

Prevalence, Characteristics and Implications of Maxillary Sinus Septa: A Cross Sectional Study Using Cone Beam Computed Tomography (CBCT) in the Qassim Population

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Abstract

Maxillary sinus septa, crucial for surgical planning due to their impact on surgical outcomes, have gained attention for their prevalence and anatomical characteristics. Aim: This study aims to investigate the incidence, location, alignment, and classification of maxillary sinus septa in the Qassim population.

A retrospective study at Qassim University's College of Dentistry analysed CBCT images of 411 individuals (238 males, 173 females) to evaluate the maxillary sinus septa's type, location, orientation, and morphology.

The analysis showed no significant gender or age differences in the frequency of maxillary sinus septa. Most septa were primary (61.34% right, 64.66% left), located anteriorly (50.42% right, 53.45% left), with a mediolateral orientation (52.10% right, 56.90% left), and exhibited complete morphology (65.55% right, 62.93% left).

Gender and age do not significantly influence the occurrence of maxillary sinus septa. Primary septa are most common, predominantly located in the anterior region with a mediolateral orientation. These findings highlight the necessity for detailed radiographic analysis in surgical planning for maxillary sinus procedures.

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Introduction

A thorough understanding of the anatomical structures within the maxillary sinus is necessary in the domains of dentistry and maxillofacial surgery. The presence of thin bone walls known as maxillary sinus septa, which extend from the floor of the sinus, was first identified by Underwood in his research.¹ Furthermore, the irregular absorption of the maxillary alveolar process has a role in the development of osseous ridges on the floor of the sinus.² Krennmair completed a taxonomy of these ridges, whereby they were categorised as primary and secondary septa.³ The development of the primary septa is seen throughout the process of maxillary development, whereas the

formation of secondary septa is associated with abnormalities occurring in the sinus air space.

Research indicates considerable variability in the frequency of maxillary sinus septa, with reported rates ranging widely from 10% to 58% in the literature.⁴ The presence and characteristics of these septa have gained attention in the surgical community due to their impact on the safety and success of surgeries like dental implants, maxillary sinus floor elevation, and endoscopic sinus procedures.⁵ Their significance became apparent when complications emerged during endoscopic and maxillary sinus augmentation surgeries.

Precisely detecting the existence and positioning of maxillary sinus septa in preoperative radiographs is essential for effective planning and the careful selection of surgical techniques, thereby minimising the risk of complications.⁶ Panoramic imaging, commonly used in dentistry, may not always reveal septa due to its two-dimensional nature, necessitating examination of sagittal and axial planes; in contrast, CBCT offers high-resolution three-dimensional imaging, facilitating precise

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measurements of septal dimensions and angles, and has been found to be more accurate than panoramic radiography in detecting sinus Morphology.⁷ When evaluating the frequency of septa by the use of cone-beam computed tomography (CBCT) in contrast to traditional radiographic methods, some studies have observed discrepancies in panoramic radiographs, which have shown false-negative rates as high as 50%.⁸

The existing literature has highlighted the lack of comprehensive studies addressing the specific prevalence, location, orientation, and types of maxillary sinus septa within the Saudi Arabian population. The main objective of this research is to comprehensively investigate the occurrence, distribution, alignment, structure, and categorisation of maxillary sinus septa among the population of Qassim. By addressing this gap in knowledge, the study seeks to contribute valuable insights that can inform and improve the planning and execution of maxillofacial surgical procedures in this specific population, ultimately enhancing the safety and efficacy of such interventions.

Materials and methods

Study Design and Study setting

The present retrospective descriptive research was conducted in the Department of Oral and Maxillofacial Surgery, College of Dentistry, Qassim University, spanning the time frame from 2022 to 2023. The research protocol received approval from the Ethics Committee of Qassim University.

Study population

A comprehensive dataset comprising 411 patient reports, ranging in age from 20 to 80 years, was extracted from the CBCT archives. These individuals had sought services at the clinic for procedures such as dental implant placement and other surgeries throughout the period from 2022 to 2023.

Sample size

In order to ascertain the necessary sample size for this investigation, a mathematical equation including the confidence level (CI), margin of error (E), and predicted proportion (P) was used. Based on a confidence level of 95%, a margin of error of 5%, and an anticipated percentage of 50%, the algorithm produced an

estimated required sample size of roughly 411 individuals.

Inclusion and Exclusion criteria

Eligible participants for accurate assessment of maxillary sinus septa met the required technical quality standards. Inclusion criteria involved individuals with both right and left maxillary sinuses accessible for analysis. The study encompassed participants aged between 18 and 60 years, without gender restriction. The inclusion criteria for CBCT scans of the posterior maxilla necessitated the nonexistence of upper molars and premolars on at least one side, a minimum visibility of 2 cm above the sinus floor, and the nonexistence of any motion or scattering aberrations.

Exclusion criteria involved participants lacking accessible CBCT scans or scans that failed to meet the required technical quality standards for precise maxillary sinus septa assessment. Furthermore, participants whose CBCT scans inadequately represented both right and left maxillary sinuses and those with limited demographic information were also excluded from the study. Any images displaying alterations in sinus wall morphology due to trauma or pathological conditions were not considered for analysis.

Data collection

Digital images were captured using a CBCT unit, "Sirona Dental Systems GmbH, Bensheim, Hessen, Germany, used with Sidexis-XG software". The data collecting approach included the acquisition of several parameters pertaining to maxillary sinus septa, such as their type, position, orientation, and morphology. Additionally, demographic information such as the age and gender of the patients was also recorded. The data was recorded using Microsoft Excel, and statistical analysis was performed using SPSS version 21.

Statistical Analysis

Descriptive statistics summarised the data, including prevalence, locations, types, and orientations of maxillary sinus septa. Chi-square tests investigated associations between variables like the presence of septa and demographic factors, revealing any significant relationships or differences.

Results

The present study consisted of a total of 411 individuals, including 238 men and 173 females (Table 1). The primary objective of the research was to analyse the distribution patterns of maxillary sinus septa types and their respective locations. In the male population, the occurrence of absence of septa in both the right and left maxillary sinuses was found to be 57.93% and 57.86%, respectively. The frequency of primary septa was found to be 17.65% on the right side and 19.25% on the left side. In contrast, secondary septa were identified at a rate of 6.72% on the right side and 13.29% on the left side. Complex septa were seen in 3.78% of instances on the right side and 1.83% on the left side. Likewise, among the female population, the occurrence of absence of septa in the right and left maxillary sinuses was found to be 42.11% and 41.41%, respectively. The occurrence rate of the primary septa was found to be 16.18% on the right side and 18.50% on the left side. In contrast, secondary septa exhibited a prevalence of 6.36% on both the right and left sides. Complex septa were detected in 2.31% of instances on the right side and an equivalent percentage of 2.31% on the left side (Figure 1). The research findings indicate that there was no statistically significant difference in the occurrence of septa between males and females. The obtained p-values of 0.38 and 0.68 for the right and left sides, respectively, support this conclusion.

		No septa	Septa	Total	pvalue
Right	Sex	Male	173	65	0.38
		Female	119	54	
	Total	292	119	411	
Left	Sex	Male	169	69	0.68
		Female	126	47	
	Total	295	116	411	

Table 1. Comparison of Presence of Septa between Males and Females.

The comparison of the presence of maxillary sinus septa in different age groups (Table 2) did not provide statistically significant variations, as shown by p-values of 0.30 and 0.59 for the right and left sides, respectively. This suggests that the occurrence of maxillary sinus septa within the examined population may not be significantly influenced by age across various age groups.

Primary septa predominated on both the right (61.34%) and left (64.66%) sides, with

secondary (26.89% and 29.31%, respectively)(Figure 2) and complex septa (11.76% and 6.03%, respectively)(Figure 4) following suit. The anterior region housed the majority of the septa on both the right (50.42%) and left (53.45%) sides, with fewer instances in the middle and posterior regions (Figure 3). Mediolateral orientation was prevalent for most septa on the right (52.10%) and left (56.90%) sides, while anteroposterior orientation was also notable, with a small percentage demonstrating both orientations (Figure 4). Additionally, most septa exhibited complete morphology on both the right (65.55%) and left (62.93%) sides, although a substantial proportion displayed incomplete morphology (Table 3).

		No septa	Septa	Total	p value
Right	Age	<20	11	35	0.30
		20-40	161	73	
		40-60	82	25	
		60-80	25	9	
		80+	0	1	
	Total	292	119	411	
Left	Age	<20	12	35	0.59
		20-40	164	70	
		40-60	80	27	
		60-80	27	7	
		80+	1	0	
	Total	295	116	411	

Table 2. Comparison of Presence of Septa among different age groups.

		N	Percentage		
Right	Type	Primary	73	61.34	
		Secondary	32	26.89	
		Complex	14	11.76	
	Location	Anterior	60	50.42	
		Middle	42	35.29	
		Posterior	9	7.56	
		More than one location	8	6.72	
	Orientation	Anteroposterior	48	40.34	
		Mediolateral	62	52.10	
		Both	9	7.56	
	Morphology	Incomplete	41	34.45	
		Complete	78	65.55	
		Left	Type	Primary	75
	Secondary			34	29.31
Complex	7			6.03	
Location	Anterior		62	53.45	
	Middle		40	34.48	
	Posterior		10	8.62	
	More than one location		4	3.45	
Orientation	Anteroposterior		46	39.66	
	Mediolateral		66	56.90	
	Both		4	3.45	
Morphology	Incomplete	43	37.07		
	Complete	73	62.93		

Table 3. Location, orientation, morphology and type of maxillary sinus septa.

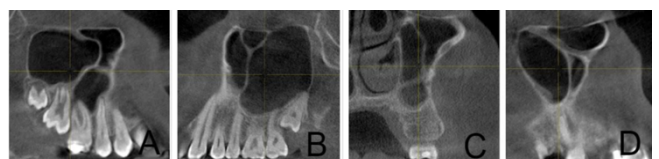


Figure 1. Illustrates different complex septa.



Figure 2. Illustrates single and multiple secondary septa. A,B Secondary septa, C. Multiple Secondary Septa.



Figure 3. Illustrates the three different locations of the septa.

A. Anterior Septa B. Middle Septa C. Posterior Septa.



Figure 4. Illustrates the two different orientations of the septa.

A. Anteroposterior B. Anteroposterior coronal section C. Mediolateral.

Discussion

The findings of this research provide important insights into the distribution and characteristics of maxillary sinus septa among the Qassim population. The study offers significant information on the occurrence and classifications of septa in the maxillary sinuses of the individuals included in the analysis. The prevalence of septa recorded in the present research, which was found to be 28.93%, is consistent with the data published by Abesi et al. In their investigation, they also discovered a similar incidence of 37.9% among 307 participants.⁹ The present research conducted a comparative analysis to determine the prevalence of septa among male and female participants. The results revealed no statistically significant difference, indicating a comparable distribution pattern between the two genders. However, a research done by Yahya et al. found that the prevalence of unilateral maxillary sinus septum was significantly larger in men (41.1%) compared to females (20%). The odds ratio (OR) was calculated to be 2.8, with a 95% confidence

interval (CI) of 1.9-3.98, and a p-value of less than 0.0001. The incidence of bilateral septum was seen to be almost equivalent in both genders, with rates of 11.86% and 12.89% for males and females, respectively.¹⁰ The current investigation found no statistically significant differences in the incidence of maxillary sinus septa across all age groups. These findings indicate that age may not have a substantial impact on the prevalence of maxillary sinus septa in the specific population under study. The data presented in this research are consistent with the results reported by Kocak et al., indicating that neither gender nor age had a significant influence on the incidence of septa.¹¹

The current investigation revealed a noteworthy incidence of the primary septa in the maxillary sinuses bilaterally, together with a substantial presence of secondary septa. This finding aligns with the findings of a research conducted by Al Zahrani et al., whereby a comparable prevalence of 52.9% for the primary septa and 47.9% for secondary septa was documented.¹² Both studies emphasise the importance of recognising the different types of septa and their implications for surgical procedures, supporting the need for careful planning and consideration during maxillofacial surgeries. These findings align with the observation that the majority of sinuses contained a single septum, corresponds with results from studies conducted by Zhang et al, Krennmair S et al, Koymen et al.^{13,14,15}

The significant occurrence of septa in the anterior region underscores the need of comprehensive preoperative imaging, particularly in this particular region, to guarantee the effectiveness and safety of surgical procedures. This conclusion is consistent with the results of a research conducted by Ferial et al., in which septa were detected in the posterior, middle, and anterior regions of the maxillary sinuses in 32.6%, 34.8%, and 52.6% of the instances, respectively.¹⁶ The study conducted by Krennmair et al., a lower incidence of complete septa in the maxillary sinus compared to the current study which reported an incidence of 0.5%. Additionally, the study highlights a higher prevalence of incomplete septa with a transverse orientation, contrasting with the arch-shaped and sagittal orientation of the septum observed in the present study.¹⁷

In comparison to Amani et al.'s findings, the current study results demonstrate a higher prevalence of complete septa (62.93%) relative to incomplete septa (37.07%) within the maxillary sinus. While Amani et al. emphasised the significant presence of incomplete septa during surgical planning, the current study results highlight a more balanced representation between complete and incomplete septa, suggesting potential variations in the prevalence of septal structures across different patient cohorts or populations.¹⁸ This discrepancy underscores the necessity of considering individual patient assessments and accounting for potential demographic and regional disparities in the planning and execution of surgical interventions.

While this study offers valuable insights into the prevalence and characteristics of maxillary sinus septa, it is essential to recognise certain limitations. Firstly, the concentration on a specific population may constrain the generalisability of the findings. Additionally, the cross-sectional design restricts the ability to establish causality, and relying on data from a single radiology center introduces the potential for selection bias. To overcome these limitations, future research endeavours could employ longitudinal designs and encompass larger and more diverse populations.¹⁹ Additionally, incorporating advanced imaging techniques and integrating clinical outcomes data would contribute to a deeper understanding of these anatomical variations in the context of surgical interventions.

Conclusions

The study revealed a high prevalence of maxillary sinus septa, with primary septa being the most common type observed. The anterior location housed the majority of these septa, predominantly with mediolateral orientation. Additionally, most septa displayed complete morphology, potentially posing challenges for surgical procedures. Age and gender did not significantly affect the occurrence of these septa within the studied population.

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Declaration of Interest

The authors report no conflict of interest.

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