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The frequency of nasal septal deviation and concha bullosa and their relationship with maxillary sinusitis based on CBCT finding

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ABSTRACT

CBCT has facilitated the differential diagnosis due to the lower dose of radiation and higher resolution compared to CTscan. This study examines the frequency of deviated nasal septum, concha bullosa and their relationship with maxillary sinusitis based on CBCT findings. This study was conducted on 500 CBCTs cans performed in 2014-2016 using Sordex Scanora 3D (Helsinki, Finland)..Two maxillofacial radiologists examined the scans in axial and coronal sections. The data analyzed using the Chi-square test and the t-test in SPSS-18. The patients mean age was 48.12±15.59 years, 27.6% had concha bullosa. There was a significant relationship between concha bullosa and gender (P=0.001) and also age (P=0.008) There were no significant relationships between nasal deviation and gender (P=0.64). No significant relationships were observed between nasal deviation and age (P=0.86) and also between maxillary sinusitis and age (P=0.503). A statistically significant relationship was observed between concha bullosa and nasal septal deviation (P<0.001). The statistical analyses showed no significant differences between septal deviation and maxillary sinusitis (P<0.001). presence of concha bullosa may be a risk factor for septal deviation as well as maxillary sinusitis. Although the presence of concha bullosa, maybe related to the patient's age, in general, maxillary sinusitis is not significantly related to age and gender.

Keywords: Nasal Septum, Concha Bullosa, CBCT

INTRODUCTION

The introduction of Cone Beam Computed Tomography (CBCT) to dentists and otolaryngologists has facilitated the differential diagnosis of normal sinonasal anatomic structures from pathologic ones. The older,more common imaging techniques are often less effective in the diagnosis of sinus diseases [1]. Mucosal inflammation can be easily diagnosed inCT scanand this imaging modality has thus become a standard method for the accurate evaluation of the nasal cavity and the paranasal sinuses[2]. Given its lower dose of radiation, greater simplicity and higher resolution, CBCTis increasingly being used as a cost-effective method for the diagnosis of sinus diseases, such as sinusitis [3]. Concha bullosa is the cystic end of the middle nasal concha. Concha exists on all sides of the nasal cavity (upper, middle and lower). The general belief is that osteomeatal obstruction, which disturbs ventilation and the mucociliary clearance of the sinuses,exposes patients to sinus diseases [2]. This variation of middle nasal turbinate is very common and different studies have reported its frequency as 14-53%. Although the incidence of polyps, mucocele and infection is rare in concha bullosa, few cases of these conditions have been reported. Studies conducted to date have not shown any definite relationships between massive concha bullosa and secondary maxillary sinusitis [1, 2]. Few studies have examined the role of septal deviation or conchal pneumatization as factors potentially affecting the development of sinusitis[4]. Numerous authors have examined the relationship

between anatomic sinonasal variations and the prevalence of sinusitis. There is still a lack of evidence supporting or rejecting the role of middle turbinate concha bullosa and nasal septal deviation in the incidence of sinusitis and these relationships are still topics for debate [2, 5]. Previous observations based on CT images suggest that, when there is a concha bullosa, the convexity of the nasal septum is toward the opposite side in a way that affects the airway between the concha and the septum. The present study examines the frequency of nasal septal deviation and concha bullosa and their relationship with maxillary sinusitis based on CBCT findings.

MATERIALS AND METHODS

The present retrospective study examined 500 CBCT scans of 250 women and 250 men visiting a doctor's office in 2014-2016. All the scans were prepared using Sordex Scanora 3D (Helsinki, Finland, Voxel Size:200 μm, Field of View:7.5cm×10cm). The images were reproduced and observed on axial coronal and sagittal planes using OnDemand3D software (Cybermed Inc., Seoul, Korea). Two maxillofacial radiologists separately examined the scans in terms of septal deviation, concha bullosa and maxillary sinusitis on axial section and coronal sections. Only the patients without a history of trauma, cleft palate, alveolar ridge, cysts, benign or malignant tumors and surgery of the maxilla, nasal cavity and paranasal sinuses were included in the study. Moreover, it was also necessary to scan only the entire walls of the maxillary sinuses of the lateral sides, bottom and top of the nasal cavity along with the conchae and nasal septae; otherwise, the scans were excluded from the study. Given that the middle concha pneumatization had the highest prevalence, were recorded as concha bullosa on the left, right or both sides. Sinusitis is the inflammation of the mucosa of the sinuses that can be caused by allergens, bacteria or viruses. In a radiograph, sinusitis is diagnosed as the thickened mucosa of the sinuses and aggregated secretions that reduce the air in the sinuses and thus increase their radiopacity. The local thickening of the mucosa at the bottom of the sinus may not be a sign of sinusitis, butrather be related to a swollen infected tooth or a necrotic pulp at that site. Cases of locally thickened mucosa of the maxillary sinuses associated with rarefying osteitis and extensive dental caries observed in the images were defined as mucositis. Septal deviation was defined as a deviation exceeding 4 mm from the midline. On the axial plane, those parts of the septum anterior to the ethmoid bulla were specified as the anterior septum and those parts posterior to the ethmoid bulla were specified as the posterior septum. The presence or absence of septal deviation and its direction (toward the left or right) in the anterior and posterior nasal septum was thus determined on the axial plane for each patient. It should be noted that all the examined scans were ordered for dental or maxillofacial diagnoses and treatments and none of the patients underwent X-ray radiation just for this study and the ethical principles of the Declaration of Helsinki were fully respected in this research. The data obtained were analyzed using the Chi-square test and the t-test in SPSS-18.

RESULTS

The patients had a mean age of 48.12 ± 15.59 years and an age range of 11 to 88. Of the 500 patients examined, 50% were male and 50% were female. A total of 27.6% of the patients showed evidence of conchal pneumatization (the concha bullosa), and 8.4% showed right pneumatization, 6.6% left pneumatization and 12.6% bilateral pneumatization. In the group with concha bullosa (n=138), 86 patients (62%) were female and 52 (38%) were male. There was a significant relationship between the presence of concha bullosa and gender (P=0.001). A significant relationship was also observed between the presence of concha bullosa and age (P=0.008).

A total of 185 patients (37%) had nasal septal deviation; Table 1 shows the frequency of each group with septal deviation. There were no significant relationships between nasal deviation and gender (95 [51%]female vs. 90 [49%]male; P=0.64). No statistically significant relationshipswere observed between nasal deviation and age (P=0.86).

A total of 33.6% of the patients showed evidence of maxillary sinusitis. The higher prevalence of sinusitis among the male patients(n=89, 53%) than the female patients (n=79, 47%) did not comprise a statistically significant difference(P=0.34). A total of 10% of all the patients hadright maxillary sinusitis, 8.6% had left maxillary sinusitis and 15% had bilateral maxillary sinusitis. The mean age of the patients with maxillary sinusitis was 48.77±15.431 years. There were no significant relationships between the prevalence of maxillary sinusitis and age (P=0.503). A statistically significant relationship was observed between the presence of concha bullosa and nasal septal deviation (P<0.001). Of the 138 patients with concha bullosa, 76 (15.2% of all the patients) had nasal septal deviation and 62 (12.4 of all the patients) had concha bullosa without nasal septal deviation (Table 2). The statistical analyses showed a significant relationship between septal deviation and maxillary sinusitis. Of the 168 patients with maxillary

sinusitis, 88 (51%) had nasal septal deviation as well, and 80 (49%) showed no signs of septal deviation. Of the 185 patients with septal deviation, 97 (52%) showed no signs of maxillary sinusitis (P<0.001); (Table 3). A significant relationship was also observed between concha bullosa and maxillary sinusitis (P<0.001); (Table 4).

Table 1 frequency of nasal septum deviation

	Frequency	Percent
SD in anterior nasal part: to right SD in posterior nasal part: to right	54	10.8
SD in anterior nasal part: to left SD in posterior nasal part: to left	62	12.4
SD in anterior nasal part: to left SD in posterior nasal part:to right	2	0.4
SD in anterior nasal part: to right SD in posterior nasal part: to left	9	1.8
SD in anterior nasal part: no SD in posterior nasal part: to left	11	2.2
SD in anterior nasal part: no SD in posterior nasal part: to right	10	2
SD in anterior nasal part: to left SD in posterior nasal part: no	14	2.8
SD in anterior nasal part: to right SD in posterior nasal part: no	23	4.6
SD in anterior nasal part: no SD in posterior nasal part: no	315	63
Total	500	100

Table 2. Relationship between concha bullosa and septal deviation

		Septal deviation		Total
		Yes	NO	
Concha bullosa	Yes	76	62	138
	NO	109	253	362
Total		185	315	500

Table 3. Relationship between maxillary sinusitis and septal deviation

		Septal deviation		Total
		Yes	NO	
Maxillary sinusitis	Yes	88	80	168
	NO	97	235	332
Total		185	315	500

Table 4. Relationship between maxillary sinusitis and concha bullosa

		Concha bullosa		Total
		Yes	NO	
Maxillary sinusitis	Yes	66	102	168
	NO	72	260	332
Total		138	362	500

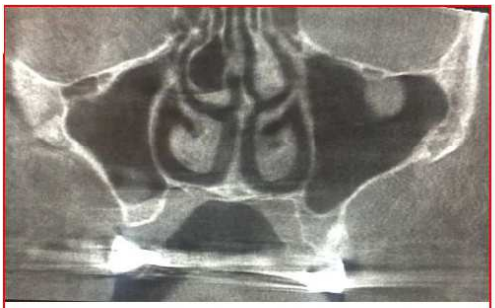
DISCUSSION

The middle turbinate may be pneumatized by the spread of the ethmoid air cells –in which case itwill be considered a concha bullosa [6]. Kyle D. Smith et al. reported the prevalence of concha bullosa as 67.5% [1] and other studies reported it as 35-53% [4, 7-9]. Some studies have reported a higher prevalence of concha bullosa in women than in men [9].

In the present study, however, the prevalence of concha bullosa wascalculated as 27.8%, which is lower than the rates reported in previous studies; just as in those studies, however, this rate was significantly higher in women. The disparity of findings may be due to the intrinsic differences in the study populations examined, the pneumatization index and the sensitivity of the method of analysis used.

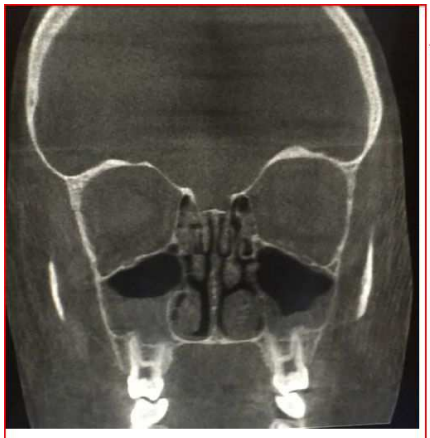
Bolger et al. observed maxillary sinusitis as thickened mucosa in 83% of their patients [2]. Nonetheless, Kyle D. Smith et al. reported this rate as 50% in their study population [1], and Lewis ME reported it as 39% and 55% (10). Of the all 500 scans examined in this study, 33.6% showed evidence of maxillary sinusitis, which is lower than the rate reported in other studies. This difference can be attributed to not only the differences between the study populations, but also to the fact that most of the patients in the present study required CBCT for dental implants and dental examinations and thus showed a lower prevalence of sinusitis than the study populations of the other studies,whichhad been referred for CT scan mostly for sinonasal symptoms. The results of this study thus appear to have a higher potential for generalizationto the entire population of the community. Unlike some studies that reported a higher prevalence of maxillary sinusitis in women[9], the present study found no significant relationships between the prevalence of maxillary sinusitis and gender.

Lewis ME. et al. reported the prevalence of concha bullosa as 24-53.6%[10], Lioyd et al. reported it as 24% [11], Zineriech reported it as 34% [12] and Bolger reported it as 53.6%. Calhoun [2] found that concha bullosa is more prevalent in patients with sinusitis than in patients with no symptoms of sinusitis. As a result, although some researchers believe that concha bullosa exposes the individual to sinus obstruction and thereby the incidence of sinusitis [5, 9, 12, 13], some other researchers argue that there is no relationship between sinusitis and concha bullosa [2, 4, 8]. The present study found a significant relationship between thepresence of concha bullosa and the incidence of maxillary sinusitis and the presence of concha bullosa appears to increase the risk of maxillary sinus obstruction and thereby sinusitis.



Right concha bullosa in coronal view
863x543mm (72 x 72 DPI)

Coronal view of septal deviation to the left
675x446mm (72 x 72 DPI)



Maxillary sinusitis without septal deviation
539x565mm (72 x 72 DPI)

Right concha bullosa
825x756mm (72 x 72 DPI)

Stallman et al. reported the prevalence of septaldeviation as 65%; in their study, the convexity of septal deviation was to the right in 51% of the cases and to the left in 49%(8). reported this prevalence as 19.4% in their study population[1]. Some studies have suggested that a significant relationship exists between septal deviation and sinusitis[8, 14-16];some others reject such a relationship[8, 17]. The prevalence of septaldeviation was 37% in the

present study. The variance in the prevalence of septal deviation may be due to the intrinsic differences between the study populations examined in different studies. In the present study, a significant relationshipwas observed between sinusitis and septal deviation. Stallman et al. reported a strong relationship between the presence of concha bullosa and septal deviation, and observinga nasal airway between the concha bullosa and the deviated septum on all the CT sections in all the cases, they concluded that septal deviation is not caused by the pressure imposed by enlarged concha and rather proposed evolutionary reasons for this relationship [8]. The present study also found a significant relationship between concha bullosa and nasal septaldeviation.

CONCLUSION

According to the present findings, it can be concluded that the presence of concha bullosa as a normal variation may be a risk factorfor nasal septaldeviation as well as maxillary sinusitis. Furthermore, the presence of nasal deviation caused by factors such as trauma may lead to maxillary sinusitis. Although some of the risk factors of maxillary sinusitis, including the presence of concha bullosa, may be related to the patient's age, in general, maxillary sinusitis is not significantly related to age and gender.

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