

Anatomical Variations of Anterior Osteomeatal Complex in Patients With Chronic Sinusitis

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Abstract

Background: Identifying predisposing factors for chronic sinusitis is very important.

Objectives: Anatomical variation of the lateral nasal wall has been investigated in several studies and it has been suggested as a predisposing factor for sinusitis.

Patients and Methods: In this case-control study, 74 patients who were diagnosed with chronic sinusitis (the case group) based on clinical criteria and CT scan were entered into the study and 74 patients without chronic sinusitis were considered as the control group. CT scans of all patients were reviewed by a radiologist to interpret and evaluate anatomic variations of anterior osteomeatal complex including nasal deviation, concha bullosa, agger nasi, lateralized uncinate, Haller's cells, paradoxical middle turbinate, and maxillary hypoplasia. Data were analyzed using the chi-squared test and Fisher's exact test with SPSS software version 18. $P < 0.05$ was considered statistically significant.

Results: Results showed that the most common sinus involved was maxillary sinus. Among anatomic variations, septal deviation and concha bullosa were associated with chronic sinusitis ($P < 0.01$ and $P < 0.032$, respectively).

Conclusions: Among anatomic variations, septal deviation and concha bullosa are predisposing factors for chronic sinusitis and we recommend that patients with chronic sinusitis be treated by surgical procedures.

Keywords: Chronic Sinusitis, Anterior Osteomeatal Complex, Anatomic Variation

1. Background

Chronic sinusitis is diagnosed based on clinical symptoms. This diagnosis requires persistent complaints of the patient for more than 12 consecutive weeks. There are many causes for chronic rhinosinusitis and there is an overlap between most of them. Pathophysiological mechanisms include two groups of external (environmental) mechanisms and internal mechanisms that are associated with the host (1). Computed tomography (CT) scan is the standard imaging method for sinus examination and it is an excellent diagnostic tool for confirming the presence of inflammation and assessing their extent in sinuses. It provides information more than what can be achieved by endoscopic studies (2). It is very important to identify predisposing factors for chronic sinusitis. Paranasal anatomic variants have been investigated in several studies and have been proposed as a predisposing factor for sinusitis (3). The importance of an anatomic variation is dependent on its relationship with osteomeatal channels and nasal airways (1, 4). Some anatomical variations are considered

pathogenic for chronic sinusitis and its recurrence (5).

Anatomic variations of middle meatus structures can complicate lateral nasal septum and anterior osteomeatal complex. Understanding these variations makes sinonasal surgery safer and more effective. Identifying these anatomical variations minimizes damages to critical structures such as the orbit and skull base (6, 7).

Anatomic variation in nasal septum is also common in children. It seems that local, systemic or environmental factors play a more important role in sinusitis of children compared to anatomic variation. Since no definite relationship exists between anatomical variation and sinus disease, the surgery in children should be avoided (8).

2. Objectives

This study aimed to examine the relationship between anatomic variations of anterior osteomeatal complex with evidence of chronic sinusitis in the radiological evaluation of patients. Based on the results of this study, the surgeon can predict the relationship between the mentioned

anatomic abnormality and the disease. Therefore, the surgeon can add the required surgery method for removal of the disorder resulting in the pathology to the treatment plan, if needed.

3. Patients and Methods

In this cross-sectional and case-control study, all patients who were referred to the ear, nose and throat clinic of Imam Khomeini hospital, Ahvaz, Iran, in 2011 and diagnosed with chronic sinusitis based on clinical criteria and also criteria of Lanza and Kennedy (1) were examined. CT scans of paranasal sinuses in coronal, axial and sagittal sections were taken from the patients. If there were radiological changes confirming clinical diagnosis in maxillary ethmoid and frontal sinuses (sinuses around anterior osteomeatal complex), patients were entered into the study. In case of previous nose surgery or systemic diseases associated with current clinical symptoms, patients were excluded from the study. Clinical and radiological data of the patients were collected and recorded. Similarly, another group of patients who were referred to the ear, nose and throat clinic with other complaints were studied as the control group. Patients were undergone similar CT scans of paranasal sinuses and if there were similar radiological changes in chronic sinusitis in radiological images, they were excluded from the study. Afterwards, CT scans of all patients were reviewed by the radiologist for interpretation and examination of anatomical variations surrounding anterior osteomeatal complex. The examination was done in terms of anatomical variations including nasal deviation, concha bullosa, agger nasi, Haller's cells, paradoxical middle turbinate, and maxillary hypoplasia. Data were analyzed using the chi-squared test and Fisher's exact test with SPSS software version 18. $P < 0.05$ was considered statistically significant.

4. Results

From a total of 148 patients, 74 cases had chronic sinusitis (the case group) and 74 patients as the control group. In the chronic sinusitis group, 44 cases (56.4%) were males and 30 cases (43.3%) were females with the mean age of 34.2 years. In the control group, 40 cases (54.1%) were males and 34 cases (45.9%) were females with the mean age of 32.5 years.

The CT scan results showed that the most common anatomic variations were nasal deviation, concha bullosa and agger nasi (Table 1). The most common involved sinus was maxillary sinus (Figure 1).

The following anatomical variations were reported: 1, nasal septum deviation: 71 patients had nasal deviation.

Table 1. Frequency Distribution of Anatomical Variations in All Studied Cases

Order	Anatomic Abnormality	Number	Percentage (of Total Cases)
1	Nasal deviation	71	48
2	Concha bullosa	47	31.8
3	Agger nasi	19	23
4	Lateralized uncinate	34	12.8
5	Haller's cells	12	8.1
6	Paradoxical middle turbinate	9	6.1
7	Maxillary hypoplasia	3	3.4

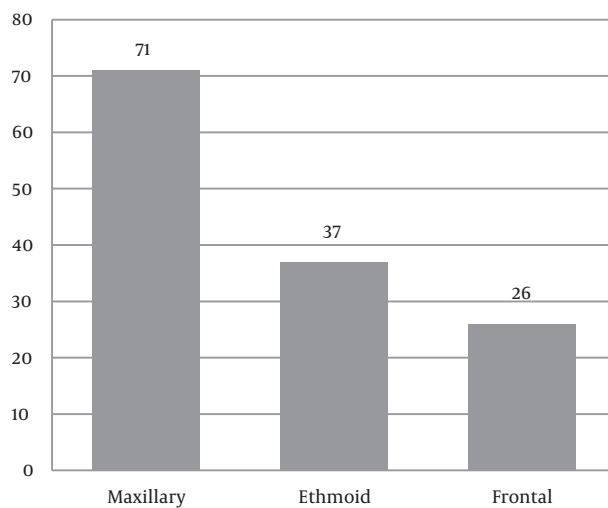


Figure 1. Frequency Distribution Diagram of Sinus Involvement in Patients With Chronic Sinusitis

In the patient group, 42 cases (59.2%) and in the control group, 29 cases (40.8%) had nasal deviation. Among 71 cases with nasal deviation, 42 patients had sinusitis while among 77 cases without nasal deviation, 32 patients had sinusitis. Nasal deviation was more common in patients with sinusitis and this difference was statistically significant ($P = 0.032$); 2, agger nasi, 34 patients had agger nasi (Figure 2). In the patient group, 20 cases (58.8%) and in the control group, 14 cases (41.2%) had agger nasi and this difference was not statistically significant ($P = 0.241$).

3, Concha bullosa: 47 patients had concha bullosa (Figure 3). In the patient group, 31 cases (66%) and in the control group, 16 cases (34%) had concha bullosa. Among 47 cases with concha bullosa, 31 patients had sinusitis while among 101 cases without concha bullosa, 43 patients suffered from sinusitis. Concha bullosa was more common in patients with sinusitis and this difference was statistically signifi-

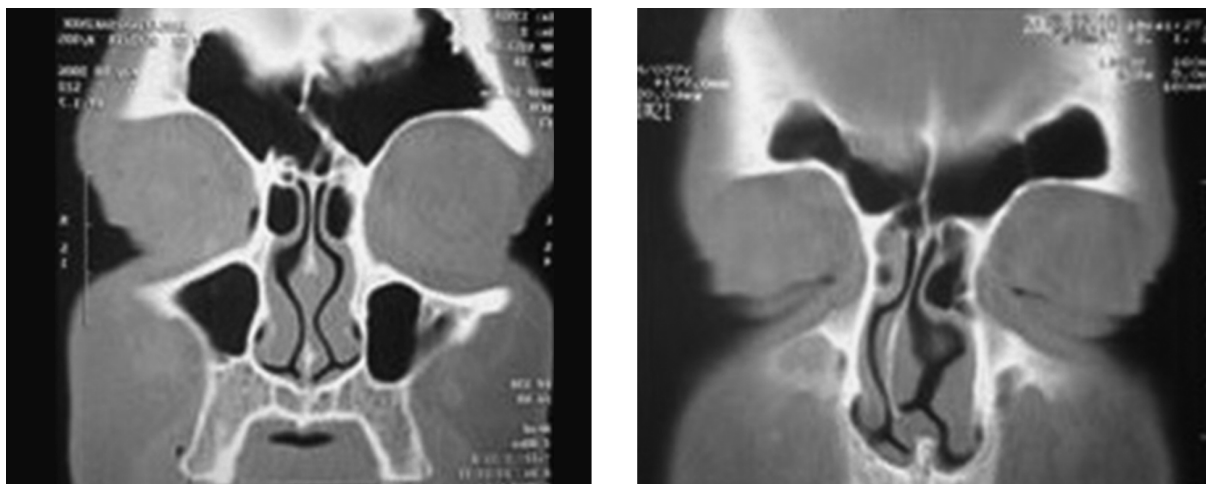


Figure 2. Agger Nasi

cant ($P = 0.008$).

4, Others: chronic sinusitis was not associated with lateralized uncinate ($P = 0.219$), Haller's cells ($P = 0.547$), paradoxical middle turbinate ($P = 0.747$), and maxillary hypoplasia ($P = 0.245$).

5. Discussion

Knowing the details of anatomical variations of paranasal sinuses is necessary for a surgeon who performs endoscopic sinus operations and also for a radiologist who conducts presurgery examination (9). Variations of anterior osteomeatal complex commonly occur. Variations may be a cause of chronic sinusitis. Therefore, proper planning is important for treatment of these variations in sinus surgery (10).

The most common reported variation was nasal septum deviation (48%), followed by concha bullosa (31.8%) and agger nasi cells (23%). Nasal septum deviation and concha bullosa were associated with chronic sinusitis ($P < 0.01$, and $P = 0.032$, respectively). Other variations were not associated with the occurrence of chronic sinusitis.

In the study of Danese (11) and Tonai (12), nasal deviation was associated with chronic sinusitis. This association was also shown in the current study ($P = 0.032$). Li believes that in terms of aerodynamics, in patients with nasal septum deviation, both sides of the nasal cavity are prone to chronic sinusitis (13). It seems that it is necessary to correct nasal deviation to address the predisposing factor in patients.

Lidov (14) and Clark (15) showed that there is an association between concha bullosa and chronic sinusitis. So, con-

cha bullosa can be considered a predisposing factor for the occurrence of chronic sinusitis. Our study also confirmed it ($P < 0.01$), while in the study of Nadas (16) and Sivasli (17) no association was found between concha bullosa and chronic sinusitis. It is probably due to the definition of concha bullosa.

Agger nasi and chronic sinusitis were not associated in the study of Sivasli (17) and Tonai (12). The results of the current study did not show agger nasi as a predisposing factor for chronic sinusitis ($P = 0.241$). It seems that the modification of this variation cannot make any changes in the course of chronic sinusitis.

In the present study, chronic sinusitis was not associated with lateralized uncinate ($P = 0.219$), Haller's cells ($P = 0.547$), paradoxical middle turbinate ($P = 0.747$) and maxillary hypoplasia ($P = 0.245$). Studies of Sivasli (17), Danese (11), Tonai (12) and Bolger (18) confirm the obtained results of the current study. However, in all studies, the small sample size can be considered as a limitation. Therefore, this group of variations cannot be definitively ineffective in the incidence of chronic sinusitis. Further studies with larger sample sizes are required to confirm the results and findings of our study.

In conclusion, we can state that chronic sinusitis treatment is based on eliminating predisposing factors. Among the mentioned variations which are more common in the general population (septal deviation, concha bullosa, and agger nasi), it seems that nasal septum deviation and concha bullosa are predisposing factors for chronic sinusitis. We recommend that patients with chronic sinusitis be treated by surgical procedures.

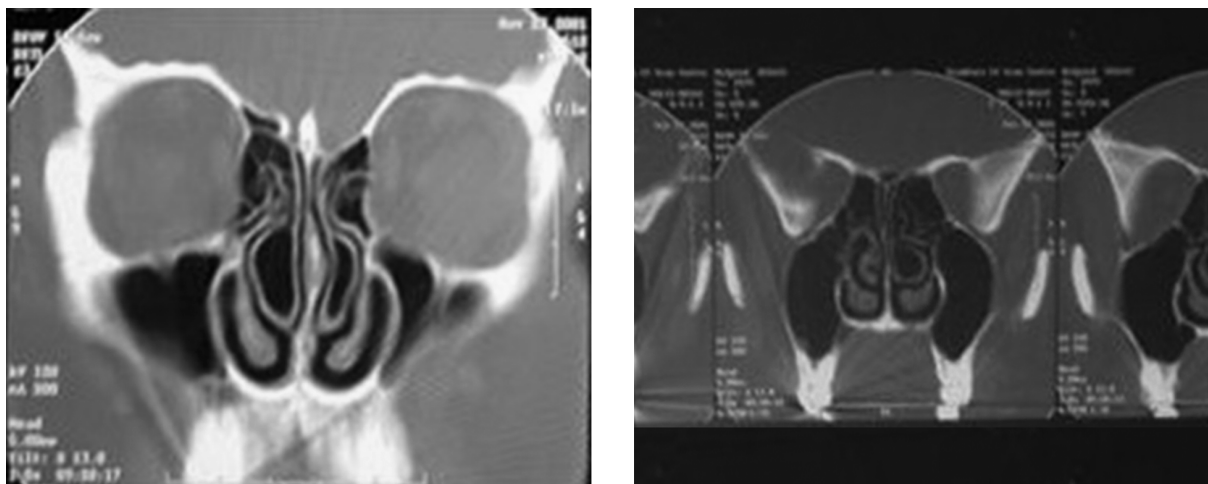


Figure 3. Concha bullosa

Table 2. Prevalence of Anatomic Variations in Patients With Chronic Sinusitis and the Control Group

Anatomic Variation	Without Chronic Sinusitis (Control)	With Chronic Sinusitis (Case)
Nasal deviation		
Has	29	42
Has not	45	32
Concha bullosa		
Has	16	31
Has not	58	43
Agger nasi		
Has	14	20
Has not	60	54
Lateralized uncinate		
Has	7	12
Has not	67	62
Haller's cells		
Has	5	7
Has not	69	67
Paradoxical middle turbinate		
Has	5	4
Has not	69	70
Maxillary hypoplasia		
Has	0	3
Has not	74	71

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Footnotes

Authors' Contribution: All authors had equal role in design, work, statistical analysis and manuscript writing.

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References

- Michael S. The pathogenesis of rhinosinusitis. 2010 :703-8. doi: [10.1016/b978-0-323-05283-2.00048-3](https://doi.org/10.1016/b978-0-323-05283-2.00048-3).
- Nikakhlagh S, Saki N, Tahmasbi M, Jouhari H. Anatomic variations of the bone in sinonasal ct scan: A report of 279 cases. 2008
- Fagnan LJ. Acute sinusitis: a cost-effective approach to diagnosis and treatment. *Am Fam Physician*. 1998;**58**(8):1795-802. [PubMed: [9835855](https://pubmed.ncbi.nlm.nih.gov/9835855/)] 805-6.
- Berjis N, Hashemi SM, Rogha M, Biron MA, Setareh M. Some anatomical variation of paranasal sinuses using sinus endoscopic approach on "cadaver" in Isfahan, Iran. *Adv Biomed Res*. 2014;**3**:51. doi: [10.4103/2277-9175.125774](https://doi.org/10.4103/2277-9175.125774). [PubMed: [24627859](https://pubmed.ncbi.nlm.nih.gov/24627859/)].
- Slavin RG, Spector SL, Bernstein IL, Kaliner MA, Kennedy DW, Virant FS, et al. The diagnosis and management of sinusitis: a practice parameter update. *J Allergy Clin Immunol*. 2005;**116**(6 Suppl):S13-47. [PubMed: [16416688](https://pubmed.ncbi.nlm.nih.gov/16416688/)].
- Buljick-Cupic MM, Savovic SN, Jovicevic JS. [Influence of anatomic variations of the structures of the middle nasal meatus on sinonasal diseases]. *Med Pregl*. 2008;**61**(3-4):135-41. [PubMed: [18773688](https://pubmed.ncbi.nlm.nih.gov/18773688/)].
- Davoodi M, Saki N, Saki G, Rahim F. Anatomical variations of neurovascular structures adjacent sphenoid sinus by using CT scan. *Pak J Biol Sci*. 2009;**12**(6):522-5. [PubMed: [19580003](https://pubmed.ncbi.nlm.nih.gov/19580003/)].
- Kim HJ, Jung Cho M, Lee JW, Tae Kim Y, Kahng H, Sung Kim H, et al. The relationship between anatomic variations of paranasal sinuses and chronic sinusitis in children. *Acta Otolaryngol*. 2006;**126**(10):1067-72. doi: [10.1080/00016480600606681](https://doi.org/10.1080/00016480600606681). [PubMed: [16923712](https://pubmed.ncbi.nlm.nih.gov/16923712/)].
- Kantarci M, Karasen RM, Alper F, Onbas O, Okur A, Karaman A. Remarkable anatomic variations in paranasal sinus region and their clinical importance. *Eur J Radiol*. 2004;**50**(3):296-302. doi: [10.1016/j.ejrad.2003.08.012](https://doi.org/10.1016/j.ejrad.2003.08.012). [PubMed: [15145491](https://pubmed.ncbi.nlm.nih.gov/15145491/)].
- 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. [PubMed: [12764803](https://pubmed.ncbi.nlm.nih.gov/12764803/)].
- Danese M, Duvoisin B, Agrifoglio A, Cherpillod J, Krayenbuhl M. [Influence of naso-sinusal anatomic variants on recurrent, persistent or chronic sinusitis. X-ray computed tomographic evaluation in 112 patients]. *J Radiol*. 1997;**78**(9):651-7. [PubMed: [9537184](https://pubmed.ncbi.nlm.nih.gov/9537184/)].
- Tonai A, Baba S. Anatomic variations of the bone in sinonasal CT. *Acta Otolaryngol*. 1996;**525**:9-13.
- Li L, Han D, Zhang L, Li Y, Zang H, Wang T, et al. Aerodynamic investigation of the correlation between nasal septal deviation and chronic rhinosinusitis. *Laryngoscope*. 2012;**122**(9):1915-9. doi: [10.1002/lary.23428](https://doi.org/10.1002/lary.23428). [PubMed: [22786708](https://pubmed.ncbi.nlm.nih.gov/22786708/)].
- Lidov M, Som PM. Inflammatory disease involving a concha bullosa (enlarged pneumatized middle nasal turbinate): MR and CT appearance. *AJNR Am J Neuroradiol*. 1990;**11**(5):999-1001. [PubMed: [2121008](https://pubmed.ncbi.nlm.nih.gov/2121008/)].
- Clark ST, Babin RW, Salazar J. The incidence of concha bullosa and its relationship to chronic sinonasal disease. *American J rhinology*. 1989;**3**(1):11-2.
- Nadas S, Duvoisin B, Landry M, Schnyder P. Concha bullosa: frequency and appearances on CT and correlations with sinus disease in 308 patients with chronic sinusitis. *Neuroradiology*. 1995;**37**(3):234-7. [PubMed: [7603601](https://pubmed.ncbi.nlm.nih.gov/7603601/)].
- Sivasli E, Sirikci A, Bayazyt Y, Gumusburun E, Erbagci H, Bayram M, et al. Anatomic variations of the paranasal sinus area in pediatric patients with chronic sinusitis. *Surg Radiol Ana*. 2002;**24**(6):399-404.
- Bolger WE, Butzin CA, Parsons DS. Paranasal sinus bony anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. *Laryngoscope*. 1991;**101**(1 Pt 1):56-64. doi: [10.1288/00005537-199101000-00010](https://doi.org/10.1288/00005537-199101000-00010). [PubMed: [1984551](https://pubmed.ncbi.nlm.nih.gov/1984551/)].