								
RIGHT	Location	A	M	P	A, M	A, P	M, P	A, M, P	Total
	A	1	2	0	0	0	0	0	3
	M	0	19	6	0	0	1	0	26
	P	1	9	4	1	2	0	0	17
	A, M	0	2	1	2	0	0	0	5
	A, P	0	1	1	1	0	0	1	4
	M, P	0	2	0	0	1	0	0	3
	A, M, P	1	1	0	0	0	0	0	2

A — anterior; M — middle; P — posterior.

Estrela et al. [3] found that the most common tooth type in premolars was Type II, whereas it was Type I as reported by Kwak et al. [12] and Kılıç et al. [8]. Consistently, Type I was the most common type in premolars in our study. In a study by Estrela et al. [3], Type HII was found to be the most frequent type in the teeth with horizontal relationship. Also, Type HI was most commonly observed in the second molars in that study [3]. Type HIII was detected in the second premolar in only one subject and horizontal relationship was generally observed in the molars in this study. In line with Estrela et al.'s [3] findings. Type HII horizontal relationship was the most common tooth type in the current study. Additionally, Type HI was most common among second molars and Type HII was most common among third molars. Type HIII was identified in the first molar in only one subject.

In the literature, there are also studies [5, 14] examining the relationship between the maxillary sinus floor and maxillary posterior teeth using the classification proposed by Jung et al. [7]. Minimal methodological differences exist between the Jung et al.'s [7] study and Kwak et al.'s [12] study. In Jung's [7] classification, Type II is considered when both roots of the tooth project into the maxillary sinus floor (MSF), whereas Kwak et al. [12] classify the tooth as Type III if there is an apical protrusion into the MSF at the buccal root apex and as Type IV if there is an apical protrusion of the palatal root apex into the MSF.

In their study, Jung et al. [7] examined first and second molars in a Korean population and reported that Type 0 (no contact of the roots with the maxillary sinus floor) was most commonly detected, followed by Type 3 (the roots project into the maxillary sinus). In the current study, Type I (no contact with MSF) and Type II (the roots contact with MSF) were most commonly observed in the first molars and second molars, respectively.

In a study by Fry et al. [5] examining maxillary posterior teeth in an Indian adolescent population (15 to 17 years of age) using Jung's [7] classification, Type 0 (no contact of tooth roots with MSF) was commonly observed in first and second premolars, whereas Type 1 (close contact of the roots with maxillary sinus) was found in first and second molars.

Underwood's septa, which were described by Underwood AS in 1910, pose a risk of perforation and bleeding during dental implant treatments [27]. In addition, sinus membrane perforation occurring during the surgery may cause problems such as the spread of inflammation to the sinus due to disruption of the barrier between the maxillary sinus and teeth or extension of a maxillary sinus infection to the teeth [25, 2, 6, 9]. Due to its clinical relevance, the presence of septa in the maxillary sinus floor has been widely investigated in many studies [1, 25, 4, 6, 9–11, 15, 17, 19, 20, 22–24]. In these studies, maxillary sinus septa were examined using imaging modalities including computed tomography (CT) [4, 9–11, 15, 22], CBCT [1, 2, 6, 16, 17, 20, 22, 23, 25] as well as in cadavers [26]. The current study examined the presence and location of septa using the CBCT method. A summary of the findings previous studies in comparison to the present study is provided in Table 8. In a study involving a population with comparable characteristics, Orhan et al. [17] identified septa in 58% of the maxillary sinuses they examined, of which 69.1% were located in the middle segment, 18.6% in the posterior segment and 12.2% in the anterior segment. In line with their findings, the prevalence of maxillary sinus septa was 46.7% in the current study, and 48.4% of the septa were located in the middle segment, 25% in the posterior segment and 11.5% in the anterior segment. In another study by Toraman-Alkurt et al. [25], which was also conducted in a similar population, it was reported that sinus septa were mostly located in the middle region (74.2%) as assessed by CBCT in comparison to the anterior region (32.3%) as assessed by panoramic radiography (PR). The authors concluded that CBCT is the correct imaging modality for examination of maxillary sinus septa. With regard to the location of septa, while there are some reports that corroborate our results [1, 2, 4, 9, 15, 17, 19, 24, 25], differential findings were reported by others [2, 11, 24]. For example, Taleghani et al. [24] reported that the prevalence of septa was highest (52.6%) in the anterior segment as opposed to the posterior region (55.4%) as demonstrated by Dragan et al. [2]. Previously, Krennmair et al. [11] have also reported that septa were most commonly located in the anterior segment of the maxilla. However, it should be noted that, septa were found to be mostly located in the middle region in many studies, which is consistent with our findings [1, 2, 4, 9, 15, 17, 19, 22, 25]. In the present study, the prevalence of septa was not significantly associated with age and sex of the individuals. While the data from many studies are in line with our finding [1, 6, 23]. Taleghani et al. [24] reported that the prevalence of septa decreases with increasing age. In the same study, no relationship was found between the prevalence of septa and the type of edentulism (full or partial).

A number of studies have reported a significantly high prevalence of septa in edentulous patients [4, 6, 9, 11]. Contrastingly, other studies found no association between the presence of teeth and the prevalence of septa [1, 15, 24]. Compared to other groups, higher prevalence rates of septa were found in the fully dentate group by Toraman-Alkurt et al. [25] and in the partially dentate group by Koymen et al. [10]. Orhan et al. [17] reported they observed a higher prevalence of septa in the partially dentate group than in the edentulous group. In the present study, the partially dentate group showed a higher prevalence of septa compared to the fully dentate and edentulous groups.

In conclusion, in this study, the presence of septa in the maxillary sinus was investigated because of its association with an increased risk of complications during surgical treatment of maxillary posterior teeth, and septa were found in 46.8% of the sinuses examined. Septa were mostly located in the middle segment, followed by posterior and anterior segments.

Table 8. Comparison of studies on maxillary sinus septa.

Authors	Year of publication	IM	SPI, n [%]	SPS, n [%]	PS, n [%]	U/B n [%]					Septa location, n [%]								
						0	1	2	3	4	U	B	A	M	P	A, M	A, P	M, P	A, M, P
Jung K. et al. [14]	2006	CT	100	38	(26.5)	147 (73)	48 (24)	4 (2)	1 (0.5)	–	–	–	15 (25)	30 (51)	14 (24)	–	–	–	–
Faramarzi M. et al. [24]	2009	CT	66	–	46 (35)	–	–	–	–	–	–	–	12 (31)	21 (54)	6 (15)	–	–	–	–
Rosano G. et al. [17]	2010	Cadaver	30	12 (40)	20 (33)	–	–	–	–	–	4 (33)	8 (67)	6 (30)	8 (40)	6 (30)	–	–	–	–
Ferrin L. M. et al. [25]	2011	CT–PR	30	24 (80)	40 (67)	–	–	–	–	–	13 (54)	11 (46)	7 (17)	24 (60)	9 (23)	–	–	–	–
Shen E.C. et al. [26]	2011	CT	423	124 (29)	173 (20)	678 (80)	153 (18)	15 (1)	1 (0.1)	–	75 (61)	49 (39)	31 (16)	105 (54)	53 (27)	3 (2)	2 (1)	–	–
Orhan K. et al. [18]	2013	CBCT	272	228 (84)	316 (58)	–	–	–	–	–	148 (47)	168 (53)	45 (12)	254 (69)	70 (19)	–	–	–	–
Sakhdari S. et al. [19]	2016	CBCT	473	212 (45)	297 (31)	649 (69)	223 (24)	72 (8)	2 (0.2)	–	136 (64)	76 (36)	–	–	–	–	–	–	–
Bornstein M. M. et al. [9]	2016	CBCT	212	141 (66)	166 (56)	128 (44)	98 (59)	53 (32)	13 (8)	2 (1)	59 (42)	82 (58)	21.4	60.7	17.9	–	–	–	–
Tadinada A. et al. [10]	2016	CBCT	36	–	43 (60)	29 (40)	20 (28)	17 (23)	5 (7)	1 (1)	–	–	–	–	–	–	–	–	–
Taleghani F. et al. [27]	2017	CBCT	300	–	44	–	–	–	–	–	–	–	52.6	34.8	32.6	–	–	–	–
Hüngerbühler A. et al. [22]	2019	CBCT	301	117 (39)	163 (27)	439 (73)	142 (23)	17 (2.8)	4 (0.7)	–	–	–	–	–	–	–	–	–	–
Değerli Ş. et al. [23]	2016	CBCT	52	20	31 (29.8)	–	–	–	–	–	–	–	6.5	74.2	19.3	–	–	–	
Current study	2021	CBCT	207	132 (63.5)	192 (46.8)	218 (53.2)	162 (39.5)	26 (6.3)	4 (1)	–	53.8	46.2	22 (11.5)	93 (48.4)	48 (25)	12 (6.3)	8 (4.2)	6 (3.1)	3 (1.6)

CT — computed tomography; CBCT — cone beam computed tomography; IM — imaging modality; N — number of subjects; PR — panoramic radiography; PS — presence of septa; SPI — septa prevalence by individual; SPS — septa prevalence by sinus; U/B — unilateral/bilateral.

When the relationship between MSF and MPT was evaluated, it was seen that molars had a closer relationship with MSF than premolars. It is believed that this study provides further insight into the anatomical relationship between the maxillary sinus floor and maxillary posterior teeth, which can aid clinicians in decision making prior to endodontic treatment procedures and during preoperative treatment planning. It is hoped these findings will contribute to literature and provide guidance to dental practitioners and other researchers for future studies.

Limitations

Cone beam computed tomography images acquired from individuals (18 to 92 years of age) residing in Gaziantep and neighbouring cities were examined. The anatomical relationship between the maxillary sinus floor and maxillary posterior teeth may differ in other populations and therefore, the data from this study cannot be extrapolated to the general population. Further studies in the Turkish and other populations involving a large number of images are warranted.

ARTICLE INFORMATION AND DECLARATIONS

Data availability statement

Data are available at the authors by request.

Ethics statement

Approval was obtained from the Ethics Committee for Clinical Trials of Gaziantep University prior to initiation of the study (No: 2021/74). All procedures followed were in accordance with the ethical standards of responsible committee on human experimentation (institutional and national) with the Helsinki Declaration of 1975, as revised in 2008.

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Conflict of interest

The authors declare no conflict of interest.

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