Original Article

J Babol Univ Med Sci
Vol 20, Issu 4; Apr 2018. P:30-34

The Evaluation of the Anatomical Variations of Osteomeatal Complex in Cone Beam Computed Tomography Images

F. Abesi (DDS, MD)[1], S.Haghanifar (DDS,MD)[2], S. Khafri (PhD)[3], A.Montazeri (DDS)[*4]

1.Dental Materials Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran.
2.Oral Health Research Center, Institute of Health, Babol University of Medical Sciences, Babol, I.R.Iran.
3.Cancer Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran.
4.Student Research Committee, Babol University of Medical Sciences, Babol, I.R.Iran.

J Babol Univ Med Sci; 20(4); Apr 2018; PP: 30-4

Received: Nov 9th 2017, Revised: Feb 24th 2018, Accepted: Apr 17th 2018.

ABSTRACT

BACKGROUND AND OBJECTIVE: Anatomical variations of ostiomeatal complex have an imperative role in pathologies of sinonasal complex, ventilation obstruction and success of surgical treatments. The purpose of this study was to evaluate the anatomical variations of osteomeatal complex in cone beam computed tomography images in North of Iran.

METHODS: In this cross-sectional retrospective study, 159 CBCT images were analyzed. Anatomical variations evaluated included Concha bullosa, Paradoxical middle turbinate, Uncinate process hypertrophy and pneumatization, hypertrophied Bulla ethmoidalis, Agger nasi cell, Maxilo-ethmoidal cell (Haller's cell) which were assessed based on the frequency, gender, unilateral/bilateral appearance and the involved side in unilateral cases (left/right). Also, two observers evaluated the data simultaneously and the result of final agreement was recorded on the checklists.The data were analyzed descriptively and analytically.

FINDINGS: From among 159 subjects, 76 (47.8%) were female and 83 (52.2%) were male. The patients were 18-80 years old (mean: 34.96±14.50 years). Agger nasi cell and concha bullosa which were observed in 143 (98.9%) and 151 (95%) cases, respectively, were the most common findings and often appeared bilaterally. The least frequency belonged to hypertrophied bulla ethmoidalis which was 9 (5.7%) and uncinate process hypertrophy which was 12 (7.5%). Paradoxical middle turbinate, uncinate process pneumatization, and Haller's cell were observed in 28 (17.6%), 57 (35.8%), and 61 (38.4%) cases, respectively. No significant relationship was found between gender and the anatomical variations. ($p>0.05$)

CONCLUSION: In the present study, Concha Bullosa and Agger Nasi Cell were the most common anatomical variations in CBCT images of paranasal sinuses, which were reported bilaterally

KEY WORD: *Anatomic variation, Paranasal sinus, Cone Beam Computed Tomography*.

Please cite this article as follows:

Abesi F, Haghanifar S, Khafri S, Montazeri A. The evaluation of the Anatomical Variations of Osteomeatal Complex in Cone Beam Computed Tomography Images. J Babol Univ Med Sci. 2018;20(4):30-4.

***Corresponding Author: A. Montazeri**
Address: Student Research Committee Babol, Faculty of Dentistry, Babol University of Medical Sciences,Ganj Afrooz Avenue, Babol, I.R Iran.
Tel: +98 11 3222904
E-mail: ali.montazeri306@gmail.com

[DOR: 20.1001.1.15614107.1397.20.4.5.9]
[DOI: 10.18869/acadpub.jbums.20.4.30]

Introduction

The OMC or Osteomeatal Complex includes Ostium, Infundibulum, Uncinate Process, Hiatus Semilunaris, Ethmoidal Bulla, and Middle Meatus. This area is the usual pathway for drainage of the frontal, maxillary, and anterior ocular airways of the sinuses, so we must carefully examine the openness (1). Concha Bullosa, one of the most common anatomical variations, is presented as a pneumatization (formation of air cavities in the bone) of the turbinates (often middle turbinates), which can be either one-way or two-sided. Paradoxical Middle Turbinate is a condition in which the middle turbine bends to one side and converges to mid-meatus and causes blockage of drainage. Hypertrophy of uncinate process, lateral or medial aberration, and pneumatization can cause OMC obstruction.

Ethmoidal Bulla is the largest anterior ethmoidal cell that appears to have the highest pneumatization, in addition, it may be filled with pus, cysts or polyps. Its hypertrophy leads to rhinosinusitis. Agger Nasi Cell is located at the level of the anterior ethmoidal and the lacrimal bone is located at the starting location of the middle turbinate. Its spread causes chronic or recurrent frontal sinusitis.

Haller's Cell extends from the anterior ethmoid to the orbital floor. Its excessive growth leads to OMC obstruction. Since these structural disorders of the osteomeatal complex rarely respond to drug treatments, they usually require surgical treatment (2). Cross-sectional analysis of these anatomical variations is effective as a part of the preoperative evaluation of the success and safety of paranasal sinuses surjery (including FESS and Rhinoplasty).

Cone Beam Computed Tomography (CBCT) provides three-dimensional images with high accuracy and precision with less radiation dose and less metal artifact compared with MDCT . CBCT images have good qualities for observing and evaluating paranasal sinuses even at the lowest radiation dose (3, 1). In study of Khojastehpour et al. in Iran, Agger Nasi cells were the most common anatomical variation (93.2%), followed by Haller's cell (68%) in CBCT images. While Ali and colleagues in India reported a 36.3% incidence for Haller's cell. Moreover, its unilateral outbreak has been more than bilateral. Shahidi and colleagues in their study stated that CBCT evaluation in patients with sinus surgery is important in increasing the position of the treatment in order to evaluate the anatomical variation (6). Evaluation of the anatomical variation of the osteomaterial complex has an effective role in the accurate diagnosis of maxillary sinus pathologies, appropriate treatment and subsequent reduction of complications, and the results indicate a veru high sensitivity and precision of CBCT imaging with lowest radiation dose (7). Therefore, the aim of this study was to determine the anatomical variation of the osteomaterial complex in CBCT images in a population of northern Iran.

Methods

This cross-sectional study was approved by the Ethics Committee of Babol University of Medical Sciences with the registration code: MUBabol.REC.1395.163. It was performed on 159 CBCT images prepared by CBCT (Giano, Newtom, Italy). In this study, the anatomical variations of the osteomeatal complex were evaluated. Required CBCT images were collected from patients referred to an oral and maxillofacial radiology clinic in northern Iran. Patients between the ages of 18 and 81 who had CBCT imaging, the cronasal sinuses, referred to ear, nose and throat specialists, were included in the study. Images with artifacts or large sinus illnesses that cause obscuring anatomical landmarks were excluded.

After collecting required CBCT images, the anatomical variations of the osteomeatal complex at different sections (0.5 mm thickness and 1 mm interval) were examined by two oral, maxillofacial radiologists simultaneously and the result of the final agreement was registrated in the checklist. Anatomical variations including Concha Bolusa, Paradoxical Middle Turbinate, Uncinate process Hypertrophy, Hypertrophy Ethmoidal Bulla, Agger Nasi Cell, and Haller's Cell were assessed in terms of frequency and gender, unilateral/bilaterally and unilaterally and side of involvment (Left / Right). In order to investigate the anatomical variations of the osteomaterial complex, all available sections were used. Data were analyzed by SPPS 22 using descriptive statistics, chi-square, and chi-square tests. $p<0.05$ was considered as significant.

Results

Of the 159 cases studied, 76(47.8%) were female and 83(52.2%) were male and between the ages of 18 and 80 years (34.96±14.5 years). In all studied subjects, at least one anatomical variation was observed and in most cases there was more than one

[DOR: 20.1001.1.15614107.1397.20.4.5.9]
[DOI: 10.18869/acadpub.jbums.20.4.30]

anatomical variation in one person. The cells of Agger Nasi Cell and Concha Bullosa were the most common findings with 143 cases (89.9%) and 151 cases (95%), which were often bilateral (Fig 1). The least frequent was in Ethmoidal Bulla hypertrophy which was observed in only 9 cases (7.5%). Only in the case of anatomical variations of the Agger Nasi Cell and Concha Bullosa were significantly bilateral and in Haller's Cell was unilateral ($p<0.05$). One-sided hypertrophy of Ethmoidal Bulla was seen in only 5 cases, all of which were left-sided. There was a significant increase in the hypertrophy of Ethmoidal Bulla in the left side than the right side ($p<0.05$) (Table 1).

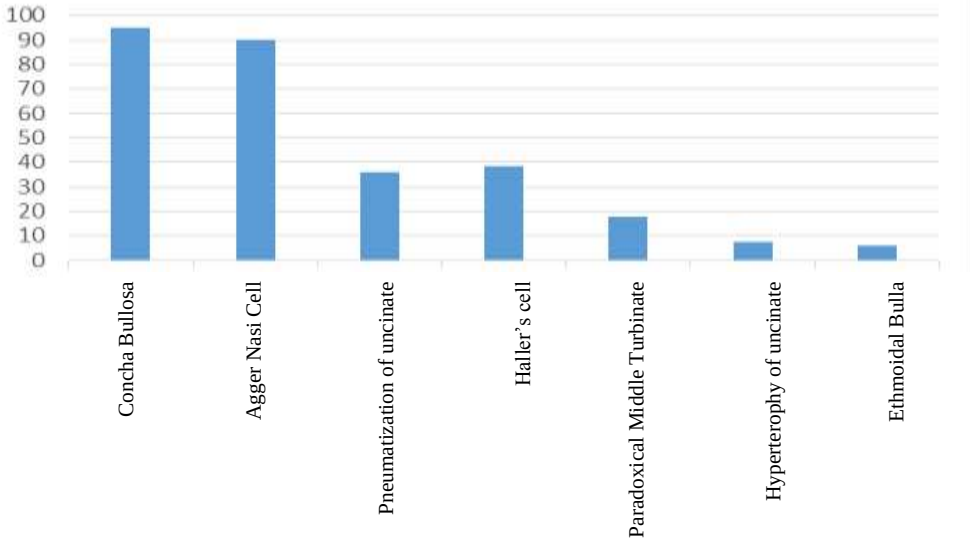

Figure 1. Frequency distribution of anatomical variations in coronal images of paranasal sinuses.

Table 1. Frequency distribution of different anatomic indices in relation to the unilateral / bilateral and side of involvment in the coronal images of paranasal sinuses

The involved anatomical index	Bilateral N(%)	Unilateral N(%)			P-value
		Total	Right	Left	
Agger Nasi Cell 143(89.9)	123(86)	20(14)	11(55)	9(45)	0.655
Concha Bullosa 151(95)	122(80.8)	29(19.2)	9(31.03)	20(68.9)	0.041
Pneumatization of uncinate process 57(7.5)	17(29.82)	40(70.17)	13(32.5)	27(67.5)	0.027
Hyperterophy of uncinate process 12(7.5)	4(33.33)	8(66.67)	5(62.5)	3(37.5)	0.48
Haller's cell 61(38.4)	8(13.11)	53(86.88)	22(41.51)	31(58.49)	0.216
Paradoxical Middle Turbinate 28(17.6)	16(57.14)	12(42.85)	6(50)	6(50)	-
Ethmoidal Bulla 9(5.7)	4(44.44)	5(55.56)	1(20)	4(80)	0.18

Discussion

In this study, Concha Bullosa was the most common anatomical variation with a frequency of 95%. This anatomical disorder plays a role in the development of chronic sinusitis and prevents mucus withdrawal (1). In various studies, the frequency of this case has been reported from less than 5% to more than 70% (10-18, 3, 2). Variable frequency of the Concha Bullosa may be due to racial differences and the size of the population studied in various studies. In this study, the bilateral presence of Concha Bullosa was significantly more than one-sided, which is in contrast with the study of Wani, in which the unilateral presence of Concha Bullosa was sifnificant compared to bilateral outbreak (11). In addition, the frequency of Concha Bullosa did not show a significant relationship with sex, which is consistent with studies by Khojastepour et al. and Budu et al. (3, 2). There was no significant correlation between the relationship between Concha Bullosa and other anatomical

[DOR: 20.1001.1.15614107.1397.20.4.5.9]
[DOI: 10.18869/acadpub.jbums.20.4.30]

variations. In the present study, Agger Nasi Cell with 89.9% frequency were the second anatomical variation of the osteomeatal complex and its bilateral prevalence was significantly higher than unilateral prevalence. Its spread can cause chronic or recurrent frontal sinusitis associated with symptoms such as pressure in the face, nasal congestion, nasal discharge, sinus pain, and headache (2).

Regarding the amount of Agger Nasi Cell , there was a significant increase in bilateral prevalence and no significant relation with sex in agreement with study of Khojastepour, While in studies of Budu et al. and Armani et al. were significantly less prevalent, there was no significant difference between the unilateral and bilateral presence in study of Wani et al. (11, 10, 2). In this study, the frequency of Haller's Cell was 38.4% and Ali, Kaygusuz, Fadda and Bolger were 2%, 16.1%, 36.3% and 45.9%, respectively (15, 12, 8, 4). In this study, the unilateral frequency of Haller's Cell was significantly higher bilateral.

In the study of Wani et al., all observed Haller's Cell was unilateral (11). But in the study of Khojastepour et al., the prevalence of bilateral cases was more than one-sided (3) and, as in the current study, there was no significant relationship with sex. Uncinate process hypertrophy can also lead to narrowing of the osteomeatal complex and therefore lead to sinusitis. In the present study, the frequency of this case was 7.5%, which was agreed by Aramani et al., which stated that this frequency was 5.6% (10). However, in the study of Wani et al , this frequency was 21%, which is much higher than the findings of the present study (11). This significant difference in the prevalence may be due to race, geography and population size. In this study, the frequency of Paradoxical Middle Turbinate was 17.6% and although its bilateral occurrence was higher, but no significant difference was observed. In the Wani and Fadda studies, the prevalence was 9.33% and 6.6%, respectively, and the unilateral presence was significantly higher than that of the present study (12,11). In this study, there was no significant relationship between gender and anomaly and there was no difference in the frequency of unilateral cases between left and right sides.

In the study of Khojastepour et al., the prevalence of this case was 10%, and it was observed in both sexes to a similar extent, its unilateral presence was more than bilateral, and the presence of unilateral prevalence in left side was two folds higher than that of the right (3). In this study, Ethmoidal Bulla hypertrophy with an frequency of 5.7% had the least anatomical variation and its unilateral prevalence was similar to bilaterall. The frequency of this anomaly was 32.8% in the study of Fadda et al., its unilateral prevalence was more than bilateral (12). In this study, Concha Bullosa and Agger Nasi Cell were the most common anatomical variations that often had bilateral presence. Therefore, due to the high prevalence of anatomical variations in the osteomeatal complex, CBCT images appear to be suitable for pre-treatment evaluation due to high resolution than other three-dimensional modalities.

Conflict of Interest: No conflicts of interest.

Acknowledgment

Hereby, we would like to thank from the Research Council of Babol University of Medical Sciences for the financial support of this research.

[DOR: 20.1001.1.15614107.1397.20.4.5.9]
[DOI: 10.18869/acadpub.jbums.20.4.30]

References

1.White SC, Pharoah MJ. Oral Radiology Principles and Interpretation, 7th ed. Mosby Elsvier; 2014.

2.Budu V, Schnider A, Tache MS, Bulescu I. Evaluation of ostiomeatal complex pathology related to endoscopic sinus surgery–a retrospective analysis. Romanian J Rhinol. 2015;5(18):2393-3356.

3.Khojastepour L, Mirhadi S, Mesbahi SA. Anatomical variations of ostiomeatal complex in cbct of patients seeking rhinoplasty. J Dent Shiraz Univ Med Sci. 2015;16(1):42-8.

4.Ali IK, Sansare K, Karjodkar FR, Vanga K, Salve P, Pawar AM. Cone-beam computed tomography analysis of accessory maxillary ostium and Haller cells: prevalence and clinical significance. Imag Sci Dentist. 2017;47(1):33-37.

5.Roman RA, Hedesiu M, Gersak M, Fidan F, Baciut G, Baciut M. Assessing the prevalence of paranasal sinuses anatomical variants in patients with sinusitis using cone beam computer tomography. Clujul Med. 2016;89(3): 423-9.

6.Shahidi S, Zamiri B, Momeni Danaei S, Salehi S, Hamedani S. Evaluation of anatomic variations in maxillary sinus with the aid of cone beam computed tomography (cbct) in a population in south of iran. J Dentist. 2016;17(1):7-15.

7.Friedrich RE, Fraederich M, Schoen G. Frequency and volumetry of infraorbital ethmoid cells (Haller cells) on cone-beam computed tomograms (CBCT) of the mid-face. GMS Interdiscip Plast Reconstr Surg DGPW. 2017;6.

8.Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. Laryngoscope. 1991;101(1):56-64.

9.Navarro JAC. The nasal cavity and paranasal sinuses: surgical anatomy. Heidelberg: Springer; 2001.

10.Aramani A, Karadi RN, Kumar S. A Study of Anatomical Variations of Osteomeatal Complex in Chronic Rhinosinusitis Patients-CT Findings. J Clin Diagn Res. 2014;8(10):1-4.

11.Wani AA, Kanotra S, Lateef M, Ahmad R, Qazi SM, Ahmad S. CT scan evaluation of the anatomical variations of the ostiomeatal complex. Indian J Otolaryngol Head Neck Surg. 2009;61(3):163-8.

12.Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G. Multiparametric statistical correlations between paranasal sinus anatomic variations and chronic rhinosinusitis. Acta Otorhinolaryngologica Italica. 2012; 32(4):244-251.

13.PÉREZ-PIÑAS I, SABATÉ J, CARMONA A, CATALINA-HERRERA CJ, JIMÉNEZ-CASTELLANOS J. Anatomical variations in the human paranasal sinus region studied by CT J Anat. 2000;197(2): 221-7.

14.Dutra LD, Marchiori E. Helical computed tomography of the paranasal sinuses in children: evaluation of sinus inflammatory diseases. Radiologia Brasileira. 2002;35:161-9.

15.Kaygusuz A, Haksever M, Akduman D, Aslan S, Sayar Z. Sinonasal anatomical variations: their relationship with chronic rhinosinusitis and effect on the severity of disease—a computerized tomography assisted anatomical and clinical study. Indian J Otolaryngol Head Neck Surg. 2014;66(3):260-6.

16.Al-Abri R, Bhargava D, Al-Bassam W, Al-Badaai Y, Sawhney S. Clinically significant anatomical variants of the paranasal sinuses. Oman Med J. 2014;29(2):110-3.

17.Liu X, Zhang G, Xu G. Anatomic variations of the ostiomeatal complex and their correlation with chronic sinusitis: CT evaluation. Zhonghua er bi yan hou ke za zhi. 1999; 34(3):143-6.

18.Zinreich SJ, Mattox DE, Kennedy DW, Chisholm HL, Diffley DM, Rosenbaum AE. Concha Bullosa: CT Evaluation. J Comp Assis Tomo. 1988;12(5):778-84.

[DOR: 20.1001.1.15614107.1397.20.4.5.9]

[DOI: 10.18869/acadpub.jbums.20.4.30]