Diagn Interv Radiol 2011; 17:205–208

ORIGINAL ARTICLE

A retrospective analysis of sphenoid sinus hypoplasia and agenesis using dental volumetric CT in Turkish individuals

Binali Çakur, Muhammed Akif Sümbüllü, Ahmet Berhan Yılmaz

PURPOSE
In adults, sphenoid sinus agenesis is an extremely rare anomaly. The objective of this study was to investigate the prevalence of sphenoid sinus hypoplasia and agenesis using dental volumetric computed tomography (DVCT) in a population of Turkish individuals.

MATERIALS AND METHODS
DVCT scans in the axial, coronal and sagittal planes of the sphenoid sinus of 384 patients were examined for evidence of sphenoid sinus agenesis and hypoplasia.

RESULTS
In the DVCT scans, bilateral agenesis of sphenoid sinus was not seen. Unilateral agenesis of sphenoid sinus was seen in 0.26% of the sample, and sphenoid sinus hypoplasia was seen in 0.52%. Unilateral hypoplasia of the sphenoid sinus was observed in 0.26% of the sample, and bilateral hypoplasia of sphenoid sinus was observed in 0.26%.

CONCLUSION
In this study, we found a low frequency of sphenoid sinus agenesis. Compared with sphenoid sinus agenesis, the frequency of sphenoid sinus hypoplasia was higher. DVCT may be used as a diagnostic tool to investigate the paranasal sinus.

Key words: • *agenesis* • *hypoplasia* • *cone-beam computed tomography* • *sinuses*

From the Department of Oral Diagnosis and Oral Radiology (B.Ç. ✉ *bcakur@atauni.edu.tr*), Atatürk University Faculty of Dentistry, Erzurum, Turkey.

Received 21 January 2010; revision requested 22 March 2010; revision received 31 March 2010; accepted 29 May 2010.

Published online 9 August 2010
DOI 10.4261/1305-3825.DIR.3304-10.1

The sphenoid sinuses are located in the body of the sphenoid bone, which may differ in size and in shape across different individuals. One or more vertical septa divide the sphenoid sinus into right and left sides, and the septum is rarely on the midline (1, 2). Absence of the sphenoid sinus is uncommon in adults; thus, it is important for surgeons to be aware of the anatomy of the paranasal sinus and its variations to effectively treat disease and avoid complications. In the literature, few cases of sphenoid sinus agenesis have been reported (1, 3–5).

The degree of pneumatization of the sphenoid sinus may vary considerably. Depending on the degree of pneumatization, the sphenoid sinus can be described as postsellar, presellar or conchal (Fig. 1). In conchal or fetal pneumatization of the sphenoid bone, rudimentary development of the sphenoid sinus is seen in 1% to 3% of cases; pneumatization is minimal and does not extent into the corpus of the sphenoid (1, 2, 4, 6). Presellar pneumatization of the sinus is situated in the anterior sphenoid bone. In this type of pneumatization, the sinus is pneumatized as far back as the anterior wall of the pituitary fossa. This type of pneumatization occurs in 10% of adults. In the postsphenoid or postsellar type, pneumatization extends back below the pituitary fossa. This type of pneumatization is present in 90% of cases. The position of the sinus and, therefore, its anatomic relationships depend on the extent of pneumatization. The sinus can sit far anterior to, just anterior to, or immediately under the sella turcica (conchal, presellar, and postsellar) (1–3, 6). Previous researchers have reported that sphenoid sinus agenesis occurs in 1% to 1.5% of the population (7–9). Sphenoid sinus agenesis occurs more frequently in patients with craniofacial anomalies or skeletal diseases (6).

The aim of the study was to investigate the prevalence of sphenoid sinus hypoplasia and agenesis using dental volumetric computed tomography in a population of Turkish individuals.

Materials and methods

We designed a retrospective study consisting of images of 384 patients (176 males, 208 females) who visited our clinic between June 2008 and June 2009. Dental volumetric computed tomography (DVCT) (NewTom-FP; Quantitative Radiology, Verona, Italy) scanning was done on supine patients; the patient's head was adjusted in such a way that the hard palate was parallel to the floor while the sagittal plane was perpendicular to the floor. The DVCT scans with 0.2-mm slices in the axial planes, 2-mm slices in the coronal planes and 2-mm slices in the sagittal planes were obtained. Imaging parameters were kV, 110; mA, 15; and FOV, 130 mm. The DVCT images were evaluated with respect to sphenoid sinus development and pneumatization. For this purpose, we examined the sphenoid sinus according to a method proposed by Eggesbø et al. (10).

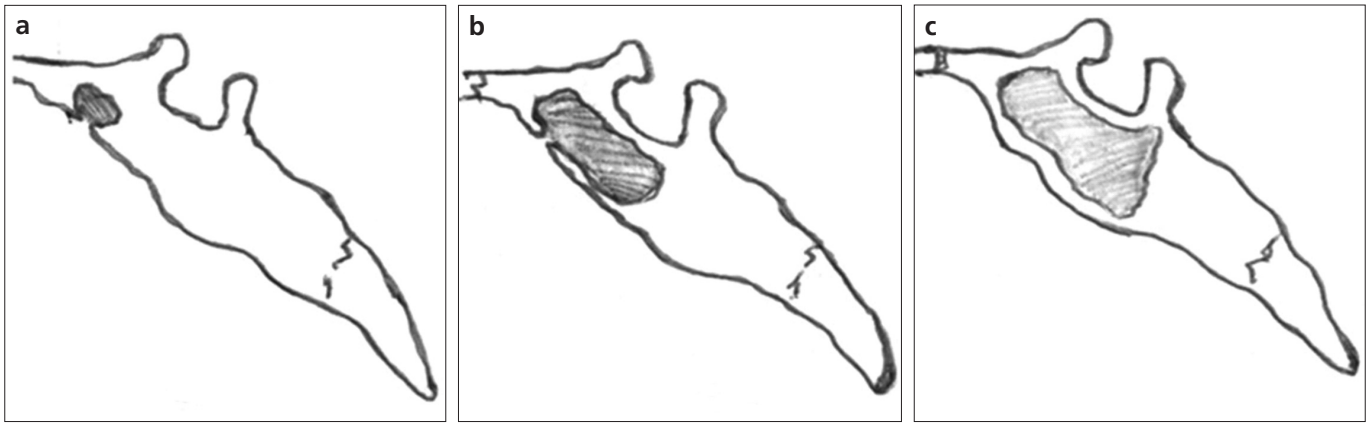

Figure 1. a–c. Conchal or fetal pneumatization **(a)**, presellar or juvenile pneumatization **(b)**, postsellar or postsphenoid pneumatization **(c)**.

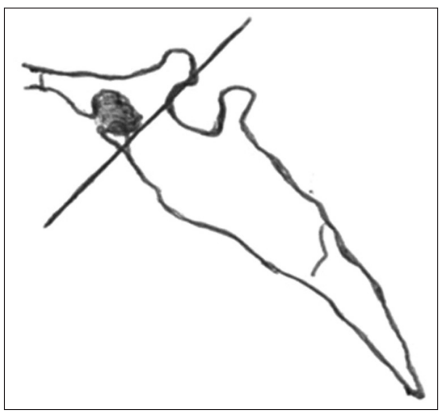

Figure 2. Sphenoid sinus hypoplasia was defined as an oval-shaped sinus with pneumatization limited to the presphenoid, i.e., anterior to the vertical plane of the tuberculum sella *(vertical line)* on the scanograms.

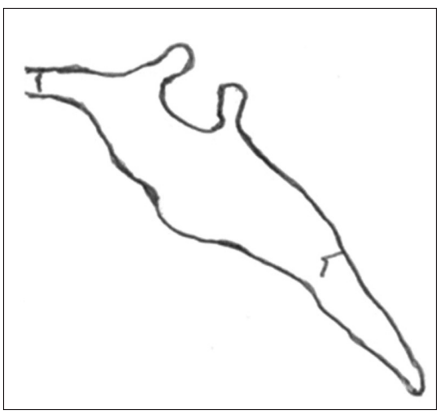

Figure 3. Agenesis of the sphenoid sinus.

In this method, sphenoid sinus hypoplasia was defined as an oval-shaped sinus with pneumatization limited to the pre-sphenoid, i.e., anterior to the vertical plane of the tuberculum sellae (vertical line) on the images, and the absence of septa (Fig. 2). Sphenoid sinus agenesis was defined as a complete lack of pneumatization in the body of the sphenoid bone (Fig. 3). We designated the age of 15 years old as the minimum age to enroll in the study because sphenoid sinuses do not complete development until puberty.

Results

In the axial, coronal and sagittal craniofacial DVCT scans, we found bilateral sphenoid sinus hypoplasia in one case (a 27-year-old male, Fig. 4). In one patient, both unilateral sphenoid sinus hypoplasia and unilateral sphenoid sinus agenesis were found (a 28-year-old female, Fig. 5). In these two cases of sphenoid sinus hypoplasia, there were no craniofacial abnormalities. In our study, bilateral sphenoid sinus agenesis was not seen. The results from the present study are summarized in Table.

Discussion

The development of paranasal sinuses begins as an evagination of the mucosa from the nasal cavities during the third and fourth fetal months. The sphenoid sinus appears in the fourth month of gestation (3). The sphenoid sinuses arise from within the nasal capsule of the embryonic nose (4). At birth, the sphenoid sinuses are recognized as a cavity with a maximum diameter of 2 mm and remains so until age 3. At approximately 3 years of age, aeration begins in the sphenoid bone. By age 7, pneumatization reaches the sella turcica. By age 12, sphenoid pneumatization reaches complete development, and the sinuses attain their full size with a volume of 7.5 mL (23x20x17 mm) (3, 4). The lack of sinus pneumatization by the age of 10 years suggests the possibility of sphenoid pathology (5). Sphenoid sinus agenesis is an extremely rare phenomenon. Previous researchers have reported that sphenoid sinus agenesis occurs in 1% to 1.5% of cases (7–9). However, most of these studies date back to the first half of the 20th century and lack the support of CT. In these anatomical studies, conchal pneumatization was interpreted as agenesis; therefore, the estimated frequency would be different than that obtained in studies using CT (4, 6). Because of its deep location and intimate structural relationship with intracranial structures, pneumatization of the sphenoid sinuses can

Table. Frequency of sphenoid sinus aplasia/agenesis

		Sphenoid sinus aplasia			Sphenoid sinus agenesis		
			Unilateral			Unilateral	
Sex	n	Bilateral	Right	Left	Bilateral	Right	Left
Male	176	1 (0.57%)	-	-	-	-	-
Female	208	-	1 (0.48%)	-	-	-	1(0.48%)
Total	384	1 (0.26%)	1 (0.26%)		-	1 (0.26%)	
	384	2 (0.52%)			1 (0.26%)		

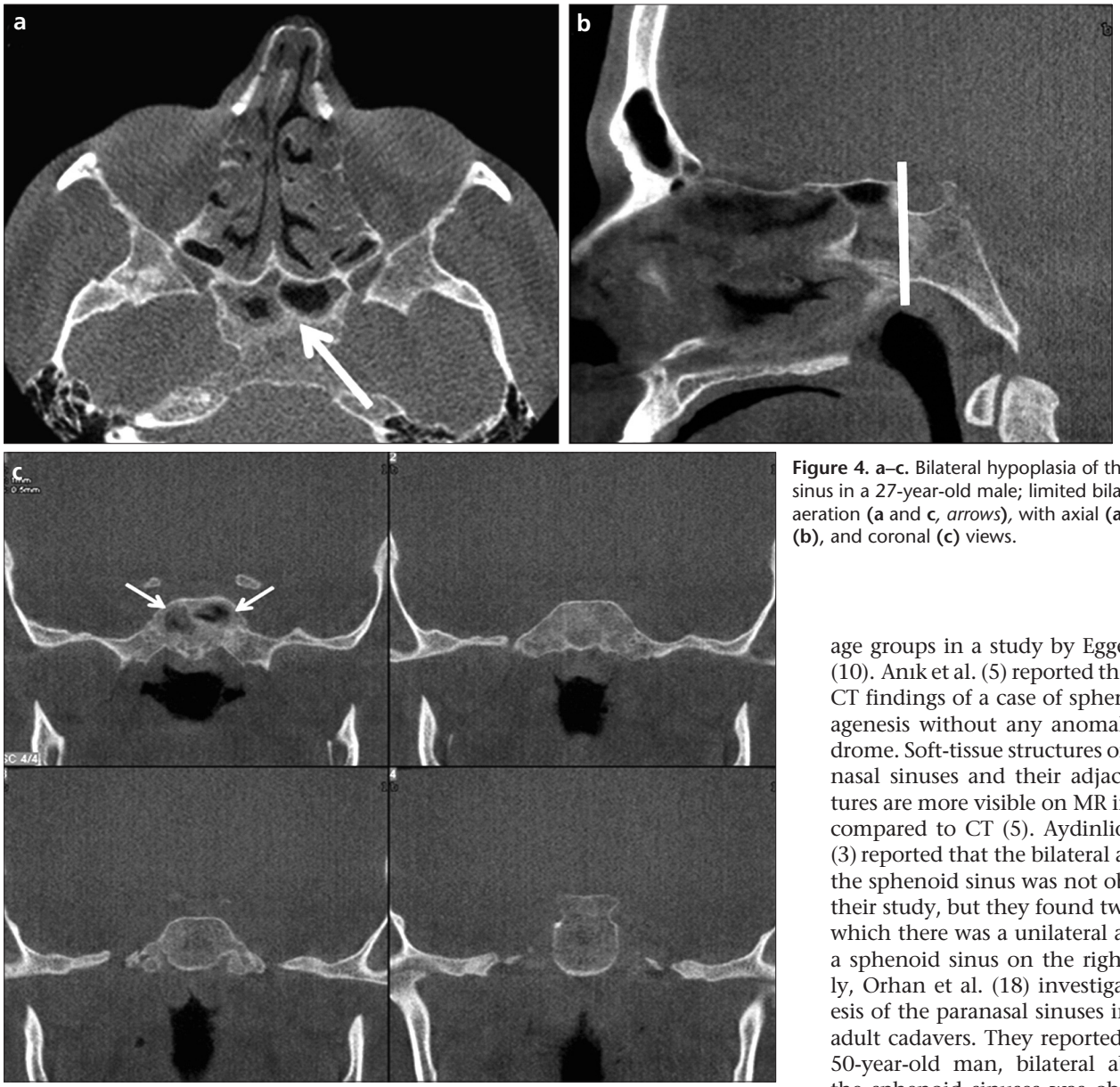

Figure 4. a–c. Bilateral hypoplasia of the sphenoid sinus in a 27-year-old male; limited bilateral aeration **(a** and **c**, *arrows*), with axial **(a)**, sagittal **(b)**, and coronal **(c)** views.

make radiographic diagnosis difficult, particularly with conventional radiographic techniques or panoramic radiography. In recent anatomical studies of the paranasal sinuses based on CT findings, sphenoid sinus agenesis was not reported (11–15). Terra et al. (16) performed computerized tomography with axial scans obtained at 5.0-mm thickness and coronal scans at 3.0-mm thickness to derive a better diagnosis. In DVCT scans, the thicknesses of the obtained axial and coronal scans are thinner than that of conventional CT. In this study, we obtained DVCT scans with 0.2-mm slices in the axial scans and 2-mm slices in the coronal scans. Therefore, the incidence of sphenoid sinus agenesis in a population is more accurate in studies using CT and DVCT (3). In the literature, there are few cases of sphenoid sinus agenesis identified by CT (4–6, 17). Antoniades et al. (17) first described sphenoid sinus agenesis in a patient with Hand-Schuller-Christian disease. Keskin et al. (6) also presented a case in which sphenoid sinus agenesis was diagnosed during the evaluation of endoscopic transsphenoidal hypophysectomy. In another report presented by Degirmenci et al. (4), the patients diagnosed with sphenoid sinus agenesis had no craniofacial anomalies or systemic skeletal diseases. No sphenoid sinus agenesis was reported in patients with cystic fibrosis or controls from all age groups in a study by Eggesbø et al. (10). Anık et al. (5) reported the MRI and CT findings of a case of sphenoid sinus agenesis without any anomaly or syndrome. Soft-tissue structures of the paranasal sinuses and their adjacent structures are more visible on MR imaging as compared to CT (5). Aydinlioğlu et al. (3) reported that the bilateral absence of the sphenoid sinus was not observed in their study, but they found two cases in which there was a unilateral absence of a sphenoid sinus on the right. Recently, Orhan et al. (18) investigated agenesis of the paranasal sinuses in 20 male adult cadavers. They reported that in a 50-year-old man, bilateral absence of the sphenoid sinuses was observed on the macroscopic examination.

Sphenoid sinus agenesis might be more common in patients with craniofacial anomalies due to less well-developed paranasal sinuses (19, 20). Furthermore, deficient resorption of the corpus sphenoidale is postulated as the pathogenesis of the sphenoid sinuses without any craniofacial anomalies (4, 17).

In conclusion, this study showed a low frequency of sphenoid sinus hypoplasia, especially agenesis. Thus, surgeons should consider the possibility of agenesis or hypoplasia of the sphenoid sinus before planning surgical procedures to avoid serious complications. DVCT may be used as a diagnostic tool to investigate the sphenoid sinus.

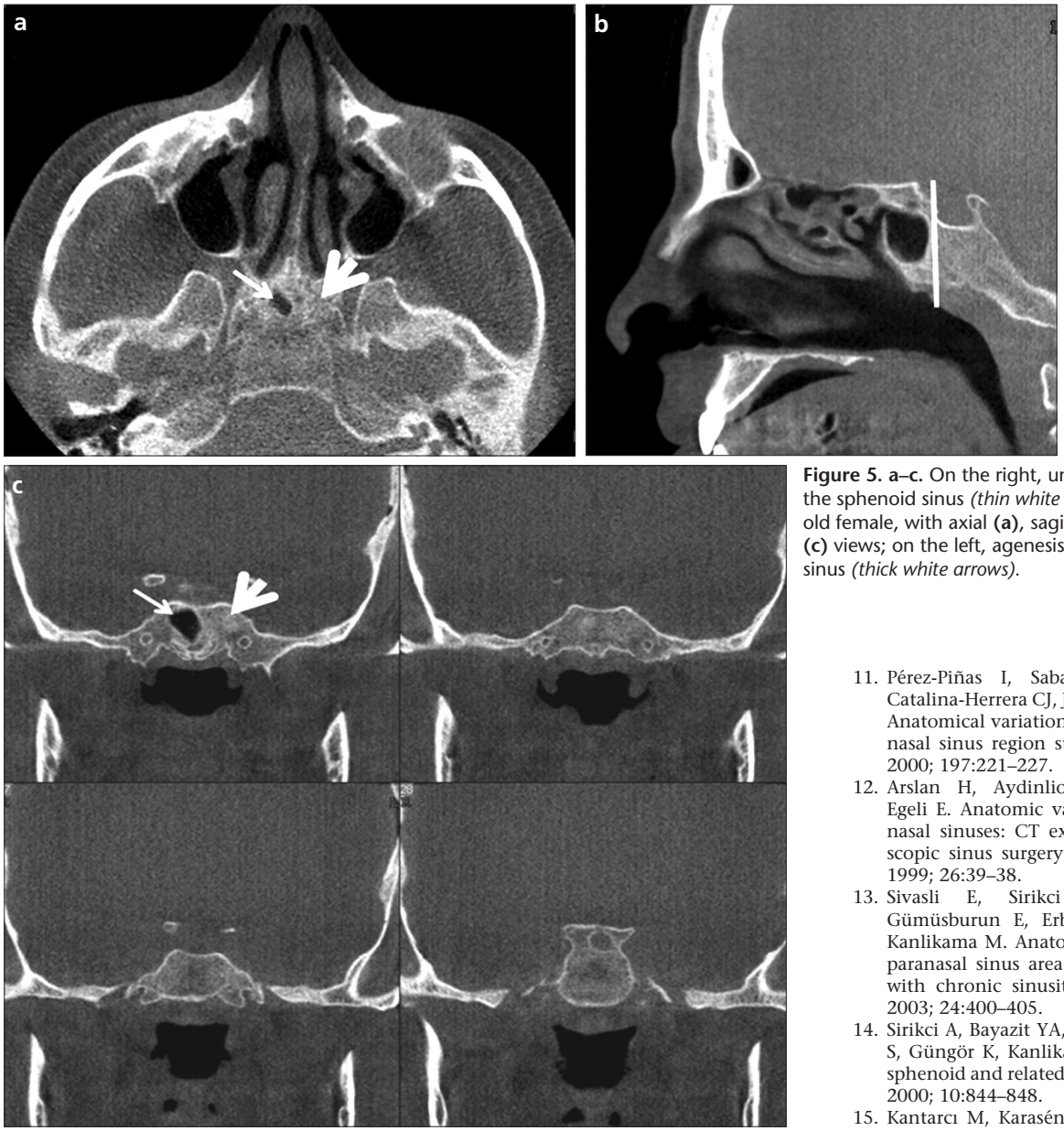

Figure 5. a–c. On the right, unilateral hypoplasia of the sphenoid sinus *(thin white arrows)* in a 28-year-old female, with axial **(a)**, sagittal **(b)** and coronal **(c)** views; on the left, agenesis of the sphenoid sinus *(thick white arrows)*.

References

1. Yune HY, Holden RW, Smith JA. Normal variations and lesions of the sphenoid sinus. Am J Roentgenol Radium Ther Nucl Med 1975; 124:129–138.
2. Yonetsu K, Watanabe M, Nakamura T. Age-related expansion and reduction in aeration of the sphenoid sinus: volume assessment by helical CT scanning. Am J Neuroradiol 2000; 21:179–182.
3. Aydinlioğlu A, Erdem S. Maxillary and sphenoid sinus aplasia in Turkish individuals: A retrospective review using computed tomography. Clin Anat 2004; 17:618–622.
4. Degirmenci B, Haktanır A, Acar M, Albayrak R, Yucel A. Agenesis of sphenoid sinus: three cases. Surg Radiol Anat 2005; 27:351–353.
5. Anik I, Anik Y, Koc K, Ceylan S. Agenesis of sphenoid sinuses. Clin Anat 2005; 18:217–219.
6. Keskin G, Ustundag E, Ciftci E. Agenesis of sphenoid sinuses. Surg Radiol Anat 2002; 24:324–326.
7. Grünwald L. Deskriptive und topographische Anatomie der Nase und ihrer Nebenhöhlen. In: Denker A, Kahler O, eds. Handbuch der Hals-Nasen-Ohrenheilkunde, vol 1. Berlin: Springer/Bergmann, 1925; 74–75.
8. Peele JC. Unusual anatomical variations of the sphenoid sinuses. Laryngoscope 1957; 67:208–237.
9. Lang J. Klinische Anatomie der Nase, Nasenhöhle und Nebenhöhlen. Stuttgart: Thieme, 1988; 87–88.
10. Eggesbø HB, Søvik S, Dølvik S, Eiklid K. Kolmannskog F. CT Characterization of developmental variations of the paranasal sinuses in cystic fibrosis. Acta Radiol 2001; 42:482–493.
11. Pérez-Piñas I, Sabate J, Carmona A, Catalina-Herrera CJ, Jiménez-Castellanos J. Anatomical variations in the human paranasal sinus region studied by CT. J Anat 2000; 197:221–227.
12. Arslan H, Aydinlioğlu A, Bozkurt M, Egeli E. Anatomic variations of the paranasal sinuses: CT examination for endoscopic sinus surgery. Auris Nasus Larynx 1999; 26:39–38.
13. Sivasli E, Sirikci A, Bayazit YA, Gümüsburun E, Erbagci H, Bayram M, Kanlikama M. Anatomic variations of the paranasal sinus area in pediatric patients with chronic sinusitis. Surg Radiol Anat 2003; 24:400–405.
14. Sirikci A, Bayazit YA, Bayram M, Mumbuç S, Güngör K, Kanlikama M. Variations of sphenoid and related structures. Eur Radiol 2000; 10:844–848.
15. Kantarcı M, Karasén RM, Alper F, Onbas O, Okur A, Karaman A. Remarkable anatomic variations in paranasal sinus region and their clinical importance. Eur J Radiol 2004; 50:296–302.
16. Terra ER, Guedes FR, Manzi FR, Boscolo FN. Pneumatization of the sphenoid sinus; case report. Dentomaxillofac Radiol 2006; 35:47–49.
17. Antoniades K, Vahtsevanos K, Psimopoulou M, Karakasis D. Agenesis of sphenoid sinus. Case report. J Otorhinolaryngol Relat Spec 1996; 58:347–349.
18. Orhan M, Govsa F, Saylam C. A quite rare condition: absence of sphenoidal sinuses. Surg Radiol Anat 2010; 32:551–553.
19. Rivero PVP, Yánez TK, García MM, Ruíz GT, Romero GP, Huelva AB. Melanoma of the sphenoid sinus. Report of a case and literature review. Acta Otorrinolaringol Esp 2004; 55:45–48.
20. Tan HKK, Ong Y, Teo MSK, Fook-Chong SMC. The development of sphenoid sinus in Asian children. Int J Pediatr Otorhinolaryngol 2003; 67:1295–1302.