

Evaluation of septas in maxillary sinus with cone-beam computed tomography

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Abstract

Aim: The aim of the study was to examine the prevalence of maxillary sinus septa (MSS) in a Turkish population, using cone-beam computed tomography (CBCT).

Methodology: The CBCT images of 350 untreated patients (178 male, 172 female ranging in age between 18 and 65) were included in this study. The presence or absence of MSS was determined in axial, sagittal, and coronal planes by considering gender and side. For statistical evaluation, a chi-square test was used to determine any differences in the prevalence of MSS with significance set at 5%.

Results: MSSs were observed in 201 out of 700 sides (28.71%) and 141 out of 350 patients (40.28%), of which, 70 were in males and 71 in females. MSS were also observed in a higher prevalence on the bilateral side. (17.14%). Female patients showed higher prevalence (41.27%) than the male patients (39.32%).

Conclusions: MSS was observed in 40.28% of examined Turkish subjects and detected more frequently in females and on the bilateral side.

Keywords: Sinus septa, cone-beam computed tomography, anatomic variation

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Introduction

Implant treatment is a prominent and safe restorative methodology speaking to a useful and corrective option. However, its use for the rehabilitation of posterior maxillary regions is usually difficult for the doctor attributable to the decreased bone height. Following tooth loss bone resorption usually starts on the alveolar process of the posterior maxilla. This natural process varies on an individual basis however oftentimes results in volume and density loss and inadequate bone height, which limits the placement of implants of normal length. For this

reason, several maxillary sinus lifting methods have been developed to increase the bone height, such as lateral window and transcrestal osteotome techniques (1).

Of these several techniques, sinus lifting with a lateral window approach is that the most often used and has been incontestable to be a reliable and certain procedure for enhancing alveolar bone height within the posterior maxilla (2). Nevertheless, like all surgical intervention, this procedure is also related to many complications, which may compromise the end result of the surgery and the success of the treatment (3). An extensive data of the anatomy and possible variations of the maxillary sinus is thus essential so as to reduce

the risk of potential complications associated with the procedure (4). Cone beam computed tomography (CBCT) may be a helpful diagnostic tool for providing a comprehensive radiographic assessment before sinus lifting surgery (5).

The cavity of the maxillary sinus is usually divided by septa. The maxillary sinus septa (MSS) are thin structures of maxillary cortical bone. These septa might divide the sinus into two or more compartments (6, 7). In 1910, the anatomist Arthur S. Underwood represented the sinus septa as thin fragile and sickleformed walls. The morphology of the maxillary sinus is influenced by the person's age and tooth loss. Edentulous and aged patients show a decreased dimension of the maxillary sinus. With regard to the development of the septa, there are two types of septa; primary septa originate from congenital diversity and secondary septa might develop after the extraction of tooth and irregular pneumatization of the sinus floor (8).

Several studies were conducted on height, location, prevalence, and morphology of the MSSs, in adult patients, using various medical imaging techniques such as CBCT (9). The angle between the septum and the median palatine suture was also assessed by some authors (10,11).

Panoramic radiographs have a poor reliability for diagnosing sinus septa, as shown in several studies (12). To prevent complications during sinus lifting procedures, a detailed preoperative radiographic visualization and examination of the maxillary sinus and related anatomical structures with CBCT has been recommended in recent guidelines. CBCT avoids structural superimposition and image enlargement and distortion, therefore allowing precise 3-dimensional (3D) image and measurement of dental and maxillofacial structures, at a lower radiation dose than traditional computed tomography (CT) (13-19).

The purpose of this study was to examine the frequency, number, location, and orientation of septa in the maxillary sinus based on CBCT imaging. Further, associations between sinus septa and individual

patient-related factors (age, sex, and dentition type) were investigated.

Materials and Methods

In this retrospective study, CBCT scans of 350 patients who visited Izmir Katip Çelebi University, Faculty of Dentistry between January 2012 and December 2017 were evaluated.

Patients consisted of 178 (50.8%) male and 172(49.14%) female patients, with a mean age of 32 years (range: 18-65 years). The CBCT scans had been taken for diagnostic purposes as a part of comprehensive evaluation for implant surgery, orthognathic surgery, impacted tooth surgery or orthodontic treatment. As a routine protocol, informed consents were obtained from all patients before exposure. All scans were obtained in supine position, using a NewTom 5G CBCT machine (QR srl, Verona, Italy), operating at 110 kVp, 1-20 mA with a 15×12 field of view (FOV) and standard resolution mode (0.2mm voxel size). Lack of demographic information, images of the maxilla only, radiographic evidence of intraosseous lesions, images of low quality, images without 15×12 FOV were considered as the exclusion criteria.

The presence of Maxillary sinus septa were detected on NNT station (QR srl, Verona, Italy) using the "zoom" tool and manipulation of brightness and contrast on a computer monitor (The RadiForce MX270W features a 27-inch large screen size and a 2560 x 1440 high-resolution) under dim lighting conditions by an experienced oral and maxillofacial radiologist. CBCT images were evaluated in axial, sagittal, and coronal planes. The maxillary sinus septa were analyzed by considering gender and side (Fig. 1, 2).

25% of the CBCT scans were randomly selected and reevaluated by the same investigator 2 weeks after the first evaluation to determine intraexaminer reliability using the intraclass correlation coefficient (ICC).



Figure 1. CBCT scans of maxillary sinus septa. Axial, coronal and sagittal planes imaging of same patient. Blue arrows show the septas.



Figure 2. CBCT scans of maxillary sinus septa. Axial, coronal and sagittal planes imaging of same patient. Blue arrows show the septas.

Statistical Analysis

All data analyses were carried out using SigmaStat (version 3.5; Systat Software, San Jose, Calif). The recorded data was statistically analyzed using Chi-square test (χ^2) to compare the prevalence of MSS between genders and sides. A probability value of 0.05 or less was set as the significance level.

Results

Intraexaminer reliability was found excellent (ICC: 0.998).

Maxillary sinus septas (MSSs) were observed in 201 out of 700 sides (28.71%) and in 141 out of 350 patients (40.28%). These septas were observed in 70 males and 71 females. Female patients showed higher prevalence (41.27%) than the male patients (39.32%). But there were not significant differences in the prevalence between gender and sides ($p=0.908$).

MSSs were also observed in a higher prevalence on the bilateral side (17.14%). 45 patients were found to have MSSs on right sides (12.85%). 36 patients were found to have MSSs on left sides (10.28%). But there was also no significant difference between right and left sides regardless of gender with respect to the incidence of the MSSs (Table 1).

Table 1. A total of 700 maxillary sinuses of 350 patients were examined(178 male and 172 female)

Gender	Laterality		
	Unilateral		Bilateral
	Right	Left	
Male	22	19	29
Female	23	17	31
Total	45	36	60

Chi- square=0.192 P=0.908 no significant difference

Discussion

Even though the dental implant therapy is quite probable and frequent for treatment of edentulous and partially edentulous patients, additional surgery is usually required because of insufficient bone height in the maxillary posterior region. Indeed, sinus floor elevation may be necessary for placement of implants (20). Nevertheless, anatomical variations within the maxillary sinus have been reported to increase the risk of Schneiderian membrane perforation, and the

presence of a sinus septum sometimes becomes the reason of perforation (21). Radiological evaluation is essential to define and find the maxillary sinus septa to lessen preoperative and postoperative complications (21). For preoperative surgical evaluation, CBCT images and panoramic radiographs are commonly used. Nonetheless, some authors reported that panoramic radiography has lots of limitations such as superimposition and magnification (22). So we used CBCT images for this study.

In the present study, we used transverse, axial, and sagittal sections of CBCT images to analyze the

features of maxillary sinus septa. Septa were observed in 40.28% of patients and in 28.71% of maxillary sinuses. The prevalence of septa was 29.7%, in which 30.1% were females, 29.4% were males, and 5% of the patients had multiple septa. Yildirim et al (21) reported that the prevalence of septa was found in 29.7% of the sinuses using CT imaging, and SaKHDari et al (16) reported that the occurrence rate of septa was 44.8% in all patients.

An occurrence rate of septa in the left sinus was 36 (10.28%), while in the right sinus was 45 (12.85%). Velasquez- Plata et al (10) found 72 septa in 312 sinuses, and detected 39 in the left sinus and 36 in the right sinus. Similar to our study, the prevalence of septa was the same at right and left side of patients in recent study. Together, these results suggest that lateralization is not an important factor when evaluating the prevalence of septa. Recent researches showed that the prevalence of septa varied from 25% to 70% (23). These differences may be related to the different age of study population and to the differences in radiological imaging technique including CT, CBCT, and two-dimensional (2D) imaging techniques (panoramic radiograph). Our results did not identify significant differences based on gender, lateralization, and the prevalence of septa. Similar to our work, Yildirim et al (22) found no correlation between sex and the prevalence of septa.

To perform surgical interventions in implant dentistry such as sinus lifting, a profound information of the anatomy of the posterior maxillary region is important (24, 25). The majority of septa detected in the present study were complete, and located on the floor of the maxillary sinus in the molar region. This is certainly of clinical significance, as the presence of septa can cause complications during SFE (20). If a sinus septum is not identified prior to the surgical intervention, the preparation or reflection of a hinge door and the elevation of the sinus membrane can be difficult or even impossible during SFE. The most common complication during SFE procedures has been reported to be a perforation of the sinus membrane. In the literature, a frequency of 11% to 56% is mentioned for such perforations (26). During SFE procedures, sinus septa have been directly correlated to an increased risk of perforations of the sinus membrane (19). Therefore, clinicians ought to examine the bony anatomy of the maxillary sinus prior to SFE procedures with appropriate radiographic imaging modalities. As panoramic radiographs have a poor reliability for detecting sinus septa, 3D radiographic imaging such as CT or CBCT scans have been suggested for proper diagnosis before SFE procedure.

Conclusions

MSS was observed in 40.28% of examined Turkish subjects and detected more frequently in females and on the bilateral side. But there was no significant difference between the number of septa and gender, lateralization. Further studies are needed.

Ethical Approval: Ethics committee approval was received for this study from Izmir Katip Çelebi University (No:2019/100).

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