©2022 ASP Ins., *Afarand Scholarly Publishing Institute, Iran*
eISSN: 2645-7687. Journal of Clinical Care and Skills. 2022;3(1):37-40.

Journal of Clinical Care and Skills

Anatomic Variations of Sphenoid Sinus from Cone Beam Computed Tomography Images in the Iranian Population

ARTICLE INFO

Article Type
Original Resaerch

Authors
Sabz Gh.[1] *MD,*
Derakhshan M.[2] *MD,*
Panahi S.R.*[3] *MD*

How to cite this article
Sabz Gh, Derakhshan M, Panahi S R. Anatomic Variations of Sphenoid Sinus from Cone Beam Computed Tomography Images in the Iranian Population. Journal of Clinical Care and Skills. 2022;3(1): 37-40.

[1]Department of Otolaryngology, School of Medicine, Yasuj University of Medical Sciences, Yasuj, Iran
[2]General Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Department of Oral and Maxillofacial Radiology, School of Dentistry, Yasuj University of Medical Sciences, Yasuj, Iran

***Correspondence**
Address: Oral and Maxillofacial Radiology School of Dentistry, Yasuj University of Medical Sciences, Yasuj, Iran
Phone: +98 (912) 0572510
Fax: +98 (74) 33232394
rogh ayehpanahi2@gmail.com

Article History
Received: January 8, 2022
Accepted: February 28, 2022
ePublished: May 11, 2022

ABSTRACT

Aims Sphenoid sinus is one of the most inaccessible paranasal sinus, and is closely correlated to many vascular and neural structures. Anatomic variation of the sphenoid sinus can complicate surgery in this area. The present study aimed to define the sphenoid sinus variations and the relevant structures using cone-beam computed tomography.

Material & Methods This cross-sectional descriptive study was performed on cone-beam computed tomography of 129 patients. Simple random sampling was used to select cone-beam computed tomography to specify the sphenoid sinus anatomical variations. Data was gathered in the form and analyzed using the descriptive and analytic tests, including the Chi-square test.

Findings The most common sphenoid sinus variations were observed for sagittal sellar (89.1%) and the lowest was Sagittal conchal (1.6%). A significant difference was also found between the frequency of axial-anterior type pneumatization and Sagittal sellar between age groups. But, no significant differences were found between males and females in terms of sphenoid sinus variations. Significant associations were also found between some sphenoid sinus variations ($p<0.05$).

Conclusion The sphenoid sinus has a highly anatomical structure variation. Sellar and pre-sellar type pneumatization are more common than conchal and post-sellar types.

Keywords Sinonasal Tract; Anatomic; Sphenoid Sinus; Cone Beam Computed Tomography

CITATION LINKS

[1] Anatomic variation of sphenoid sinus and related structures in Libyan population: CT scan study [2] Repair of carotid artery perforations during transsphenoidal surgery [3] Anatomic variations of the sphenoid sinus and their impact on trans-sphenoid pituitary surgery [4] Normal variations of sphenoid sinus and the adjacent structures detected in cone beam computed tomography [5] The anatomical variability of the sphenoid sinus in CBCT - a retrospective study [6] A study of anatomical variations of osteomeatal complex in chronic rhinosinusitis patients-CT findings [7] The anatomy and physiology of the sphenoid sinus [8] Analysis of pneumatization and neurovascular structures of the sphenoid sinus using cone-beam tomography (CBT) [9] Anatomic variations of sphenoid sinus pneumatization in a sample of Turkish population: MRI study [10] Patterns of pneumatization and septation of the sphenoidal sinus [11] Extensions of the sphenoid sinus: a new classification [12] As variações na anatomia do seio esfenoidal e assoalho selar para realização de endoscopia transesfenoidal em adultos [13] Sphenoid sinus types, dimensions and relationship with surrounding structures [14] Sphenoid sinus: anatomic variations and their importance in trans-sphenoid surgery [15] Sphenoid sinus: An anatomic and endoscopic study in Asian cadavers [16] Variations in sphenoid sinus anatomy with special emphasis on pneumatization and endoscopic anatomic distances [17] Hyperaeration of the sphenoid sinus: cause for concern?

Introduction

The sphenoid sinus is a deep and inaccessible paranasal sinus in the skull. This structure is surrounded by many vital structures, such as the cavernous sinus, optic nerve, and internal carotid artery [1]. One of the serious complications of transsphenoidal surgery is the injury to the optic nerve or internal carotid artery [2]. Safe access to the sellae is notably influenced by the pattern of pneumatization in the sphenoid sinus. Moreover, anatomic variations are likely to predispose the sphenoid sinus to recurrent or chronic sinusitis. Hence, the sphenoid sinus anatomical variations have an important impact on the possibility of complications in surgical procedures [3]. Knowing more about the variable regional anatomy of the sphenoid sinus decreases the surgical complications that follow transsphenoidal and functional endoscopic sinus surgery [4]. The sphenoid sinus has an irregular configuration, and different degrees of pneumatization may be encountered; absent or extensive [1].

The wide availability of cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI) makes it easy to investigate the anatomy of sphenoid sinus preoperative [3]. Currently, the increasing use of CBCT in the placement of dental implants, treatment of sinuses, and many other similar instances has helped to determine all anatomic structures and answer the questions of different anatomical variants.

Studies have shown that anatomical changes in the sphenoid sinus lead to complexity of symptoms and potentially serious complications. To minimize neurovascular injury during surgery, CBCT can be used in the preoperative evaluation of patients undergoing sphenoid sinus endoscopic surgery [4, 5].

Despite the complicated anatomical structures of the sphenoid sinus and its vital surgical relationships, the number of relevant studies using CBCT is very limited in the Iranian population. This research aimed to investigate the frequency of sphenoid sinus variations on CBCT images.

Materials & Methods

This cross-sectional study was performed on CBCT of 195 patients who had been referred to a Dr. Panahi Radiology Center, Yasuj, Iran, from January to August 2020. Cochran's formula was used to determine the sample size (n=129). Simple random sampling was used to select CBCT to specify the sphenoid sinus anatomical variations, and 47 males and 82 females were selected. Patients who were 12 to 65 years old were placed in three categories (10- 25 years old, 26-40 years old, and 41-55 years old). The patients whose CBCT scanning was needed for evaluating the sinonasal region were included in this research. Patients with a history of systemic disease that could have affected craniofacial growth, surgical procedures in this region, periodontal disease, history of previous orthodontic treatment, trauma to the head or face, massive polyposis, clefts, fibrous dysplasia, and benign or malignant tumors that could cause changes in the sinonasal anatomy were excluded.

The subjects voluntarily participated in our experiment and completed a written informed consent form. All CBCT images were taken under specific conditions (effective radiation time between 2 and 6 seconds, 10 to 42mA based on patients' size and voxel size 0.15mm). All scans were captured with a PaX-i3D Green (Va tech America, Fort Lee, NJ, USA) and assessed in the sagittal, coronal, and axial planes by two radiologists. If there was any disagreement between the two examiners, the ultimate determination was made by consulting the skilled radiologist. Analyses of all scans were repeated after two weeks, and the findings were documented. The assessed sphenoid sinus variations include the conchal, sellar, pre-sellar, coronal-sphenoid, coronal-lateral, coronal-lesser wing, and axial-anterior type-pneumatization.

The analyses were done using version 19.0 of SPSS software. Descriptive and analytic methods such as the Chi-square test were used for analysis. The P-value of <0.05 was regarded as statistically significant.

Finding

The most sphenoid sinus variation was sagittal-sellar, and the least was sagittal-conchal. Pre-sellar type of sphenoid sinus variation was moderate in prevalence (10.1%). The prevalence of coronal sphenoid and coronal lateral variation were higher than coronal lesser wing (Table 1).

A significant difference was also found between the frequency of axial-anterior type-pneumatization and Sagittal-sellar in three groups of age (p<0.05). But no significant differences were found between males and females in terms of sphenoid sinus variations (Table 1).

Table 1) The frequency results of sphenoid sinus variations based on age and sex (the numbers in parentheses are in percent)

Variations	**All**	**Age (years)**			**p.**	**Sex**		**p.**
		<25	26-40	>40		Male	Female	
Sagittal-conchal	2 (1.55)	2 (100.00)	0	0	0.27	1 (50.00)	1 (50.00)	1
Sagittal-sellar	114 (88.39)	39 (34.21)	59 (51.75)	16 (14.04)	0.02	42 (36.50)	73 (63.50)	0.95
Sagittal-pre-sellar	13 (10.08)	6 (46.20)	7 (53.85)	0	0.27	4 (30.80)	9 (69.20)	0.65
Coronal-sphenoid	51 (39.53)	15 (29.41)	27 (52.94)	9 (17.65)	0.053	17 (32.70)	36 (67.30)	0.48
Coronal-lateral	67 (51.94)	27 (40.91)	32 (48.48)	7 (10.61)	0.50	27 (40.30)	40 (59.70)	0.34
Coronal-lesser wing	24 (18.60)	8 (36.35)	12 (54.55)	2 (9.10)	0.87	7 (30.40)	16 (69.60)	0.51
Axial-anterior type-pneumatization	81 (62.79)	33 (41.25)	42 (5250)	5 (6.25)	0.03	29 (38.30)	52 (61.70)	0.84

Discussion

In this study, we evaluated CBCT images of 129 patients to determine the prevalence of anatomical variation of the sphenoid sinus in the Yasuj population in southwest Iran. This study is the first study to evaluate the anatomical variation in this region.

The sphenoid sinus is located at the base of the skull. By the age of 10, it expands anteriorly posteriorly, and laterally, but its full expansion occurs after adolescence [1, 2].

The vital structures adjacent to the sphenoid sinus are the internal carotid artery and the optic nerve, which may be invaded during sphenoid sinus surgery, depending on the extent of the posterior and lateral anterior expansion of the sphenoid sinus.

Anatomical variations play an important role in the ventilation and drainage of the paranasal sinuses. Therefore, they must be carefully evaluated before surgery [6]. Depending on the extension of sphenoid bone pneumatization, the sphenoid sinus has been described as being sellar, pre-sellar, or conchal [7, 3] and Güldner *et al.* classified the sphenoid sinus into the following four groups based on the pneumatization; Type I: conchal, Type II: pre-sellar, Type III: sellar, and Type IV: post-sellar [8].

In this study in different age groups, the prevalence of sagittal sellar variation was different and this difference was significant. Also, axial anterior type pneumatization in different age groups was different and this difference was significant. Other types of variations didn't differ significantly in age groups.

The prevalence of sagittal sellar type in this study was higher than other types of sphenoid sinus variations (89.1%), which is in line with the findings of Sevinc *et al.* (83%) [9], and Banna & Olutola (85.7%) [10]. The sellar type of sphenoid sinus is classified according to the extensions of the pneumatizations in six types: lateral, anterior, sphenoid body, lesser wing, clival, and combined [11]. A different classification includes type I pneumatization, with completely absent or minimal sphenoid sinus, and type II, corresponding to a pre-sellar type, type III, with the posterior sinus wall beneath the sella turcica; there are two models of type IV in which the posterior wall of the sinus is behind the sellae, with or, respectively, without air in the dorsal sellae [8]. In sellar region surgery, the degree and size of pneumatization of the sphenoid sinus are very important. For prevention of surgical complications and proper approach to operation field, precise scanning of the sellar region and sphenoid sinus is needed. Evaluation of the carotid artery and septum of the interspinous is essential [3]. For the transsphenoidal approach, the conchal type of sphenoid sinus is not contraindicated.

In this study, the sagittal conchal variation of sphenoid sinus was lower than other variations types (1.6%). This result is in line with the results of studies [7, 12, 13] but not in line with the results of Seddighi *et al.* and Tan & Ong's studies [14, 15]. In the study of Tan and Ong pre seller type was lower than other types of variations.

In the pre-sellar sphenoid sinus type, there is no bulge on the sellar floor [16]. For exploring the base of sella turcica clivus, the anterior wall of the pre-sellar type needs to be drilled. However, in the pre-sellar type, the extension of pneumatization is as far as the tuberculum sellae, in the sellar type pneumatization extends into the body of the sphenoid sinus. During the transsphenoidal approach, to obtain total exposure of the base of sellae the anterior and medial walls of the sphenoid sinus can be removed [17]. Extreme pneumatization containing other structures such as the carotid arteries and the optic nerves needs careful attention. Depending on the sphenoid sinus extension of pneumatization the bony structures overlying the optic nerve and internal carotid artery may never exist or be very thin. In this study, the prevalence of pre-sellar was 10.1%. The incidence of pre-sellar type in some studies was reported as less than 27% [3, 7, 9].

Limitations of the present study included ethnic diversity in southwestern Iran and a low sample size. Another limitation of the study was that participants were selected from only one radiography clinic and clients from similar clinics were not considered. It is suggested that more studies be conducted with a larger number of samples in different regions of the Iranian population.

Conclusion

The sphenoid sinus has a highly anatomical structure variation. Sellar and pre-sellar type pneumatization are more common than conchal and post-sellar types. The anatomical variations of the sphenoid sinus tend to give rise to the complexity of symptoms and complications Surgeons and radiologists should pay attention to anatomical variations when making preoperative assessments, and it is very important to be aware of these variations. CBCT screening should be used in the pre-surgical evaluation of patients under consideration of endoscopic sphenoid sinus surgery to minimize perioperative neural and vascular injury.

Acknowledgments: We wish to thank the surgeons of the ear, nose throat department for their support of this study.

Ethical Permissions: In this research, the code of ethics with the number IR.YUMS.REC.1399.086 was obtained from the research ethics committee of Yasuj University of Medical Sciences.

Conflicts of Interests: The authors of this manuscript certify that they have no conflict of interest regarding this research.

Authors' Contributions: Sabz Gh (First author), Main Researcher/Introduction Writer/Discussion Writer (35%); Derakhshan M (Second author), Assisstant Researcher/Methodologist/Analyst (25%); Panahi SR

(Third author), Main Researcher/ Introduction Writer/Discussion Writer/Methodologist (40%)

Funding/Support: There was no funding.

References

1- Hewaidi G, Omami G. Anatomic variation of sphenoid sinus and related structures in Libyan population: CT scan study. Libyan J Med. 2008;3(3):128-33.

2- Fukushima T, Maroon JC. Repair of carotid artery perforations during transsphenoidal surgery. Surg Neurol. 1998;50(2):174-7.

3- Hamid O, El Fiky L, Hassan O, Kotb A, El Fiky S. Anatomic variations of the sphenoid sinus and their impact on trans-sphenoid pituitary surgery. Skull Base. 2008;18(1):9-15.

4- Rahmati A, Ghafari R, AnjomShoa M. Normal variations of sphenoid sinus and the adjacent structures detected in cone beam computed tomography. J Dent. 2016;17(1):32-7.

5- Schwerzmann MC, Suter VGA, von Arx T. The anatomical variability of the sphenoid sinus in CBCT - a retrospective study. Swiss Dent J. 2021;132(1).

6- 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):KC01-4.

7- Baskin JZ, Kuriakose MA, Lebowitz RA. The anatomy and physiology of the sphenoid sinus. Operat Tech Otolaryngol Head Neck Surg. 2003;14(3):168-72.

8- Güldner C, Pistorius SM, Diogo I, Bien S, Sesterhenn A, Werner JA. Analysis of pneumatization and neurovascular structures of the sphenoid sinus using cone-beam tomography (CBT). Acta Radiol. 2012;53(2):214-9.

9- Sevinc O, Is M, Barut C, Erdogan A. Anatomic variations of sphenoid sinus pneumatization in a sample of Turkish population: MRI study. Int J Morphol. 2014;32(4):1140-3.

10- Banna M, Olutola P. Patterns of pneumatization and septation of the sphenoidal sinus. J Can Assoc Radiol. 1983;34(4):291-3.

11- Wang J, Bidari S, Inoue K, Yang H, Rhoton Jr A. Extensions of the sphenoid sinus: a new classification. Neurosurgery. 2010;66(4):797-816.

12- Del Carmen Becerra Romero A, Barkhoudarian G, Eduardo da Silva C, Henrique Pires de Aguiar P, Laws Júnior ER. As variações na anatomia do seio esfenoidal e assoalho selar para realização de endoscopia transesfenoidal em adultos. Jornal Brasileiro de Neurocirurgia. 2022;23(1):11-7. [Portuguese]

13- Štoković N, Trkulja V, Dumić-Čule I, Čuković-Bagić I, Lauc T, Vukičević S, et al. Sphenoid sinus types, dimensions and relationship with surrounding structures. Ann Anat. 2016;203:69-76.

14- Seddighi A, Seddighi A, Mellati O, Ghorbani J, Raad N, Soleimani MM. Sphenoid sinus: anatomic variations and their importance in trans-sphenoid surgery. Int Clin Neurosci J . 2014;1(1):31-4.

15- Tan HKK, Ong YK. Sphenoid sinus: An anatomic and endoscopic study in Asian cadavers. Clin Anat. 2007;20:745-50.

16- Kayalioglu G, Erturk M, Varol T. Variations in sphenoid sinus anatomy with special emphasis on pneumatization and endoscopic anatomic distances. Neurosciences. 2005;10(1):79-84.

17- Carter LC, Pfaffenbach A, Donley M. Hyperaeration of the sphenoid sinus: cause for concern?. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999;88(4):506-10.