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Türk popülasyonunda sfenoid sinüs varyasyonları ve cerrahi planlamadaki önemi: BT çalışması

Onur Sıldıroglu (*), Ali Kemal Sivrioglu (*), Kemal Kara (*), Guner Sonmez (*), Ersin Ozturk (*), Ferhat Cuce (*), Muzaffer Saglam (*), Hakan Mutlu (*), Murat Salihoglu(**)

SUMMARY

Variations of the sphenoid sinus in Turkish population and importance in surgical planning: a CT study

Trans-sphenoidal approach is the standard surgical method for pituitary adenomas. It is important to determine its variations and relationship to adjacent vital structures. The purpose of this study was to investigate the prevalence of variations of the sphenoid sinus on paranasal CT in Turkish population and their importance in surgical planning. We reviewed the paranasal CT examinations of 228 patients retrospectively that were performed between 2010-2014. Sphenoid sinus dimensions, wall thickness, structure of quantity the intersinus septum, interval between optic channel, pneumatization and variations of the sphenoid sinus was assessed. The determined anatomical variations and the their prevalence were demonstrated as follows: pneumatization of the pterygoid process in 78 patients (34%), pneumatization of the anterior clinoid process in 32 patients (14%), vidian canal protrusion in 21 patients (9.2%), vidian canal dehiscence in 22 patients (9.6%), optic nerve protrusion in 30 patients (13.1%), optic nerve dehiscence in 15 patients (6.6%), maxillary nerve protrusion in 59 patients (25.9%), maxillary nerve dehiscence in 5 patients (2.2%), carotid artery protrusion in 29 patients (12.7%), carotid artery dehiscence in 6 patients (2.6%), onodi cell (Figs. 2 and 3) in 13 patients (5.7%). Presence of multiple septations was found in 81 patients (35.6%), a single intersinus septum was found in 128 patients (56.1%) and no septation was found in 19 patients (8.3%). Preoperative recognition of sphenoid sinus variations with paranasal CT maybe beneficial so that the limits of dissection can be identified and the complications can be avoided during the trans-sphenoidal approach.

Key words: *Sphenoid sinus, pneumatization, intersinus septum, trans-sphenoidal approach.*

ÖZET

Transsfenoidal yaklaşım pituiter adenomun cerrahi tedavisinde standart yöntem kabul edilir. Bu yüzden sfenoid sinus varyasyonlarını ve komşu vital yapılarla ilişkisini değerlendirmek önemlidir. Çalışmamızın amacı Türk popülasyonunda paranazal BT inceleme ile sfenoid sinüsün varyasyonlarının prevalansını ve cerrahi planlamadaki önemini araştırmaktır. Radyoloji departmanımızda 2010-2014 tarihleri arasında 228 olgunun paranazal BT incelemeleri retrospektif olarak değerlendirildi. Sfenoid sinüs boyutları, duvar kalınlıkları, intersinüs septumun yapısı, optik kanallar arası mesafe, sfenoid sinüs pnömatizasyonu ve varyasyonları değerlendirildi. Tespit edilen anatomik varyasyonlar ve prevalansları: 78 olguda (%34) pterygoid proçes pnömatizasyonu, 32 olguda (%14) anterior klinoid proçes pnömatizasyonu, 21 olguda (%9.2) vidian kanal pnömatizasyonu, 22 olguda (%9.6) vidian kanal dehisensi, 30 olguda (%13.1) optik sinir protrüzyonu, 15 olguda (%6.6) optik sinir dehisensi, 59 olguda (%25.9) maksiller sinir protrüzyonu, 5 olguda (%2.2) maksiller sinir dehisensi, 29 olguda (%12.7) karotid arter protrüzyonu, 6 olguda (%2.6) karotid arter dehisensi, 13 olguda (%5.7) ise onodi hücresidir (Şekil 2-3). Sfenoid sinüslerde 81 olguda (%35.6) multiple, 128 olguda (%56.1) tek septum tespit edilirken 19 olguda (%8.3) septasyon izlenmedi. Paranasal BT ile sfenoid sinüs varyasyonlarının değerlendirilmesi transsfenoidal cerrahi sırasında cerrahi disseksiyonun limitini saptama ve komplikasyonların önlenmesi açısından önemlidir.

Anahtar Kelimeler: *Sfenoid sinus, pnömatizasyon, intersinus septum, trans-sfenoidal yaklaşım.*

*GATA Haydarpasa Training Hospital, Department of Radiology, Uskudar, Istanbul, Turkey.
**GATA Haydarpasa Training Hospital, Department of Otolaryngology, Uskudar, Istanbul, Turkey.

Ayrı Basım İsteği: Onur Sıldıroglu
GATA Haydarpasa Training Hospital,
Department of Radiology, Uskudar, Istanbul, Turkey.
e-mail: sildiroglu@yahoo.com

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Introduction

Sphenoid sinus is a bony hole with a lot of neurovascular structure around it. It locates through the sphenoid bone. Anatomical variations of the sphenoid sinus must be evaluated before the endoscopic sinus surgery to avoid the possible complications. Especially the anatomic variations of the optic nerve and carotid artery dehiscence are great problems that can be injured during the surgery (1). Surgeons must carefully plan the preoperative work-up and the important step of this work-up is sphenoid sinus imaging. The computed tomography (CT) is the best imaging modality to demonstrate paranasal sinuses.

The purposes of this study were to investigate the prevalence of anatomic variants of the sphenoid sinus on paranasal CT scan in Turkish population and their importance in surgical planning.

Materials and Methods

Patient selection

Our institutional review board approved this retrospective cross-sectional study. We reviewed the unenhanced paranasal CT examinations of 228 patients (118 females, 110 males; age range 18-68 years, mean age 35.6 years) retrospectively that were performed in our radiology department between January 2010 and February 2014. The patients were referred to the paranasal CT (PCT) for the evaluation of the underlying cause of sinus headache. There was not any exclusion criteria.

CT scan

The studies were performed on a 64-MDCT (Brilliance-64, Philips Medical Systems, Eindhoven, Netherlands) with an FOV of 14–16, 120 kVp, 210 mAs and a slice thickness of 0.625 mm. The axial plane was the inferior orbital meatal plane (anthropologic plane). Coronal reconstruction was post-processed. Axial and coronal views were obtained in neutral position and hyperextension of the head respectively.

Image and istatistical analysis

Two experienced radiologists evaluated the paranasal CT images in both soft tissue and bone windows independently. Sphenoid sinus dimensions, thickness of anterior and posterior wall of the sphenoid sinus, thickness, structure and the quantity of intersinus septum, thickness of the origin intersinus septum on the sphenoid walls, interval between both optic channel, pneumatization and variations of the sphenoid sinus was assessed. The average of each variable, min-max values and prevalence were calculated.

RESULTS

The anteroposterior diameter of the sphenoid sinuses ranged from 1.1 to 3.2 cm (mean= 2.3 cm). Transverse diameter of the sphenoid sinuses ranged from 2.3 to 5.2 cm (mean= 3.4 cm). The determined anatomical variations and the prevalence of them were demonstrated as follows: pneumatization of the pterygoid process in 78 patients (34%), pneumatization of the anterior clinoid process in 32 patients (14%) (Figs. 1, 2 and 3), vidian canal protrusion in 21 patients (9.2%) (Fig.1),

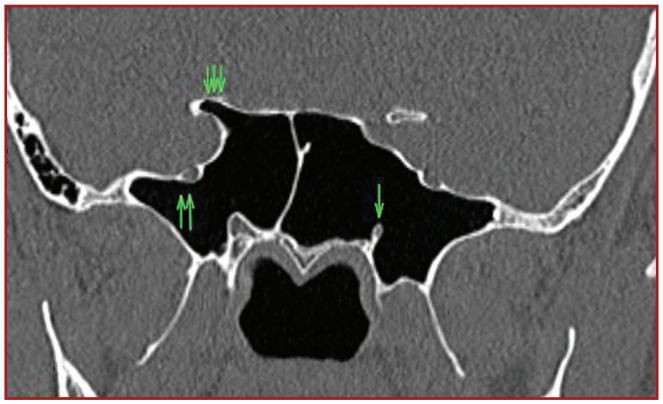

Figure 1. Vidian canal protrusion (arrow) on coronal CT. Note that maxillary nerve dehiscence (double arrow) and pneumatization of the anterior clinoid process (triple arrow).

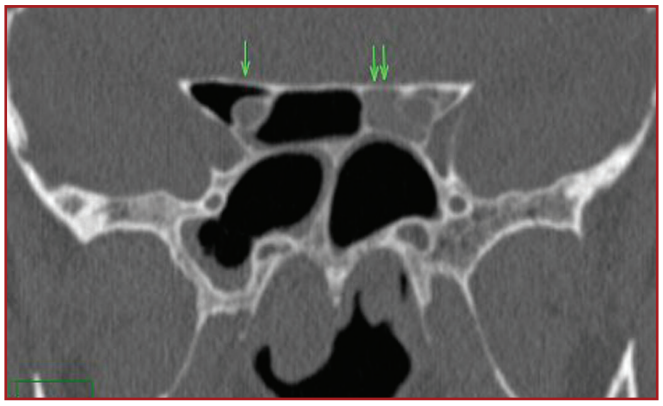

Figure 2. Pneumatization of the right anterior clinoid process and optic nerve protrusion (arrow) on coronal CT. Additionally, mucus-filled Onodi cell was seen on the left side (double arrow).

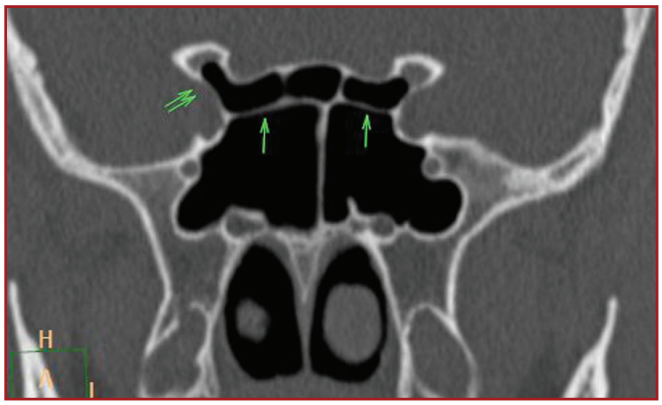

Figure 3.Coronal CT image shows Onodi cells on both sides (arrow). Pneumatization of the right anterior clinoid process is also seen (double arrow).

vidian canal dehiscence in 22 patients (9.6%), optic nerve protrusion in 30 patients (13.1%), optic nerve dehiscence in 15 patients (6.6%), maxillary nerve protrusion in 59 patients (25.9%), maxillary nerve dehiscence in 5 patients (2.2%) (Fig. 1), carotid artery protrusion in 29 patients (12.7%), carotid artery dehiscence in 6 patients (2.6%), onodi cell (Figs. 2 and 3) in 13 patients (5.7%). Presence of multiple septations was found in 81 patients (35.6%), a single intersinus septum was found in 128 patients (56.1%) and no septation was found in 19 patients (8.3%) (Table 1). The intersinus septum attached onto carotid canal was found only in 7 patients (3.1%). Mean thickness of intersinus septum was 2.4 mm (min: 2 mm, max: 5.2 mm). Transverse diameter between both optic canal was found 2.2 cm (min: 1.4 cm, max: 2.9 cm). Thickness of anterior wall of the sphenoid sinus was found 4.1 mm (min: 2.4 mm, max: 11.2 mm) (Table 2).

Table 2. Measurements of findings

Findings	Mean (mm)	Min-Max (mm)
Thickness of intersinus septum	2.4	2-5.2
Transverse diameter between both optic canal	2.2	1.4-2.9
Thickness of anterior wall of the sphenoid sinus	4.1	2.4-11.2
Anteroposterior diameter of the sphenoid sinuses	2.3	1.1-3.2
Transverse diameter of the sphenoid sinuses	3.4	2.3-5.2

Tablo 1. Anatomical variations of sphenoid sinus

Anatomical variations (Total patients:228)		Patient numbers (n)	Percent (%)
Pneumatization of the pterygoid process		78	34
Pneumatization of the anterior clinoid process		32	14
Vidian canal	protrusion	21	9.2
	dehiscence	22	9.6
Optic nerve	protrusion	30	13.1
	dehiscence	15	6.6
Maxillary nerve	protrusion	59	25.9
	dehiscence	5	2.2
Carotid artery	protrusion	29	12.7
	dehiscence	6	2.6
Onodi cell		13	5.7
Septation	multiple	81	35.6
	single	128	56.1
	no	32	10.8
Intersinus septum attached onto carotid canal		7	3.1

Discussion

Sphenoid sinus has a great importance in transsphenoidal access to the pituitary gland because of its relationship with vital structures such as the optic nerve and internal carotid artery (2). Hence, additional radiological assessment of the sphenoid sinus and the related neurovascular structures is inevitable before surgery.

Sphenoid sinus has many variations. Anterior clinoid process pneumatization incidence was found 13.3-16%, pterygoid process pneumatization incidence was found 15.5-43.6%, vidian canal protrution prevalence was found 7.5-13.3 %, incidence of bone defect onto carotid artery was found 4.8-22 %, incidence of the projection of foramen rotundumun into sinus was found 4-12.9 % and the incidence of onodi cell was found 0-18 % in the literature (3-9). We detected lower rate of carotid dehiscense to the literature but pneumatization of pterygoid process and anterior clinoid process, vidian canal protrusion ratios were close to those rates that is reported in the entire literature. In another study, it was reported that there was dehiscence of the bony wall surrounding the vidian nerve in 6% of the cases (n=100) (10). In our study, we found this ratio as 9.6%. Analysis of radiographic anatomy of the vidian canal is necessary to decrease the complications following endoscopic trans-sphenoidal surgery and vidian neurectomy. In addition, a close association of internal carotid artery with the sphenoid sinus makes it vulnerable for injury during surgery. If the surgeon is unaware of dehiscence or protrusion of the artery, even fatal hemorrhage may happen (11)

Bademci and Unal (12) reported protrusion of the optic nerve in 34.4% of the cases and dehiscence in 7.7%. In our study we found the ratio of optic protrusion as 13% and dehiscence as 7.7%. In case of protrusion or dehiscence, an injury can occur either due to a surgical trauma. The risk of blindness is high if the surgeon damages the nerve within the sinus (13). D P et al. were reported the protrusion of the maxillary nerve into the sinus in 1% and bony dehiscence in 20% of the cases (10). The maxillary nerve protrusion was encountered in 59 patients (25.9%), and maxillary nerve dehiscence was seen in 5 patients (2.2%) in our study. Our maxillary nerve protrusion ratio is similar to the entire literature.

It should known that the maxillary nerve is susceptible to iatrogenic injuries when protruding or in the presence of bony dehiscence around the maxillary nerve.

Sphenoethmoidal (Onodi) cells are posterior ethmoidal cells that extend laterally, superiorly, and posteriorly to the sphenoid sinus and are intimately associated with the optic nerve. Shpilberg et al reported a 12% prevalance of onodi cells (1) and we found a very similar ratio (13%) in our study.

There is usually a thin septum inside the sphenoid sinus. This septum must be removed to expose the floor of the sella. The septum usually deviates to one side, dividing the sinus into two unequal cavities, thereby resulting in an asymmetrical appearance of the sella turcica floor. The number and location of the septum is important from a surgical point of view. Disorientation within the sinus may mislead the surgeon to vital structures. Hamid et al. (14) reported that in their study consisting of 296 patients they found no septation in 32 patients (10.8 %), single inter sphenoid septum in 212 patients (71.6 %), an accessory septum in 32 patients (10.8 %) and multiple intersphenoid septa in 20 patients (6.8 %). We found a high multiseptate ratio but lower ratios of single or no septation comparing with the ratios in literature. The evaluation of the sphenoid septa should be done in coronal and axial plane before transphenoidal surgery. Literature describes the septum deviates quite laterally in 32 to 40% of patients and terminates on the carotid artery (15). When this happens, it is common that it inserts on the carotid canal or the optic canal (16). In this situation, it is wise to use extreme caution while removing the terminal septum in order to prevent accidental and disastrous injury to the carotid artery (17). In our study, the intersinus septum on the carotid canal was found only in 7 patients. This ratio is quite low depending on literature. But in these cases there was only one septum. Fernandez-Miranda et al. said that if there was more than one septa, at least one of these septa is inserted on the carotid canal in 87% of the cases (16).

The optic nerve, internal carotid artery, cavernous sinus of the sinus and anterior cranial fossa should be examined on CT prior to the transsphenoidal sinus surgery. Coronal paranasal CT examination is the most effective method for preoperative screening (3,4). Although CT images in coronal plan are required for evaluation of maxillary, vidian and optic nerve dehiscence and protrusion, axial images are better in the evaluation of intercarotid dimension and sphenoid septa.

Our study has several limitations. First of all, sphenoid sinus variations may differ between sexes. We didn't point this issue in our study. Secondly, we didn't compare the sphenoid sinus variations with the complications of the endoscopic sinus surgery.

In conclusion, the complex morphology and risky anatomical relations of the sphenoid sinus make the endoscopic sinus surgery a challenge for the surgeon. Preoperative recognition of sphenoid sinüs variations by the radiologist maybe beneficial so that the limits of dissection can be identified and the complications can be avoided during the trans-sphenoidal approach.

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