

## Evaluation of maxillary sinus septal type and height in partially edentulous maxilla using spiral computed tomography

Farah A. Hadi, B.D.S., M.Sc. <sup>(1)</sup>

Areej A. Najm, B.D.S., M.Sc. <sup>(1)</sup>

Mohammed A. Kadhum, B.D.S., M.Sc. <sup>(1)</sup>

### ABSTRACT

**Background:** The presence of anatomic variations within the maxillary sinus such as septa has been reported to increase the risk of sinus membrane perforation during sinus elevation procedure for implant placement. This study aimed to measure the septal heights and correlate it with different types of septa.

**Material and methods:** Thirty patients (15 males and 15 females) with partially edentulous maxillae and mean age (35) years were enrolled in this study. Sixty sinuses scanned with Spiral multislice Computed Tomography, septal height measured after evaluation of septal type whether it was primary or secondary.

**Results:** The results showed that 72.5 % of the septa detected were primary and this is statistically significant when compared with the percentage of secondary type (27.5%). There was a statistically significant difference in the height of septa between the two types, and the primary septa were higher. There was no significant difference between septal type and sex.

**Conclusions:** A sound knowledge of maxillary sinus anatomy and anatomic variations such as septa is essential to prevent complication during surgical interventions involving this region.

**Key words:** Maxillary sinus septa, CT, septal height, septal type. (J Bagh Coll Dentistry 2014; 26(4):116-119).

**الخلاصة:** ظهور الاختلافات التشريحية داخل الجيوب الأنفية مثل الحاجز تتسبب في زيادة خطورة ثقب غشاء الجيب الأنفي خلال عملية زرع الأسنان. تهدف هذه الدراسة إلى قياس ارتفاع الحاجز داخل الجيوب الأنفية وربط ذلك المستوى مع الأنواع المختلفة للحواجز. **المواد والطريقة:** ثلاثون مريضاً (15 ذكور و 15 إناث) ذوي فك الرد جزئياً ومتوسط عمر 35 سنة خضعوا للدراسة، 60 جيب أنفي مسح وفحص باستخدام المقراس الحزوني. تم قياس ارتفاع الحاجز داخل الجيب الأنفي بعد تحديد نوع الحاجز إن كان أولي أو ثانوي. **النتائج:** 72,5 % من الحواجز التي وجدت كانت من النوع الأولي وكان الفرق ذو دلالة احصائية عند مقارنته مع نسبة النوع الثانوي 27,5 % . وجدت فروق ذات دلالة احصائية في ارتفاع الحاجز بين النوعين الأولي والثانوي حيث كان الارتفاع أكبر في النوع الأولي. لم يوجد فرق احصائي بين نوع الحاجز أو ارتفاعه بين الجنسين. **الاستنتاج:** المعرفة السليمة بتشريح الجيوب الأنفية والاختلافات التشريحية مثل حاجز الجيب الأنفي بعد امر ضروري لمنع المضاعفات أثناء التدخلات الجراحية في هذه المنطقة.

### INTRODUCTION

Dental implants have become very commonly used tools for the rehabilitation of partial and total lack of tooth. After the loss of molar and premolar teeth, a serious resorption affect the amount of vertical bone occurs with the increased-osteoclastic activity in Schneiderian membrane, at the maxillary posterior region <sup>(1)</sup>.

Maxillary sinuses (MS) are facial pyramidal cavities with thin walls corresponding to the orbital, alveolar, facial, and infratemporal aspects of the maxilla. The size, shape, and wall thickness of this anatomic structure vary from one individual to another <sup>(2,3)</sup>. Some maxillary sinuses present septa; the septa of the maxillary sinuses are bony crests inside the sinus <sup>(4)</sup>. They were first mentioned in a detailed description of maxillary sinus anatomy by Underwood in 1910 <sup>(5)</sup> as a consequence, are referred to as Underwood's septa. The etiology of maxillary septa has been hypothesized by several authors. Underwood <sup>(5)</sup> described septa as arising between areas of 2 adjacent teeth and located in 3 specific sections (anterior, middle, and posterior) of the sinus floor; these 3 sections correspond to 3 defined periods of tooth activity, which are separated from each other by intervals of time.

Neivert <sup>(6)</sup> proposed that septa were derived from the finger-like projections produced by the embryologic out-pouching of the ethmoid infundibulum. Moreover, Krenmair et al <sup>(7)</sup> classified septa into primary (which arise from the development of the maxilla) and secondary (which arise from irregular pneumatization of the maxillary sinus floor after tooth loss) and hypothesized that, as teeth are gradually lost, atrophy begins at different times in different regions. the same was stated by dakhli etal <sup>(8)</sup>, Etiologically, antral septa constitute congenital and acquired malformation. Congenital septa also referred to as "primary septa", can develop in all maxillary sinus regions and evolve during the growth of the middle part of the face, while the atrophy of the maxillary alveolar process proceeded irregularly in different regions, leaving bony "crests" on the maxillary sinus floor, also known as "secondary septa", which can be considered the result of tooth loss and atrophy <sup>(4)</sup>.

Radiographic identification of these structures is important, since the design of the lateral window during sinus lift procedures is based on the presence and size of maxillary sinus septa <sup>(9)</sup>.

Studies indicate that CT scans are more reliable than panoramic radiographs in the preoperative analysis. Today, CT can be

(1)Assistant Lecturer, Department of Oral Diagnosis, College of Dentistry, University of Baghdad

performed in axial and coronal planes with 3-dimensional views for diagnosis and treatment of this region, the 3-dimensional CT avoids the superimposition and problems due to magnification and offers to visualize the craniofacial structures with more precision than the 2-dimensional conventional methods<sup>(10)</sup>.

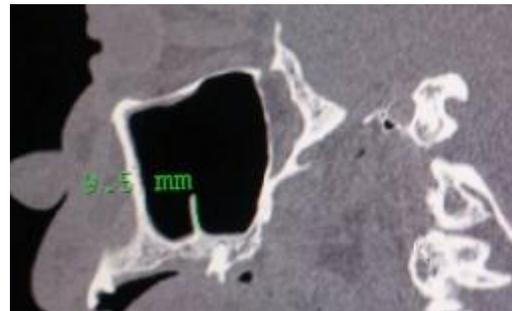
The aims of the study was to measure maxillary sinus septal height and correlate it with different types of septa to offer the clinician, through an accurate investigation of the anatomy of the maxillary sinus septa, the tools to carry out sinus-lift procedures under safe conditions.

## MATERIALS AND METHODS

Thirty patients (15 males and 15 females) with partially edentulous maxillae with age ranged from (20-50) years attended the Maxillofacial Department at Al-Karkh General Hospital in Baghdad city who admitted to have Spiral CT scan for the brain and paranasal sinuses for different diagnostic purposes and for dental implant planning. Sixty maxillary sinuses have been included in the study; any patients who had previously maxillary sinus surgery or having a pathological condition were not included in the study.

Spiral CT scans for (right & left) maxillary sinuses were taken for each patient. The information obtained was assessed in the (axial and sagittal) sections that may be further manipulated by rotation about any axis to display the septa of maxillary sinus from many angles. This multislice CT scan images were used to analysis of septa type at floor position whether primary or secondary. Then Measurement of septal height in millimeters (mm) was made from

the base of septum to the highest point and correlates it with the two types of septa, as shown in figure 1.



**Figure 1: Measurement of maxillary sinus septal height in sagittal section CT.**

## RESULTS

In this tomographic study 30 patients (60 sinuses) were evaluated, 62 septa were detected (40 % single and bilateral, 36.6 % single and unilateral while 23.4 % were multiple septa). A closer examination revealed 72.5 % of septa located superior to a maxillary tooth (primary septa) and 27.5 % of septa located superior to an edentulous ridge (secondary septa) as shown in table 1.

The relation between septal type and sex, the prevalence of primary septa was higher in female; while the secondary type was higher in male as shown in figure 2. The mean height of primary septa was 9.3 mm (SD 4.9; range 3.5-20.3 mm), where as the mean height of secondary type was 6.7 mm (SD 3.09; range 2-13.8 mm). The details were reported in table 2.

**Table 1: Number and percentage of maxillary sinus septal types in the study sample**

Septal type	Male		Female		Total		P- value
	N	%	N	%	N	%	
Primary	15	57.6	30	83.3	45	72.5	0.04 S
Secondary	11	42.4	6	16.7	17	27.5	
Total	26	100	36	100	62	100	

**Table 2: Maxillary sinus septal height measurements (mm) compared to septal type**

Septal type	Septal height						P- value
	Mean	SD	SE	Range	Up 95% conf.limit	Low 95% conf.limit	
Primary	9.3	4.9	1.2	3.5 - 20.3	11.9	6.8	0.01 S
Secondary	6.7	3.09	0.4	2 - 13.8	7.6	5.8	
Total	8	3.9	0.8	2.75 - 17.0	9.7	6.3	

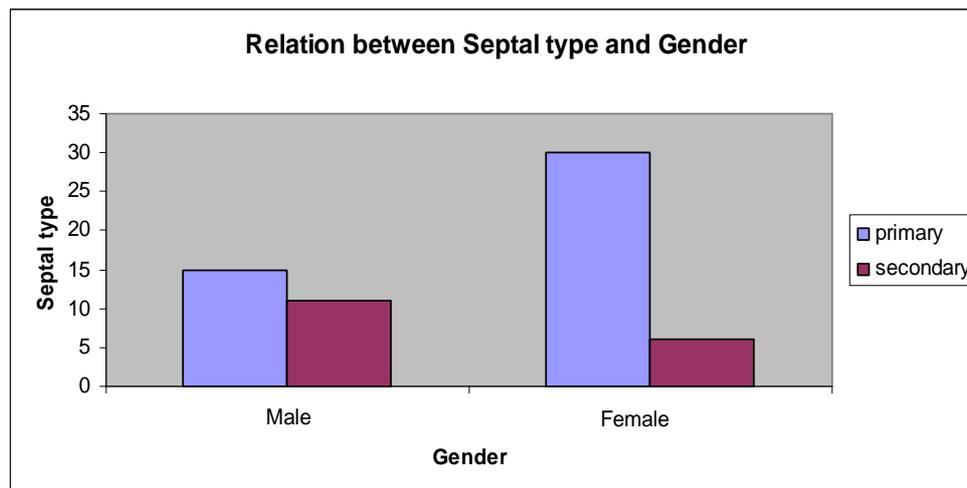


Figure 2: Distribution of septal type in relation to sex

## DISCUSSION

Many authors have reported the presence of MS septa and their relevance to surgical procedures. This anatomic variation was first described by Underwood in 1910<sup>(5)</sup>.

The presence of MS septa can be detected in panoramic radiographs. However, CT and CBCT are definitely the preferred imaging techniques for the assessment of this anatomic variation.

Septa appear to develop in either of 2 ways, either primary (developmental) or secondary as a result of tooth loss and remnant interseptal bone. Tooth loss and pneumatization adjacent to either a primary or secondary septum may also exaggerate the height or size of a septum.

It is impossible to label a septum located apical to an edentulous ridge as primary or secondary without a radiographic history of the sinus in question. Thus, it can be stated that septa located apical to dentate regions are primary (developmental), and septa located apical to an edentulous region can be either primary or secondary.

In 1910 Underwood<sup>(5)</sup> examined 45 dried skulls and reported a mean height of septa between 6.4 and 12.7 mm. Ulm et al.<sup>(11)</sup> considered the existence of septa if they measured more than 2.5 mm.; this criterion has been followed by several groups of authors<sup>(12,13,14)</sup>. Ulm et al.<sup>(11)</sup> conducted an observational study on 41 patients and reported a mean height of septa was 7.9 mm. Plata et al.<sup>(12)</sup> conducted CT scan analysis of 312 sinus (patients age range 24-86 Y), and assessed each septa at three points: the mean height for the lateral aspect was 3.5 mm; 5.9 mm for the central aspect; and 7.6 mm for the medial one. Kim et al.<sup>(13)</sup> used the same method as Plata et al.<sup>(12)</sup>, and reported mean heights of 1.6 mm in the lateral aspect, of 3.5 mm in the

middle aspect and 5.5 in the medial one. Some of the previously mentioned studies were agreed with the results of this study and the others were not, there were two possible explanations can be that all the septa were included, unlike Kim et al.<sup>(13)</sup>, who discounted septa below 2.5mm, and the precise nature of CTs that enabled more accurate identification of septa. The reason why all septa were included was that even small septa can be a challenge for sinus floor elevation, especially for the inexperienced surgeon.

Plata et al.<sup>(12)</sup> and Kim et al.<sup>(13)</sup> compared primary and secondary septa of partially edentulous patients, Kim et al.<sup>(13)</sup> found significantly greater heights in primary septa, whereas Plata et al.<sup>(12)</sup> found that primary septa were significantly shorter. The results of the current study agreed with Kim et al.<sup>(13)</sup>, but differed from those reported by Plata et al.<sup>(12)</sup> and this may be due to differences between methods of measurement, tools utilized to gather data, and variation among populations studied, in addition secondary septa formed after tooth loss and pneumatization of sinus floor that happened at various patients age depending on time of teeth lose and the age ranged included in Plata study was greatly differd from those in the present study. González- Santana et al.<sup>(14)</sup> used OPG to study maxillary sinus septa and registered heights between 2.5 and 6 mm. this result was greatly differed from the result of the current study and this may be due to greater accuracy of CT and on the other hand OPG was very limited and sometimes not reliable and failed to show septa and other anatomical landmarks, in addition to possibility of giving false negative results.

In anatomic study conducted by Rosano et al.<sup>(15)</sup>, 20 antral septa examined and reported a mean height of 8.72 mm (SD, 4.26; range, 3.7-18.4

mm). This result was confirmed with the result of the current study.

As a conclusion, Septa of various heights developed in all parts of maxillary sinus. Primary septal was higher than secondary septa because it was developed early and continuous growth happened along the life time; therefore extensive evaluation with appropriate radiograph technique is required, CT scan imaging is today the preferred method for preoperative detection of septa and other anatomic variation in patients who are candidates for sinus surgery and implant procedure.

## REFERENCES

1. Damlar I, Evlice B, Kurt SN. Dental volumetric tomographical evaluation of location and prevalence of maxillary sinus septa. *Cukurova Medical J* 2013; 38 (3): 467-74.
2. Koymen R , Gocmen-Mas N, Karacayli U, Ortakoglu K, Ozen T, Yazici A. Anatomic evaluation of maxillary sinus septa: surgery and radiology. *Clinical Anatomy* 2009; 22 (5): 563-70.
3. Poleti M, Fernandes L, Oliveira-Santos C, Capelozza A, Chinellato L, Rubira-Bullen L. Case Report: Anatomical Variation of the Maxillary Sinus in Cone Beam Computed Tomography. *Hindawi Publishing Co. Case Reports in Dentistry* 2014.
4. Rosano G, Taschieri S, Gaudy J, Lesmes D, Del Fabbro M. Maxillary sinus septa: A cadaveric study. *J Oral Maxillofac Surg* 2010; 6(8): 1360-4.
5. Underwood AS. An inquiry into the anatomy and pathology of the maxillary sinus. *J Anat Physiol* 1910; 4: 344-54.
6. Neivert H. Surgical anatomy of the maxillary sinus. *Laryngoscope* 1930; 40 (1):16-22.
7. Krenmair G, Ulm CW, Lugmayr H. Maxillary sinus septa: Incidence, morphology and clinical implications. *J Craniomaxillofac Surg* 1997; 25: 261.
8. Dakhli I, Abdelsalam Z, Salem D, Omar G. Validity of tridimensional CT study of maxillary sinus reconstruction in potential implant site. *Cairo Dental J* 2009; 25(3): 329-36.
9. Ferrín L, Galán-Gil S, Rubio-Serrano M, Peñarrocha-Diago M, Peñarrocha-Oltra D. Maxillary sinus septa: A systematic review. *Med Oral Patol Oral Cir Bucal* 2010; 15 (2): 383-6.
10. Orhan K, Seker B, Aksoy S, Bayindir H, Berberoğlu A, Seker E. Cone Beam CT evaluation of maxillary sinus septa prevalence, height, location and morphology in children and an adult population. *Med Princ Pract* 2013; 22:47-53.
11. Ulm CW, Solar P, Krenmair G, Matejka M, Watzek G. Incidence and suggested surgical management of septa in sinus lift procedures. *Int J Oral Maxillofac Implants* 1995; 10: 462-5.
12. Plata D, Hovey LR, Peach CC, Adler ME. Maxillary sinus septa: a 3- dimensional computerized tomographic scan analysis. *J Periodontol* 2002; 17: 854-60.
13. Kim MJ, Jung UW, Kim CS, Kim KD, Choi SH, Kim CK. Maxillary sinus septa: prevalence, height, location and morphology. A reformatted computed scan analysis. *J Periodontol* 2006; 77: 903-8.
14. Gonzalez H, Penarrocha M, Guarinos J, Sorni M. A study of the septa in the maxillary sinuses and the subantral alveolar process in 30 patients. *J Oral Implantol* 2007; 33: 340-3.
15. Rosano G, Taschieri S, Gaudy J, Lesmes D, Fabbro M. Maxillary Sinus Septa: A Cadaveric Study. *J Oral Maxillofac Surg* 2010; 4: 1360-4.