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Concha Bullosa and Associated Osteomeatal Anatomical Variations on CBCT Images

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Objectives Concha bullosa is the most common anatomical variation of the middle turbinate, which can be associated with symptoms such as headache, nasal congestion, and loss of smell. This study aimed to evaluate the frequency of concha bullosa and its association with osteomeatal anatomical variations in an Iranian population using cone-beam computed tomography (CBCT).
Methods This retrospective study evaluated CBCT images of 99 patients. Presence of concha bullosa, nasal septal deviation and paradoxical middle concha was evaluated. The frequency of these anatomical variations and their associations were analyzed.
Results The study included CBCT scans of 60 women (60.6%) and 39 men (39.4%). According to the results, 57 cases (57.6%) of nasal septal deviation were observed. Concha bullosa was present in 51.5% of the cases (51 cases). Fifty-one patients (51.5%) had evidence of concha bullosa located in the right concha (23.5%), involving the left concha (39.2%), and bilaterally distributed (37.2%). There was no significant difference between males and females regarding the presence of concha bullosa (P=0.092). The relationship between the presence of concha bullosa and nasal septal deviation was not statistically significant (P=0.796).
Conclusion The presence of nasal septal deviation and concha bullosa in this study seemed to be in accordance with prior studies. The presence of concha bullosa was not significantly associated with the presence or laterality of nasal septal deviation.
Keywords Cone-Beam Computed Tomography; Anatomy; Turbinates

Introduction

Concha bullosa is the most common anatomical variation of the middle turbinate caused by extensive pneumatization of the middle turbinate, also known as the bullous middle turbinate. [1] The etiology of concha bullosa is not fully understood, although abnormal growth and development of the maxilla and other facial structures, congenital anomalies, mouth-breathing and nasal septal deviation have been mentioned in literature. [2] Its prevalence in different populations is reported from 14% to 53.6%. [3, 4] Concha bullosa can be associated with various symptoms such as headache, nasal congestion and loss of smell. The significance of concha bullosa is related to its possible association with chronic sinusitis. Chronic sinusitis is a relatively common problem and one of the main causes of morbidity among patients. [4] Its diagnosis is based on clinical judgments and anterior and posterior examination of the nose. [5] Large and extensive concha bullosa can obstruct the middle meatus; thus, preventing sinus clearance. [6, 7] Also, airflow restriction leads to decreased oxygen pressure, which ultimately impairs the growth of the paranasal sinuses, reduces the motility of the nasal cilia, and increases bacterial growth in the sinuses and nose. [8]
Cone-beam computed tomography (CBCT) provides the clinicians with detailed imaging of the paranasal sinuses and nasopharynx. [9] The study of anatomical variations has become easier since these techniques make it possible to accurately examine anatomical structures simultaneously and from different dimensions. Discovering anatomical variations and understanding the underling etiology of patients' discomfort can help therapists in diagnosis and appropriate treatment of patients. Considering the significance of concha bullosa in patients' overall health and its association with chronic sinusitis, we sought to investigate the prevalence of concha bullosa in an Iranian population.

Methods and Materials

In this retrospective study, data were collected from patients referred for CBCT imaging to a radiology center in Mashhad, Iran. The CBCT images of patients presented from October 2020 to October 2021 were collected and evaluated. The study was conducted in accordance with the declaration of Helsinki and the study protocol was approved by the Local Committee of Research and Ethics (IR.MUMS.DENTISTRY.REC1399.117).
All patients had been referred by otolaryngologists for CBCT. Patients aged 18 to 60 years, whose maxillary sinus region and nasal complex were completely visible on CBCT scans were included and those with sinonasal developmental anomalies, history of trauma or surgery in the sinonasal region or extensive sinus disease, and images with severe artifacts were excluded. All images had been taken with Planmeca ProMax 3D Mid CBCT scanner (Helsinki, Finland) by a radiology technician with the exposure settings of 90 kVp and 10 mA with 20 ×17 cm field of view. Voxel size was 0.2 mm and slice thickness was 0.5 mm. The CBCT images were assessed using Planmeca Romexis V.5.3.4 software by a dental radiology specialist. In the axial plane, the vertical line crossing the

posterior nasal spine was indicated as the reference midline. Presence of nasal septal deviation, concha bullosa, and paradoxical middle concha was evaluated (Figure 1).
Nasal septal deviation was defined as a deviation greater than 4 mm from the reference midline in the coronal plane. Pneumatization of the middle conchae was assessed in coronal and axial planes, and presence of concha bullosa, its laterality and unilateral or bilateral nature were recorded. The paradoxical middle concha was defined as concha with the concave side facing the nasal septum, and the edge curved infero-medially. The frequencies of the findings were recorded and analyzed in terms of gender, laterality and unilateral or bilateral nature. IBM SPSS Statistics version 21 was used for data analysis and Pearson's Chi-square test was used for between-group comparisons. To analyze binary probabilities, one-sample binomial test was used. P<0.05 was considered statistically significant.

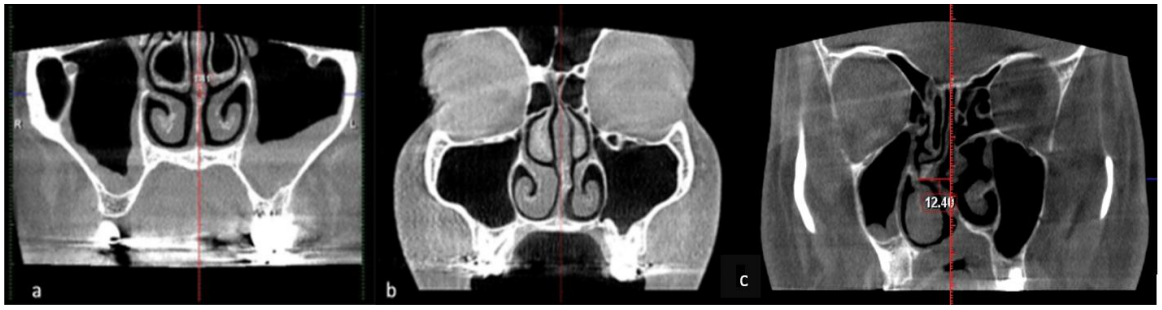

Figure 1. a: Bilateral concha bullosa, b: Paradoxical middle Concha, c: Septal deviation

Results

A total of 99 CBCT scans were evaluated, from which 60 belonged to female patients and 39 belonged to male patients. The mean age of patients was 42.7±10.9 years (range 19 to 60 years). Table 1 shows the prevalence of CBCT findings and their distribution in male and female patients. Fifty-seven patients (57.6%) had septal deviation; of which, 22 showed left side deviation and 35 presented right side deviation (approximately 2:3 left to right ratio; P= 0.791). There was no statistically significant difference in presence of septal deviation in males (59.0%) compared with females (56.7%; P = 0.820).

Table 1- Prevalence and gender distribution of concha bullosa, nasal septal deviation and paradoxical middle concha

	Female n(%)	Male n(%)	Total n(%)
Nasal Septal Deviation			
Present	34 (56.7)	23 (59.0)	57 (57.6)
Absent	26 (43.3)	16 (41.0)	42 (42.4)
Concha Bullosa			
Present	35 (58.3)	16 (41.0)	51 (51.5)
Absent	25 (41.7)	23 (59.0)	48 (48.5)
Paradoxical Middle Concha			
Present	5 (8.3)	1 (2.6)	6 (6.1)
Absent	55 (91.7)	38 (97.4)	93 (93.9)

Of 99 CBCT scans reviewed, 51 (51.5%) had evidence of concha bullosa located in the right concha (23.5%), involving the left concha (39.2%), or bilaterally distributed (37.2%). The mean age of patients with concha bullosa was almost similar to that of patients without concha bullosa (42.1±11.7 vs. 43.3±10.1 years; P=0.583). There was no significant correlation between gender and presence of concha bullosa (P=0.092, Table 2). Paradoxical middle concha was observed in 6 cases (6.1%); of which, 5 were females. Statistically, there was no gender preference in this regard (P=0.240, Table 1).
The relationship between the presence of concha bullosa and nasal septal deviation was not statistically significant (P=0.796, Table 3). From 42 patients without septal deviation, 50% had concha bullosa. Thirty patients (30.3%) had a combination of both concha bullosa and septal deviation. Out of 30 cases with septal deviation, 14 (46.7%) had contralateral, 7 (23.3%) had ipsilateral, and 9 (30%) had bilateral concha bullosa.

Table 2- Comparison of concha bullosa frequency between males and females

			Presence of concha bullosa		Total
			Present	Absent	
Gender	Females	Number	35	25	60
		Percentage	58.3%	41.7%	100%
	Males	Number	16	23	39
		Percentage	41%	59%	100%
		Number	51	48	99
		Percentage	51.5%	48.5%	100%
Chi-square test			X^2=2.83	P=0.092	

Table3- Comparison of the frequency of concha bullosa in patients with and without nasal septal deviation

			Presence of concha bullosa		Total
			Present	Absent	
Nasal septal deviation	Absent	Number	21	21	42
		Percentage	50%	50%	100%
	Present	Number	30	27	57
		Percentage	52.6%	47.4%	100%
	Total		51	48	99
			51.5%	48.5%	100%
Chi-square test			X^2=0.067	P=0.796	

Discussion

This study indicated that 57.6% of the cases had nasal septal deviation on CBCT scans the majority (61.40%) of which had right-sided deviation. Previous literature has reported rates of nasal septal deviation ranging from 49.5% to 79.9% on CBCT scans. [8, 10-12] Such prevalence rates are approximately similar to the values obtained in the present study. Higher prevalence rates in studies by Kucybata et al, (79.9%) Kaya et al, (89.9%) and Moshfeghi et al. (86.6%) may be due to the fact that they recruited patients with underlying pathologies in the paranasal sinus, whom are more likely to have septal deviations. [8, 13, 14] Moreover, Kaya et al. used CT scans for assessments. [13]

Smith et al. examined anatomical differences in 883 CBCT images and reported a 19.4% rate for nasal septal deviation.[11] Their study was conducted in the United States, and anatomical variations in different populations could be a factor for the lower prevalence rates observed compared with ours.

In the present study, concha bullosa was observed in 51.5% of the cases and 11.8% had paradoxical middle concha. Kaya et al. reported similar prevalence rates of 51% and 8.6% for concha bullosa and paradoxical middle concha, respectively. [13] Other studies have reported prevalence rates of 31.7%, 37.7%, 42.1%, and 67.3% for concha bullosa. [8, 10, 15, 16]

In contrast, Abesi et al. reported 95% prevalence of concha bullosa and a significantly higher incidence of bilateral concha bullosa compared to unilateral cases. [17] In their study, the prevalence of paradoxical middle turbinate was 17.6%. This difference can be due to racial differences in the study population. Smith et al., reported concha bullosa in 67.5% of their cases. [11] However, in a study by Smith et al. concha bullosa was defined as pneumatization in any of the turbinates.

In our study, there was no significant difference between males and females with regard to the presence of concha bullosa, which was consistent with the results of previous studies. [10, 11, 15] It has been suggested that presence of concha bullosa may be associated with nasal septal deviation. [3, 12, 18, 19] Since the presence of nasal septal deviation results in extra space in one side of the nasal cavity, the occurrence of concha bullosa may be augmented. [12] However, in our study, individuals with and without nasal deviation did not differ significantly in the incidence of concha bullosa. Also, people with septal deviation to the left and right did not significantly vary in orientation of concha bullosa, which was consistent with the studies by Smith et al, and Al-Rawi et al. [11, 15] Other studies also found no association between chronic sinusitis and nasal septal deviation or concha bullosa. [20, 21] Hatipoglu et al. found that sinusitis was associated with more severe degrees of nasal septum deviation and people with more severe deviations were at greater risk of sinusitis. [22] On the other hand, Kennedy et al. suggested that anatomical variations are only predisposing factors to sinusitis and have no etiological role in its development. [23]

Another issue is to consider is the diversity of these variations in different races and populations. [24] Among the anatomical variations that are frequently studied in articles, nasal septum deviation and concha bullosa are more commonly discussed. There are several other anatomical variations in addition to those investigated in this study, such as Agger nasi cell, uncinate process and Haller cell.s [25-28] Their possible role in various factors such as sinus drainage should also be considered. Since the current study was conducted on CBCT scans, the correlation of anatomical variations with patients' symptoms could not be analyzed. Further research into the association of these anatomical variations with patients' symptoms and management is recommended.

Conclusion

The presence of nasal septal deviation and concha bullosa in this study seems to be in accordance with prior studies. The presence of concha bullosa was not significantly associated with the presence or laterality of the nasal septum deviation.

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Conflict of Interest

No Conflict of Interest Declared■

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