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CONGRESS PROCEEDING

Evaluation of the Effect of Nasal Septal Deviation and Concha Bullosa on Maxillary Sinus Volume by Cone Beam Computed Tomography

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Abstract

Purpose: The aim of this study was to examine, using cone beam computed tomography images, the direction and severity of nasal septal deviation as well as the relationship between the presence of concha bullosa with maxillary sinus volume.
Materials and Methods: : In this retrospective study, images of 50 individuals who had been referred for cone beam computed tomography imaging for a variety of reasons were used. Age, gender, the direction and severity of the nasal septal deviation, and the presence and types of concha bullosa, were all investigated. The maxillary sinus volume was calculated using the Simplant Pro 16 program (Materialise NV, Leuven, Belgium). SPSS v.22 software was used for all statistical analyses. The statistical significance level was accepted as $p<0.05$.
Results: In the study, cone beam computed tomography images of 50 individuals (29 women and 21 men) were analyzed. Age and mean maxillary sinus volume correlated negatively, weakly, and statistically significantly. There was a statistically significant difference between maxillary sinus volume the values men and women. It was also demonstrated that there was no significant relationship between the right and left maxillary sinus volumes and the nasal septal deviation direction or the existence of concha bullosa.
Conclusions: The findings of this study showed that nasal septal deviation and concha bullosa had no effect on maxillary sinus volume. The maxillary sinus volume and increasing age were found to be negatively correlated. It was found that maxillary sinus volume was higher in men than in women.

Key words: Nasal septal deviation; concha bullosa; maxillary sinus volume; cone beam computed tomography

Introduction

Four paranasal sinuses in the maxillofacial region are the frontal, sphenoid, maxillary, and ethmoid air cells. Because of its proximity to the teeth, the maxillary sinus, which is the largest and first to form among the paranasal sinuses, is a crucial dental structure.[1] The nasal fossa, the zygomatic bone, the floor of the orbit, the premolar teeth, the molar teeth, and the tuber maxilla are all surrounded by the air-filled pyramidal sinuses known as the maxillary sinuses.[2] The nasal septum deviation (NSD), age, and gender are only a few of the factors that could have an impact on the maxillary sinus volume (MSV).[3]

Asymmetry of the nasal septum is a defining characteristic of NSD. Growth is a factor in post-traumatic deviations and malformations of the nasal septum, which can lead to major airway blockages and aesthetic issues.[4] Elahi et al.[5] classification's is one of the most commonly used in the field of dentistry despite the fact that there are many categories relating to the angulation of the nasal septum. This classification considers angles below 9° to be mild, angles between 9° and 15° to be moderate, and angles beyond 15° to be severe.

The middle turbinate is pneumatized in concha bullosa (CB), the most frequent morphological variant of the osteomeatal complex.[6] Studies have shown that CB decreases maxillary sinus airflow and increases the incidence of inflammatory disorders of the maxillary sinus.[7] Studies investigating the effect of these variations on the volumetric variations of the maxillary sinuses have produced mixed results, despite the fact that it has been established in the literature

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that NSD and CB block optimal airflow and may increase a person's susceptibility to sinus disease.[5]

Although computed tomography (CT) is still regarded as the "gold standard" for paranasal sinus imaging, cone beam computed tomography (CBCT) has lately become increasingly popular because of a low-dose and cost-effective technique.[8] Also, compared to CT, CBCT can reconstruct images with thinner slice thicknesses and has higher spatial resolution. With all of these features, CBCT is the most effective imaging method for investigating hard tissue lesions in the maxillofacial region.

The purpose of this study was to investigate the direction and severity of NSD as well as the association between CB and MSV using CBCT images.

Methods

The Department of Oral and Maxillofacial Radiology at Erciyes University Faculty of Dentistry received 50 referrals for CBCT imaging between November 2014 and December 2021 for a variety of reasons. These referrals were used in this retrospective study. Erciyes University Clinical Research Ethics Committee evaluated and authorized this study (Protocol number 2022/451).

CBCT images were all captured using a Newtom 5G device (FP, Quantitative Radiology, Verona, Italy). Participants in the study had CBCT images with the perform diagnostic definition and resolution, and they had to be at least 18 years old. Participants in the study had CBCT images with the perform diagnostic quality and resolution, and they had to be at least 18 years old. The study excluded the records of patients whose histories included a nasal bone fracture, surgery, maxillary sinus surgical treatment, obstructed maxillary sinus ostium, nasal polyp, or nasal tumor. The NSD angle was defined as the angle formed by the nasal septum's most deviated part and a straight line drawn from the anterior spina nasalis to the crista galli.[5] Additionally, the NSD's curved side revealed the deviation's direction. Bolger et al.[9] classified CB as lamellar, bulbous, and extensive. In this study, the presence of any one of these three categories was considered to be a "presence" of CB (Figure 1).

The NNT program (NNT Software, V9.01, New Tom, Italy), which was the specific computer program of the CBCT device, recorded the images in DICOM format. The images were then reconstructed using the Simplant Pro 16 program (Materialise NV, Leuven, Belgium). In order to create MSVs with this program, the maxillary sinus shape and volume values were calculated using the segmentation wizard technique, drawing/erasure mask, and air value thresholding[7] (Figure 2).

All measurements were performed independently under identical conditions by a researcher with two years of clinical experience working in the department of oral and maxillofacial radiology and a researcher with five years of clinical experience who was an expert in the department of oral and maxillofacial radiology. Twenty percent (10 patients) of the study participants had their measurements repeated a month later as randomly. The measurements taken by the two researchers were averaged to provide the study's data. All measurements were made on a Dell Precision T5400 workstation (Dell) computer with a 19-inch monitor (Dell E190S). The resolution of this monitor was 1920 x 1080 and the same standard settings were used for each measurement. In addition, the observers made their measurements independently of each other, with the viewing room dark.

The statistical analyses were performed out by using IBM SPSS Statistics Version 22.0. For descriptive statistics like age and gender, values for percentage, mean, maximum, and minimum are presented. ANOVA and the independent t-test were used to investigate the association between NSD direction, severity, and the presence or type of CB and MSV. The correlation between the NSD angle and the MSV was also calculated, as was the Pearson correlation coefficient. The intraclass correlation coefficient was used to calculate the intra-observer reproducibility. The statistical significance level was accepted as $p<0.05$.

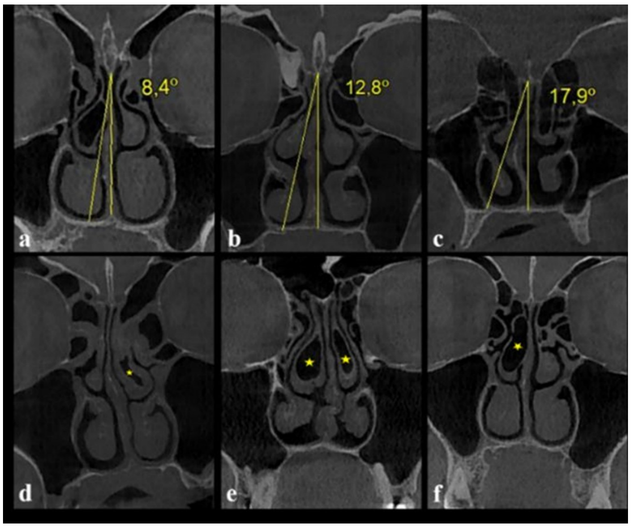

Figure 1. Coronal CBCT images a: Mild nasal septal deviation, b: Moderate nasal septal deviation, c: Severe nasal septal deviation, d: Lamellar concha bullosa, e: Bilateral bulbous concha bullosa f: Extensive concha bullosa

Results

According to the classification developed by Cohen[10], intra-observer and inter-observer correlations were very strong. The mean ICC values for the intra-observer correlation were 0.855 for observer 1 and 0.892 for observer 2. The inter-observer correlation was found to be 0.879. In the study, CBCT images of 50 individuals (29 women and 21 men) were analyzed. The ages of the individuals ranged from 18 to 67 (mean 34.62±12.81 (for women 34.79±11.76, for men 34.38±14.44)). Three age categories for people are used: 18–25, 26–40, and 41–67. Age and mean MSV correlated negatively, weakly, and statistically significant. ($r=-0.303$, $p=0.032$) Additionally, the MSV values for men and women varied statistically significantly ($p=0.008$).

There was no statistically significant difference between these age groups in terms of right and left MSV. It was also demonstrated that there was no significant relationship between the right and left MSV and the NSD direction or the existence of CB (all $p>0.05$) (Table 1). The individuals' mean NSD angles were 10.00±3.19°. In right-sided NSD, the mean deviation angle was 9.75±3.25°; in left-sided NSD, it was 10.35±3.16°. According to statistics, this difference was not statistically significant. ($p=0.517$). Insignificant correlations between right and left MSV and NSD angle were observed ($r=-0.097$, $p=0.503$ / $r=0.058$, $p=0.686$).

Both on the right and left sides, 34% of CB was found. On the right, lamellar type is present in 11 individuals (22%), bulbous type is present in 3 individuals (6%), and extensive type is present in 3 individuals (6%) Lamellar type was observed in 11 people (22%), bulbous type in 4 people (8%), and extensive type in 2 people (4%), if on the left side. CB was observed ipsilaterally in 7 individuals and contralaterally in 8 individuals, depending on which side of the nasal septum was deviated. Also, CB was observed bilaterally in 9 individuals.

Depending on the severity of their NSD, those with a right deviated nasal septum were found to no significantly difference between the right and left MSV. Similar to this, individuals with a left deviated nasal septum were not significantly different between right and left MSV in terms of the severity of NSD. Additionally, there was no obvious relationship between the localization of CB and the right and left MSV (T(Table 2)).

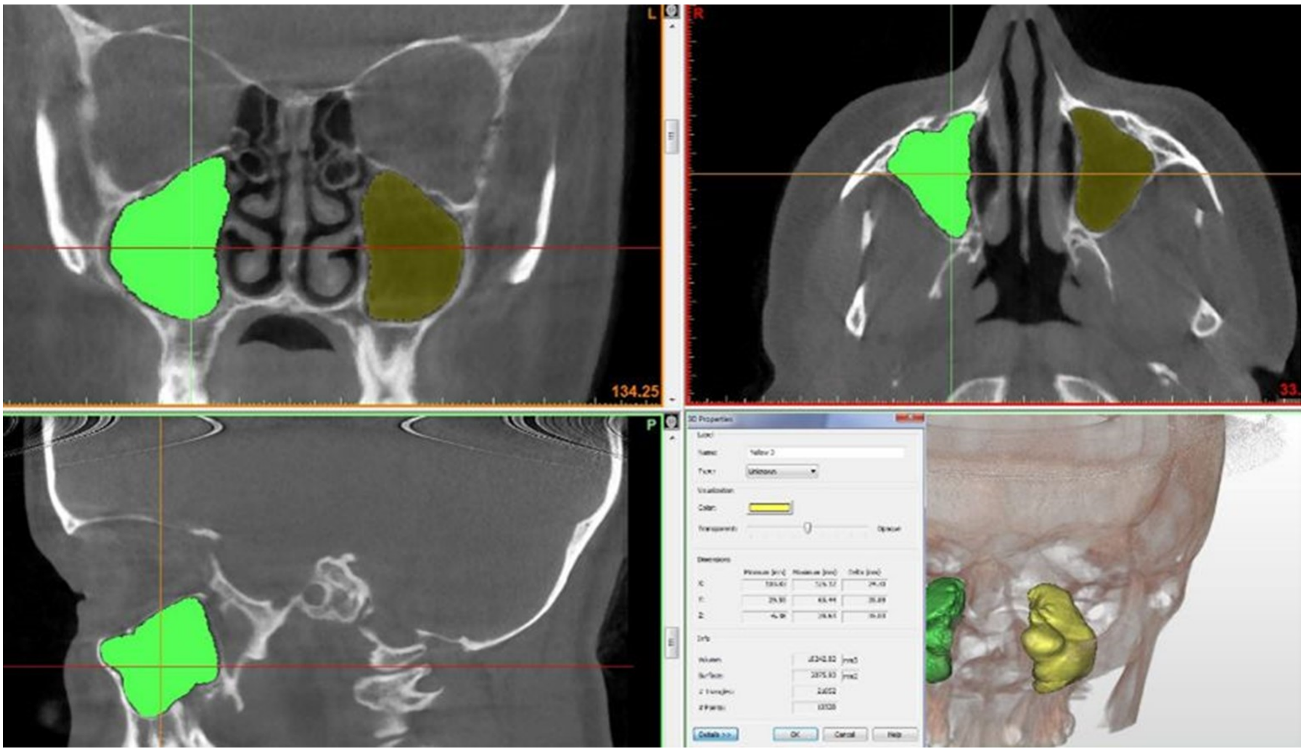

Figure 2. Segmentation and three-dimensional configuration of maxillary sinus volume in Simplant Pro 16 software

Table 1. Evaluation of the effect of gender, age group, nasal septum deviation direction and presence of concha bullosa on maxillary sinus volume

Gender	N	Right MSV (mm3)	p	Left MSV (mm3)	p
Female	29	14475.27±5491.14	0.042*	14637.22±4358.88	0.001*
Male	21	18069.44±6636.51		19231.33±5055.49	
Age Groups					
18-25	17	17705.19±6117.85	0.089	18216.09±5027.04	0.095
26-40	19	16653.05±6249.33		16815.29±5342.80	
41-67	14	12988.92±5520.61		14226.66±4454.76	
Direction of NSD					
Right	29	15266.86±7083.37	0,341	16128.54±5753.82	0.485
Left	21	16976.29±4701.14		17171.89±4242.55	
CB					
Absence	25	14794.04±6024.88	0.177	15419.94±5124.28	0.116
Presence	25	17175.61±6259.67		17713.55±5017.75	

N: Number of individuals, MSV: Maxillary sinus volume, NSD: Nasal septal deviation, CB: Concha bullosa, *: p<0.05

Discussion

Because of its proximity to the nasal tissues and the maxillary teeth, the maxillary sinus is a significant component, particularly in maxillofacial surgical procedures. Therefore, oral radiologists who interpret tomography prior to the surgery should be familiar with the anatomical structures in the nasal region in addition to the maxillary sinus. Recently, the examination of these regions has frequently used CBCT, a low-dose, cost-effective technique.[11]

By interference with sinus drainage, NSD, and CB can cause sinus pathologies.[11] In this study, it was also examined if two often-seen variances affected MSV in a significant way. This study discovered that MSV declined with increasing aging. Similar to this, Emirzeoglu et al.[12] and Velasco-Torres et al.[13] observed a negative connection between age and MSV in their studies on 394 patients over the age of 10 and 77 patients over the age of 18 respectively. Unlike them, we only included people who were over the age of 18 in this study because paranasal sinus pneumatization can last till that age. When the association between MSV and gender was examined in this study, it was discovered that men had higher MSV values than women. MSV values were higher in men than in women, according to reports by Tassoker et al.[14] and Kalabalık and Tarım Ertaş[15], supporting this finding.

It is still unclear how NSD and MSV are related. According to Kapusuz Gencer et al.[3], minor and moderate septal deviations have no noticeable impact on MSVs, and only severe septal deviations cause MSV to be smaller on the deviation side than on the contralateral side. In a computed tomography study looking at the relationship between NSD and MSV and maxillary sinusitis, Karatas et al.[16] observed that in moderate septal deviations, MSV tended to be higher on the contralateral side. Kucybala et al.[4] reported that while not classifying their patients based on the NSD angle, they found that neither right nor left deviations of NSD had an effect on MSV. This study discovered no relationship between mild, moderate, or severe septal deviations and either the right or left MSV. Similar to this, Al-Rawi et al.'s[6] investigation of NSD and MSV in Arab people observed no connection between the two conditions. The number of participants in the study groups and racial disparities can be attributed to the study results' variations as well as the methodological similarities in these studies.

Numerous studies in the literature have failed to correlate the presence of CB with MSV.[4,6,14,15] This study demonstrated no rela-

Table 2. Evaluation of the severity of nasal septal deviation and the effect of concha bullosa location on maxillary sinus volume

NSD Right	N	Right MSV (mm3)	p	Left MSV (mm3)	p
Mild	12	17565.83±7910.15	0.315	16922.50±6166.23	0.825
Moderate	14	14096.84±6397.58		15662.24±5887.46	
Severe	3	11531.12±5480.27		15128.72±4717.99	
NSD Left					
Mild	7	14376.05±4718.00	0.170	14806.97±3900.28	0.181
Moderate	11	17883.61±4628.54		18090.72±4387.52	
Severe	3	19716.67±2766.87		19320.99±2637.86	
CB					
Absence	25	14794.04±6024.88	0.212	15419.94±5124.28	0.105
Right	8	14225.04±3820.63		14970.60±2422.96	
Left	8	18760.29±8392.88		19666.04±6094.78	
Bilaterally	9	18389.73±5501.54		18416.19±5099.23	

N: Number of individuals, MSV: Maxillary sinus volume, NSD: Nasal septum deviation, CB: Concha bullosa

tionship between the presence of any CB and MSV, which is similar to previous studies.

The absence of enough individuals with severe NSD to perform a statistically accurate analysis was one of the primary limitations of our study. The sample size and participant count will both be increased, along with the inclusion of additional paranasal sinus variants like CB, in order to perform a larger study.

Conclusion

The findings of this study showed that NSD and CB had no effect on MSV. MSV and increasing age were found to be negatively correlated. Additionally, it was found that MSV was higher in men than in women.

Author Contributions

Study Idea / Hypothesis: B.Y., R.A. Study Design: B.Y., R.A. Consultancy: E.M.C. Data Collection: B.Y., R.A., M.K.Y., F.D. Literature Review: B.Y., R.A., M.K.Y., F.D. Statistical Analysis and Interpretation of Results: R.A. Article Writing: B.Y. Critical Review: B.Y., R.A., M.K.Y., F.D., E.M.C.

Conflict of Interest

All authors declare that they have no conflict of interest.

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