



RESEARCH ARTICLE

MAXILLARY SINUS SEPTA: PREVALENCE AND ASSOCIATION WITH GENDER AND LOCATION IN THE MAXILLA AMONG ADULTS IN SANA'A CITY, YEMEN

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Abstract



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Background and aims: Maxillary sinus septa are partitions of cortical bone dividing the sinus into multiple compartments. Their presence and dimension are of relevance to periodontitis, oral and maxillofacial surgeons as well as otolaryngologists. The aim of this study was to determine the prevalence and association of maxillary sinus septum with gender and location in maxilla among adults in Sana'a city, Yemen.

Methods: This is a retrospective study carried out on 633 patient orthopantomograms (OPGs) which had visible maxillary sinus without pathological or developmental changes from the first of March 2021 to the end of February 2022 at the Department of Oral and Maxillo-Facial Surgery, Faculty of Dentistry, Sana'a University and private clinics in Sana'a city. Bivariate analysis was performed to test for association between the dependent variables (maxillary sinus septum presence, presentation and position) and independent variables (gender and location).

Results: The mean age of the patients was 29.59 years, range from 16 -56 years, and females 380 (60.0%). Of 259 (40.9%) maxillary sinus septum identified, 206 (79.5 %) were from females. Majority 180 (69.5%) were unilateral, while 79 (30.5%) were bilateral. Occurrence of unilateral maxillary sinus septum was higher in males 104 (41.1%) with OR=2.8, 95% CI=1.9-3.98, $p<0.0001$; than females (20%), while bilateral septum occurs roughly in equal rates in both gender (11.86 VS 12.89%).

Conclusions: This study has shown a significant proportion of maxillary sinus septum among patients with visible orthopantomogram without pathology in Sana'a, Yemen, with the highest proportion being females. There is therefore the need for the occurrence and presentation of maxillary sinus septum in this study to serve as a baseline data in the treatment of dental implant and surgical procedures in Sana'a, Yemen.

Keywords: Maxillary sinus; prevalence; septa; variation, Yemen.

INTRODUCTION

Previously, the maxillary septum was considered a normal contrast with little clinical significance. But nowadays, the importance of the maxillary septum has become clear after the popularity of maxillary sinus

augmentation procedures for dental implants. The mechanism controlling septal development is not known to be clear, although a role for irregular sinus floor pneumatization after tooth extraction has been suggested. Determining the location and structure of the sinus septum is essential for sinus surgeries and

especially sinus augmentation in implant surgery¹. The maxillary sinus septum is the septum of the cortical bone that divides the floor of the maxillary sinuses into multiple compartments, which are known as recesses². The role of the septum is to separate the sinuses into two or more antras, as well as to strengthen the bone structure of the sinuses¹. It is known that the presence and dimensions of the maxillary septum are of practical relevance to periodontists, oral and maxillofacial surgeons, as well as ENT specialists³. The existence of the maxillary sinus septum has been revealed to be a risk factor for sinus membrane perforation during external lifting procedures of the maxillary sinus⁴. Disappointingly, there is inadequate data on the prevalence and pattern of the maxillary sinus septum and its relationship to maxillary sinusitis. Regarding implant placement, septa that appear in the floor of the sinuses or along the side wall can interfere with their placement either directly by being in the area of their placement or indirectly by impeding wall height during the side sinus approach⁵. Structurally, the maxillary sinus septum has been described as inverted gothic arches originating from the inferior and lateral walls of the sinuses and reaching a sharp edge along their apical edges; they can divide the sinuses into two or more parts⁶. Vinter *et al.*, note that the resorption of the maxillary alveolar process takes place irregularly in different areas leaving bony apex on the floor of the sinusoids⁷. Krennmair *et al.*, classifies the congenital and acquired septum into primary septum, which can develop in all regions of the maxillary sinuses, arising during maxillary development, and secondary septa, which arise from irregular pneumatization of the sinus floor following tooth loss⁸. However, the exact mechanism responsible for maxillary septum development is still unclear, although a role for the irregular pneumatization of the sinus floor following tooth loss has been suggested⁵. The prevalence of multiple septa in the maxillary sinus varies from 7% to 58% in the literature⁷. However, possible differences between ethnic groups may contribute to these differences⁹.

In Yemen, epidemiological or curative studies devoted to research in dental sciences are still limited and none of these studies dealt with the prevalence of maxillary sinus septa in sample of Yemeni population¹⁰⁻⁰, and for this reason it is necessary to strengthen, update, build and continue to bear the costs of studies on topics of interest to oral and dental surgery with a plan to achieve a better effect to the public and health, with the dissemination of appropriate knowledge with a plan to enhance the success of surgical procedures and reduce the potential subsequent consequences of the failure of these treatments. Therefore, this study will provide an insight on the prevalence of maxillary sinus septa in sample of Yemeni population.

MATERIALS AND METHODS

This is a retrospective study carried out in the Department of Oral and Maxillo-Facial Surgery, Faculty of Dentistry, Sana'a University clinics after

ethical approval from the institution. The study was carried out for a period of 12 months.

Sample size calculation: The sample size of 634 was estimated assuming an expected prevalence of maxillary sinus septum of 34.18% from a previous study in Yemen³¹, margin of error 3.69 with a confidence level of 95% using the Epi Info 7.2 calculator (CDC, Atlanta, USA), but 633 it is the number that was collected and its data analyzed, and this difference would not affect the results of the study.

Study population:

Inclusion criteria: This includes all the patients orthopantomograms acquired from Proline XC modal (Planmeca Co., Helsinki, Finland) taken as part of treatment planning or oral diagnosis, that had full set of teeth with clear and visible maxillary sinuses, from the first of March 2021 to the end of February 2022.

Data collection: The orthopantomograms were examined by an oral and maxillofacial radiologist (to obtain more accurate results) to reveal the maxillary sinus septum. Presence or absence of maxillary sinus septum, presentation, position, and location were retrieved then register with patient age and sex data using a questionnaire that was kept until the results were analyzed.

Exclusion criteria: Orthopantomogram with poor quality, lacking sufficient contrast, distorted image and clarity with evidence of previous sinus intervention and pathological or developmental changes in the maxillary sinuses were excluded from the study (they were excluded because it is difficult to reveal the maxillary sinus septum).

Statistical analysis: Data were analyzed with Epi Info 7.2 (CDC, Atlanta, USA). The continuous variable (age) was summarized with mean and standard deviation while the categorical variables (maxillary sinus septum presence, presentation, position, location, and patients age group and gender) were summarized with frequency and percentages and display as tables. Bivariate analysis was performed to test for association between the independent variables (gender and location) and dependent variables (maxillary sinus septum presence, presentation and position). A p -value<0.05 was considered statistically significant.

Ethical Consideration: Ethical approval for this study, No: 371 dated January 21, 2021 was obtained from the Medical Ethics and Research Committee of the Faculty of Medicine and Health Sciences, Sana'a University. All procedures were according to the ethical guidelines of the review committee.

RESULTS

The study included 253 (39.96%) males and 380 (60.04%) females. Most of the participants were in the age group 26-35 years (40.6%), followed by 16-25 years (37.3%) and 36-45 years (19.3%), while only 2.8% were in the age group >45 years. The mean age of the patients was 29.59 years, and range from 16-56 years. The current rate of the maxillary septum was 40.9% (Table 1). Considered the septa presentation, the rate of bilateral septum was 52.96%, while the rate of the unilateral septum was 54.2%. Looking at septa

position, the rate of right septum was 57.64%, while the rate for the left septum was 42.35%.

Table 1: Characteristics of patients.

Characteristics	n (%)
Age group (years)	Mean age =29.59 years Range =16-56 years
16-25	236 (37.3)
26-35	257 (40.6)
36-45	122 (19.3)
> 45	18 (2.8)
Total	633 (100)
Gender	
Male	253 (39.96)
Female	380 (60.04)
Maxillary septum	
Present	259 (40.9)
Absent	374(59.1)

Considering the septa location, most of the septa location was anterior (42.94%), followed by the middle location (37.05%), while the posterior septal location was only 20% (Table 2). There was no significant association of the presence of the maxillary septum with gender with OR=0.95, 95% CI=0.69-1.3, $p=0.75$.

Table 3: Association of maxillary sinus septum presence with gender and location.

Characteristics	Maxillary sinus septum	Bivariate analysis	
	n (%)	OR (95% CI)	p
Gender			
Male n=253	134 (52.96)	0.95 (0.69-1.3)	0.75
Female n=380	206 (54.21) Reference		
Location			
Anterior n=633	146 (42.94)	3.05 (2.34-3.99)	<0.0001
Middle n=633	126 (37.05)	2.1 (1.6-2.7)	<0.0001
Posterior n=633	68 (20)	0.67 (0.5-0.9)	0.009

Considering the association of maxillary sinus septum bilateral presentation with gender and location, there was no significant association of the bilateral presence of the maxillary septum with gender with OR=0.9, 95% CI=0.55-1.4, $p=0.69$. While there was a significant association of the presence of the bilateral maxillary septum with the anterior location with OR=3.2, 95% CI=2.1-4.9, $p<0.0001$. Also, there was a

Table 4: Association of maxillary sinus septum bilateral presentation with gender and location.

Characteristics	Septum presentation	Bivariate analysis	
	Bilateral n (%)	OR (95% CI)	p
Gender			
Male n=253	30 (11.86)	0.9 (0.55-1.4)	0.69
Female n=380	49 (12.89) Reference		
Location			
Anterior n=146	56 (38.35)	3.2 (2.1-4.9)	<0.0001
Middle n=126	43 (34.12)	2.4 (1.5-3.6)	<0.0001
Posterior n=68	35 (51.47)	4.99 (2.96-8.4)	<0.0001
Total n=633	134 (21.16)		

Considering the association of maxillary sinus septum unilateral presentation with gender and location, there was significant association of the unilateral presence of the maxillary septum with male gender with ratio=41.1%, OR=2.8, 95% CI=1.9-3.98, $p<0.0001$.

There was a significant association of the presence of the maxillary septum with the anterior site with OR=3.05 95% CI=2.34 - 3.99, $p<0.0001$. Also, there was a significant association between the presence of the maxillary septum with the middle site with OR=2.1, 95% CI=1.6-2.7, $p<0.0001$.

Table 2: Presentation, position and location of maxillary sinus septum (n=633).

Septum presence	n (%)
Septum presentation	259 (40.9)
Bilateral	134 (52.96)
Unilateral	206 (54.2)
Septum position	
Right	196 (57.64)
Left	144 (42.35)
Septum location	
Anterior	146 (42.94)
Middle	126 (37.05)
Posterior	68 (20)

However, there was no association between the presence of the maxillary sinus septum with posterior location with OR=0.67, 95% CI=0.5-0.9, $p=0.009$ (Table 3).

significant association between the presence of the bilateral maxillary septum with the middle location with OR=2.4, 95% CI=1.5-3.6, $p<0.0001$. Also, there was a significant association between the presence of the bilateral maxillary septum with the posterior location with OR=4.99, 95% CI=2.96-8.4, $p<0.0001$ (Table 4).

There was a significant association of the presence of the unilateral maxillary septum with the anterior location with OR=4.9, 95% CI=3.4-7.2, $p<0.0001$.

Also, there was a significant association between the presence of the unilateral maxillary septum with the

middle location with OR=4.3, 95% CI=2.8-6.5, $p<0.0001$. Also, there was a significant association between the presence of the unilateral maxillary septum with the posterior location with OR=2.2, 95% CI=1.3-3.6, $p=0.002$ (Table 5). Considering the

association of maxillary sinus septum right position with gender and location, there was no significant association of the right presence of the maxillary septum with gender with, OR=1.38, 95% CI=0.98-1.9, $p=0.06$.

Table 5: Association of maxillary sinus septum unilateral presentation with gender and location.

Characteristics	Septum presentation Unilateral n (%)	Bivariate analysis	
		OR (95%CI)	<i>p</i>
Gender			
Male n=253	104 (41.1)	2.8 (1.9- 3.98)	<0.0001
Female n=380	76 (20)		
Location			
Anterior n=146	81 (55.47)	4.9 (3.4- 7.2)	<0.0001
Middle n=126	69 (54.76)	4.3 (2.8- 6.5)	<0.0001
Posterior n=68	30 (44.12)	2.2 (1.3- 3.6)	0.002
Total n=633	180 (28.43)		

There was a significant association of the presence of the right maxillary septum with the anterior location with OR=4.9, 95% CI=3.3-7.2, $p<0.0001$. Also, there was a significant association between the presence of the right maxillary septum with the middle location

with OR=3.8, 95% CI=2.5-5.7, $p<0.0001$. Also, there was a significant association between the presence of the right maxillary septum with the posterior location with OR=2.8, 95% CI=1.95-3.98, $p<0.0001$ (Table 6).

Table 6: Association of maxillary sinus septum right position with gender and location.

Characteristics	Septum position Right n (%)	Bivariate analysis	
		OR (95%CI)	<i>p</i>
Gender			
Male n=253	89 (35.18)	1.38 (0.98- 1.9)	0.06
Female n=380	107 (28.16)		
Location			
Anterior n=146	86 (58.9)	4.9 (3.3- 7.2)	<0.0001
Middle n=126	70 (55.56)	3.8 (2.5- 5.7)	<0.0001
Posterior n=68	40 (58.82)	2.8 (1.95- 3.98)	<0.0001
Total n=633	196 (30.96)		

Considering the association of maxillary sinus septum left position with gender and location, there was significant association of the left position of the maxillary septum with male gender with ratio= 28.1% (vs 19.1% of female), OR=1.6, 95% CI=1.1-2.3, $p=0.009$. There was a significant association of the presence of the left maxillary septum with the anterior

location with OR=3.3, 95% CI=2.2- 5, $p<0.0001$. Also, there was a significant association between the right maxillary septum with the middle location with OR=3.99, 95% CI=2.6- 6.1, $p<0.0001$. Also, there was a significant association between the presence of the right maxillary septum with the posterior location with OR=2.5, 95% CI=1.4-4.3, $p=0.004$ (Table 7).

Table 7: Association of maxillary sinus septum left position with gender and location.

Characteristics	Septum position Left n (%)	Bivariate analysis	
		OR (95%CI)	<i>p</i>
Gender			
Male n=253	71 (28.1)	1.6 (1.1- 2.3)	0.009
Female n=380	73 (19.21)		
Location			
Anterior n=146	60 (41.1)	3.3 (2.2- 5)	<0.0001
Middle n=126	57 (45.2)	3.99 (2.6- 6.1)	<0.0001
Posterior n=68	27 (39.71)	2.5 (1.4- 4.3)	0.004
Total n=633	144 (22.75)		

DISCUSSION

The present study observed the maxillary sinus septum on panoramic radiographs. This method is the most common diagnostic method used in preoperative evaluation of the paranasal sinuses, and it is affordable³². The incidence of the maxillary septum at the current study was 40.3% by subjects (Table 2);

numbers roughly parallel to those reported among the Jordan population by Samara *et al.*,³³ where the prevalence of maxillary sinus septum was 42.3%³³. Zyl *et al.*,³⁴ however, they reported a higher prevalence of maxillary sinus septum where the prevalence of maxillary sinus septa was 69%, with a large number of these patients showing multiple septa³⁴. On the other hand, Yang *et al.*,³⁵ a very low prevalence of 9% of the

maxillary sinus septum was reported³⁵. This difference in prevalence can be justified by the dissimilar methods used in the different studies, or by differences between CT and panorama machines, as recent versions make visualization and identification of the upper septum much easier, and this is reflected as higher prevalence. The result of the current study showed no association between septal incidence and sex as septal prevalence was almost equal in both sexes (males=52.96% vs females=54.2%, with OR=0.95, 95% CI=0.69-1.3, $p=0.75$) (Table 3). These results were different from the observations reported by Shen *et al.*,⁹ Al-Zahrani *et al.*,³⁶ Orhan *et al.*,³⁷; the male septal rate was higher than that of female patients. Obtained results also differ from those reported by Park *et al.*,¹ and Malik *et al.*,³⁸ where the septum rate is higher in females than in males^{1,38}. The average maximum bite force in males is observed to be significantly higher than in females, which could explain the difference in septa prevalence based on sex in previous studies³⁹. Moreover, in the current study, there was significant association of the unilateral presence of the maxillary septum with male gender with ratio=41.1%, OR=2.8, 95% CI=1.9-3.98, $p<0.0001$ (Table 5). Similar observations have been reported in studies by Shen *et al.*,⁹ Al-Zahrani *et al.*,³⁶ and Orhan *et al.*,³⁷. However, a greater prevalence of females has been observed by Park *et al.*,¹ and Malec *et al.*,³⁸.

The right maxilla showed a greater spread of the septum compared to the left (64.44% vs 35.2%) (Table 2). Dandekeri *et al.*,⁵ and Kannaperuman *et al.*,⁴⁰ studies have also shown a greater presence of the septa on the right side than on the left side^{5,40}; While Park *et al.*,¹ note a greater prevalence of the left-sided septum although Park *et al.*, result's was not statistically significant¹. While Samara *et al.*,³³ reported that the occurrence and rate of the maxillary septum in the right and left sinuses are more often than not the same, which is about 8%³³; in fact this is also comparable to the results of Shen *et al.*, where the rate of the nasal septum on the right side was comparable to the left side⁹.

Septa are categorized under headlines such as septa morphology, orientation and location. When septa are estimated in terms of location, anterior septa be located between the first and second premolar locality (sinus anterior wall) and the mesial of the first molar. The septa of middle region are existent between the mesial of the first molar and the mesial of the second molar. Posterior septa are between the distal of the second molar and the posterior sinus wall⁴¹. The current study showed that the largest number of septa was located in the anterior region (42.94%) followed by the middle region (37.05%) and less frequently the posterior region (20%) (Table 2). Similar prevalence of the septum in the anterior region was revealed by Selcuk *et al.*,⁴² and Jang *et al.*,⁴³ studies in which the anterior septum is reported to be more prevalent than the middle and posterior region^{42,43}. However, current findings were different from those reported by Park *et al.*,¹; Shen *et al.*,⁹ and Orhan *et al.*,³⁷ in which septal prevalence in the middle region was the predominant

feature in both CBCT (cone beam tomography) panoramic radiography.

Due to the raise in sinus floor elevation measures by general practitioners, additional complications of sinus floor elevation are observed. This is may be due to deficient in formal training or insufficient training to perform this type of surgery and ignorance of sinus anatomy. This underscores the need for studies of the maxillary sinus for the different regions of the world. Schneiderian membrane perforation has been reported to be as high as 44% as reported by Cakur *et al.*,⁴⁴ and Schwartz-Arad *et al.*,⁴⁵. One of the possible causes of such a high perforation rate of the Schneiderian membrane during sinus floor elevation is the presence of septum⁴⁵. Presence of septa in the floor of the sinus or along the lateral wall, can interfere with the placement of an implant either directly by being present in its area of placement or indirectly by hindering the elevation of the wall during lateral sinus approach⁵.

Limitations

This research suffers from specific limitations ranging from common flaws (not all results and answers to all research questions were comparative and justified) due to the lack of previous comparable studies in Yemen. There were methodological problems such as one case missing from the study, and the participants were not representative of the population of Yemen, so it is recommended that further studies in a larger sample size be conducted in different regions in Yemen using CT technology.

CONCLUSIONS

This study has shown a significant proportion of maxillary sinus septum among patients with visible orthopantomogram without pathology in Sana'a, Yemen, with the highest proportion being females. The most common septum presentation was unilateral which appears typically among males. There is therefore the need for the occurrence and presentation of maxillary sinus septum in this study to serve as a baseline data in the treatment of dental implant and surgical procedures in Sana'a, Yemen.

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AUTHOR'S CONTRIBUTIONS

Alhadi YAA: supervision. **Al-Shamahi NYA:** examination of orthopedic images. **AL-Haddad KA:** methodology, conceptualization. **Al-Kholani AIM:** formal analysis, review. **Al-Najhi MMA:** critical review, supervision. **Al-Shamahy HA:** writing original draft, literature survey. **Al-labani MA:** data curation, investigation. All authors revised the article and approved the final version.

DATA AVAILABILITY

The data supporting the findings of this study are not currently available in a public repository but can be made available upon request to the corresponding author.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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