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Evaluation of Paranasal Sinus Anatomic Variations and Mucosal Changes with Cone Beam Computed Tomography

SUMMARY

Background/Aim: Anatomical variations of paranasal sinuses are common and play an role in disrupting the drainage of the sinuses, which often causes chronic sinusitis. In this article, anatomical variations of the paranasal sinuses and its relationship with mucosal changes were evaluated retrospectively by cone beam computed tomography (CBCT) which is also known as dental volumetric tomography. Material and Methods: CBCT data of 500 patients who applied to Cukurova University Faculties of Dentistry for any reason were retrospectively evaluated by maxillofacial radiologist. Anatomical variants of paranasal sinuses were included in the study. Mucosal thickening greater than 2 mm in the maxillary sinus was considered pathological. Results: The most common anatomic variation in the study was the nasal septal deviation, found in 302 (60.4%) patients. The least common anatomic variation in the study was lower concha pneumatization found in 3 (0.6%) patients. Mucosal thickening of the maxillary sinus was observed in 271 (54.2%) cases in the right sinus and 260 (52%) cases in the left sinus (p>0.05). Conclusions: Nasal septum deviation was the most common variation in the study. According to the results of our study, concha bullosa, haller cell and the uncinate process had no definite effect on mucosal thickening in the maxillary sinus.

Key words: CBCT, Paranasal Sinuses, Mucosal Changes, Anatomical Variations

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Introduction

The maxillary, ethmoid, sphenoid and frontal sinuses form the paranasal sinuses. These sinuses contain air and are connected to the nasal cavity through ostiums[1]. The last common way of drainage and aeration of frontal, maxillary and anterior ethmoid air cells is called an osteomeatal complex. Concha bullosa, haller cell and agger nasi cells are anatomical variations of the osteomeatal complex[2]. Anatomical variations of this region are common and play an important role in disrupting the drainage of the sinuses, which often causes chronic sinusitis[3]. On the other hand, anatomical variations must be evaluated correctly in the successful and safe implementation of functional sinus surgery[4]. In chronic diseases of this region, preoperative imaging methods are used. Computerized Tomography (CT) is considered the gold standard for the display of this region[5]. CT provides detailed visualization of the nasal cavity, lateral nasal wall, osteomeatal complex and sinuses prior to functional endoscopic sinus surgery[6]. However, the disadvantage is that the cost and radiation doses of CT application are high. For these reasons, CBCT application is an ideal method of dentistry for dentistry. Besides that, the exact role of CBCT in the otolaryngology area is still uncertain. CBCT eliminates some of the disadvantages of CT, in this respect it is superior[5,7].

In studies conducted on this region in the literature, it was observed that CT was used as an imaging method and use of CBCT is limited. In this article, anatomical variations of the paranasal sinuses and its relationship with mucosal changes were evaluated retrospectively by CBCT which is also known as dental volumetric tomography.

Material and Methods

It was planned to retrospectively evaluate CBCT data of 500 patients who applied to Çukurova University Faculties of Dentistry for any reason between November 2014 and May 2016. Our study was approved by Çukurova University Medical Faculty Non-Interventional Clinical Research Ethics Committee as decision No. 20.

Criteria of images included in the study

Patients who did not suffer from trauma or accident in his head and neck within the image area of the paranasal sinuses, without systemic or genetic disease, without congenital disease such as cleft lip and palate, and who did not undergo surgical operation in the areas to be examined were included in the study.

CBCT data were excluded from the study when the desired regions were not within the image area, images with patient or device-related errors during the shooting, and artefacts formed in the image due to metallic filling or crown bridge prostheses that made evaluation impossible.

Technical specifications and images assessment conditions of CBCT device

CBCT images were obtained with dental volumetric imaging system (Planmeca ProMax 3D Mid, FACE module) operating at 90 kV and 8 mA. Image analyzes were performed using a software (Planmeca Romexis Version 4.4.0.R, Planmeca Oy, Helsinki, Finland).

Evaluated regions and evaluation criteria

Nasal septal deviation, concha bullosa, haller cell, uncinate process pneumatisation, nasal septal pneumatization, paradoxical middle turbinate, lower concha hypertrophy, lower concha pneumatization, crista galli pneumatisation, maxillary sinus pneumatization, maxillary sinus septa, maxillary sinus hypoplasia, maxillary sinus exostosis as paranasal sinus anatomical variants were included in the study (Figures 1-5). Anatomical variations were evaluated using axial, coronal and sagittal sections as variation or no variation. In anatomic variations that can be seen bilaterally, both sides were evaluated separately. Mucosal thickening greater than 2 mm in the maxillary sinus was considered pathological (Figure 6). In addıtıon, the effect of anatomical variations (concha bullosa, uncinate process pneumatisation and haller cell) located close to the middle meatus of the paranasal sinuses and possibly causing narrowing of the osteomeatal complex and therefore thought to cause mucosal changes in the maxillary sinuses, on the mucosal thickening in the maxillary sinuses were investigated.

Figure 1. Asterisk: Concha bullosa Arrow: Nasal septal deviation

Figure 2. Arrow: Haller Cell

Figure 3. Arrow: Paradoxıcal middle turbınate pneumatization

Figure 4. Arrow: Uncinate process

Figure 5. Arrow: Crista galli pneumatization

Figure 6. Coronal cross-section of the mucosal thickening of the right and left maxilla CBCT

Special evaluation forms were prepared for this study. It was evaluated by an oral maxillofacial radiologist.

Data analysis

The data obtained from the study were transferred to the computer in the SPSS 23.0 package program and analyzed. Continuous variables were presented as mean ± standard deviation, and frequency data were presented as number (%). Chi-square test was used to compare the data obtained, and the statistical significance level of these tests was considered as $p< 0.05$.

Results

In this study, paranasal sinus anatomic variations of 500 patients were examined (51% males and 49% females). The age of all patients was between 18 and 81 and the average was 39.7 (± 16.178). No significant relationship was found between age and gender and anatomical variations. ($p> 0.05$)

In the study, the frequency of paranasal sinus anatomical variation is given in the Table 1. Mucosal thickening of the maxillary sinus was observed in 271 (54.2%) cases in the right sinus and 260 (52%) cases in the left sinus (Table 2). No significant correlation was found between the presence of uncinate pneumatization, haller cell and concha bullosa and mucosal thickening in the maxillary sinus ($p> 0.05$).

Table 1. Anatomical variation prevalence

ANATOMICAL VARIATIONS	NUMBER	**PERCENT**
NASAL SEPTAL DEVIATION	302	60.4
CONCHA BULLOSA RIGHT	159	31.8
CONCHA BULLOSA LEFT	169	33.8
CONCHA BULLOSA BILATERAL	116	23.2
HALLER CELL RIGHT	87	17.4
HALLER CELL LEFT	90	18.0
LOWER CONCHA HYPERTROPHY RIGHT	150	30
LOWER CONCHA HYPERTROPHY LEFT	118	23.6
PARADOXICAL MIDDLE TURBINATE RIGHT	42	8.4
PARADOXICAL MIDDLE TURBINATE LEFT	44	8.8
NASAL SEPTAL PNEUMATIZATION	30	6.0
UNCINATE PROCESS PNEUMATIZATION RIGHT	47	9.4
UNCINATE PROCESS PNEUMATIZATION LEFT	47	9.4
LOWER CONCHA PNEUMATIZATION	3	0.6
CRISTA GALLI PNEUMATIZATION	7	1.4
MAXILLARY SINUS PNEUMATIZATION RIGHT	145	29
MAXILLARY SINUS PNEUMATIZATION LEFT	159	31.8
MAXILLARY SINUS SEPTA RIGHT	222	44.4
MAXILLARY SINUS SEPTA LEFT	236	47.2
MAXILLARY SINUS HYPOPLASIA RIGHT	11	2.2
MAXILLARY SINUS HYPOPLASIA LEFT	4	0.8
MAXILLARY SINUS EXOSTOSIS RIGHT	5	1
MAXILLARY SINUS EXOSTOSIS LEFT	7	1.4

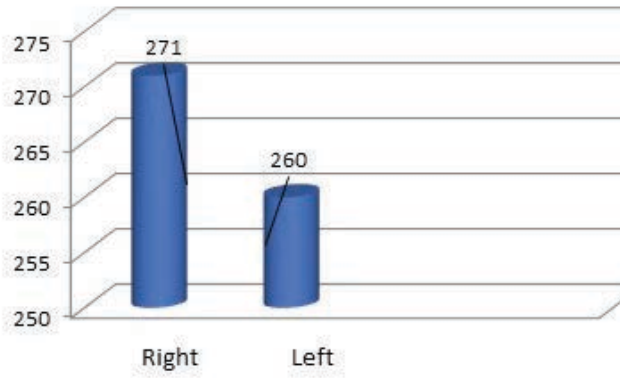

Table 2. Prevalence of maxillary sinus mucosal thickening

Discussion

Paranasal anatomical variations may play a role in the etiology of chronic rhinosinusitis (CRS), but this issue is still unclear[8]. Nasal septum deviation is the most common variation in the population in our study (60.4%). The prevalence of this variation, determined in some studies, was reported to be 19.4%[9], 65%[10], and 59.5%[11]. If nasal septum deviation is in contact with hypertrophic concha or concha bullosa and narrows the middle meatus, this can cause infection of all sinuses by disrupting normal mucus drainage[11].

Concha bullosa is the pneumatisation of the middle turbinate[12]. In our study, the rate of right concha bullosa was 31.8%, the rate of left concha bullosa was 33.8%, and bilateral turbinate ratio was 23.2%. When the literature was examined, the prevalence of concha bullosa in children and adults was reported to be 34.1%[13], 44%[10] and 51%[14]. However, the effect of concha bullosa on sinus infection is controversial. In a study, it was reported that concha bullosa is highly associated with sinus pathologies[15]. Nevertheless, in many studies, no relationship between concha bullosa and sinus pathologies was found[16].

Infraorbital ethmoidal air cells are called Haller cells[17]. In the studies in the literature, the prevalence of the haller cell is 27.3%[2] 7.8%[11]. In our study, the rate of haller cell right was 17.4% and the rate of haller cell left was 18%.

In our study, the rate of lower turbinate pneumatization and hypertrophy was lower than some studies in the literature [18,19] . The ratio of paradoxical middle turbinate right was 8.4% and the ratio of paradoxical middle turbinate left was 8.8%. In the literature, the prevalence of paradoxical middle turbinate varies between 11.6[2] and 30%[20]. The rate of nasal septal pneumatisation was 6%. Nasal septal pneumatisation prevalence in previous studies was reported as 6%[21] and 2%[10].

In our study, the rate of uncinate prosess pneumatisation right and left was 9.4%. Uncinate prosess pneumatisation prevalence in literature was reported to be 2%[21], 5%[22], and 13.8%[11]. It was reported that uncinate process may cause functional blockage in the osteomeatal complex, and that the large contact formed by the middle concha of a prominently medially bent or pneumatized process is the most common pathological finding in patients with sinusitis in their populations[22].

Crista galli is normally bony. When ventilated, it can connect with the anterior recess, causing obstruction of the ostium, thereby leading to chronic sinusitis and mucocele formation. Another rare anatomical variation in our study findings was crista galli pneumatisation at rate of 1.4%. In literature, the prevalence of this variation was reported to be 2.4%[23], 3.3%[11].

In our study, it can be said that the incidence of septa from maxillary sinus variations is close to the study of Park *et al.* using three-dimensional imaging method[24]. The incidence of maxillary pneumatization, hypoplasia and exocytosis is lower than the studies in the literature[25-28].

In the literature, in the studies conducted mostly with CT, there is a difference in the rates of anatomical variations in the paranasal sinus. We think that difference in prevalences of anatomic variations may be due to the reasons for performing these studies, made in different populations, different classifications of anatomical variations, and changes in the image quality of the different imaging devices used.

There is no consensus in the literature on the amount of mucosal thickening considered pathological. However, mucosal thickenings of 2 mm or more than 5 mm are considered abnormal[29,30]. We included mucosal thickening of 2 mm and above to be abnormal, and found the right mucosal thickening rate as 54.2% and the left mucosal thickening rate as 52%. In the literature, the prevalence of mucosal thickening of the maxillary sinus ranged from 12%[31] to 60.5%[30]. We did not find that the presence of uncinate process pneumatization, haller cell and concha bullosa affect mucosal thickening in the maxillary sinus ($p > 0.05$).

Conclusions

Nasal septum deviation was the most common variation in the study. Concha bullosa, haller cell and the uncinate process pneumatization had no definite effect on mucosal thickening in the maxillary sinus. CBCT designed for the maxillofacial region and being applicable for both before functional sinus surgery or endoscopic examination

of otolaryngologists and before implant surgery of dentists can be preferred in the evaluation of the paranasal sinuses and their anatomical variations, due to their advantages such as the image detail and low radiation dose.

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