Original Article

Indian Journal of Anatomy
Volume 6 Number 2, April - June 2017
DOI: http://dx.doi.org/10.21088/ija.2320.0022.6217.7

Morphological Study of Sphenoid Sinus and its Relation with Surrounding Neurovascular Structures

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Abstract

Introduction: The pituitary gland is located below the centre of the brain and over the sella on the cerebral surface of the body of sphenoid. The sphenoid air sinus opens into the roof of the nasal cavity via the aperture on the posterior wall of sphenoethmoidal recess above the turbinates. Since only a thin layer of bone separates sphenoid sinus from pituitary gland above and nasal cavity below, transseptal approach to the pituitary lesions is feasible rather than transcranial approach. *Material & Methods:* Study was conducted on 30 sagitally sectioned head and neck specimens at the level of nasal septum in formalin fixed human cadavers from the Department of Anatomy, from our institute. The parameters were recorded and photographed. *Results:* Among 30 specimens 12 were presellar, 5 sellar, 10 postsellar and 2 were conchal types. Normal intersphenoid septum were found in 17 cadavers, whereas accessory septum in 9 cadavers and multiple intersphenoid septum in 3 cadavers. Among 17 normal septal patterns, 5 were inserting towards ICA and 3 were around optic canal. The part of the roof of sphenoid sinus underlying ICA showed dehiscence in 2 specimens. No optic canal dehiscence in sphenoid sinus in this study. *Conclusion:* The complex anatomy of sphenoid sinus and its risky anatomical relations with internal carotid artery and optic nerve make it a challenge for the surgeon. This anatomical study of sphenoid sinus will help to guide the surgical plan and dissection of sinus during transsphenoidal approach to pituitary gland.

Keywords: Sphenoid Sinus; Trans-Sphenoid Approach; Pituitary Gland; Internal Carotid Artery and Optic Canal.

Introduction

The sphenoid bone consists of body, the lesser and greater wings. The body of sphenoid bone develops from presphenoid and postsphenoid ossification centres with contribution from medial crus of orbitosphenoid. Adjacent to vomer two paired ossification centres appears, called bones of Bertin. They enclose unossified rostrum of basisphenoid. This will be first place of sphenoid pneumatization. The relation of vascular and nervous structures such as the optic nerve, maxillary nerve, vidian nerve and internal carotid artery to the ossification centres of sphenoid body explains their close relation of above structures to sphenoid sinus [1].

The sinuses may be classified into three main types: sellar, the commonest type, where the sinus extends for a variable distance beyond tuberculumsellae; presellar, where the sinus extends posteriorly towards, but not beyond tuberculumsellae; conchal, where the small cavity of sinus separated from sellaturcica by 10mm of trabecular bone. In 15% of individuals, the optic nerve, may project into the sinuses from their lateral walls. Dehiscences in the osseous walls of either sinus may occasionally leave their mucosa in contact with the overlying dura mater.

The pituitary gland is located below the centre of the brain and over the sella on the cerebral surface of the body of sphenoid. The sphenoid air sinus opens into the roof of the nasal cavity via the aperture on the posterior wall of sphenoethmoidal recess above the

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Received | 03.01.2017, **Accepted** | 11.03.2017

turbinates. Since only a thin layer of bone separates sphenoid sinus from pituitary gland above and nasal cavity below, transeptal approach to the pituitary lesions is feasible rather than transcranial approach. However the surgical path of transeptal surgery is extremely deep and narrow, and view is blocked by crucial neurovascular structures. In addition close proximity of the sphenoid sinus to the carotid artery and optic canal plus the high levels of variation between the anatomical structures of sphenoid sinus and sellar floor, make the approach even more difficult [2].

Material and Methods

Study was conducted on 30 sagitally sectioned head and neck specimens at the level of nasal septum in formalin fixed human cadavers from the Department of Anatomy from our institute. Sagital section was taken just lateral to median plane to retain the intersphenoid septum. So we got the two halves of sphenoid sinus one with septum and other with cavity of sinus. Then dissection of intersphenoid septum was undertaken to see the insertion of septum and accessory sepyum. Then we cleaned the roof to expose the carotid canal and lateral wall for optic canal relations. The parameters were recorded and photographed.

Aims and Objectives

1. Study of anatomical types of sphenoid sinus in relation to sellatursica.
2. Study of intersphenoid septum and its inseriton.
3. Relation of carotid protuberance and optic canal to the sphenoid sinus.

Results

In this study we found different types of sphenoid sinus. Among 30 specimens 12 were presellar (Figure 1), 5 sellar (Figure 4), 10 postsellar (Figure 2) and 2 were conchal (Figure 3) types (Table 1). Normal intersphenoid septum were found in 17 cadavers, whereas accessory septum in 9 cadavers and multiple intersphenoid septum in 3 cadavers. Among 17 normal septal patterns, 5 were inserting towards ICA and 3 were around optic canal. The part of the roof of sphenoid sinus underlying ICA showed dehiscence in 2 specimens. No optic canal dehiscence in sphenoid sinus in this study.

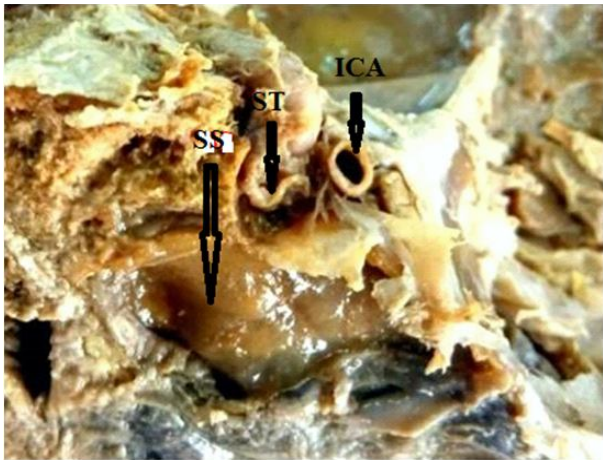

Fig. 1: Presellar type of sphenoid sinus
SS – Sphenoid sinus, ST- Sellaturcica, ICA – internal carotid artery

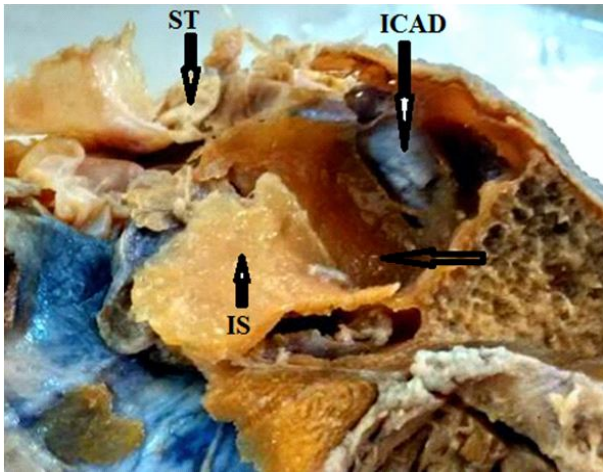

Fig. 2: Postsellar type of sphenoid sinus with internal carotid artery dehiscence at the anterolateral aspect of sinus
ICAD- internal carotid artery dehiscence, IS –Intersphenoid septum

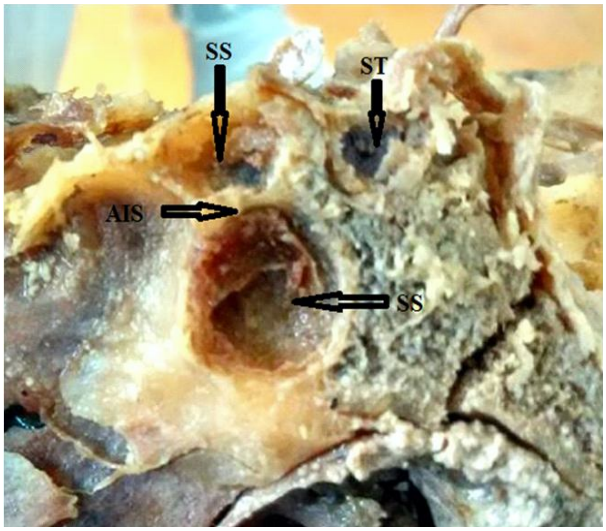

Fig. 3: Choncal type of sphenoid sinus with accessory intersphenoid septum
AIS – Accessory intersphenoid septum

Table 1: Comparision of types of sphenoid sinus with other studies

	Presellar type %	Sellar type %	Postsellar %	Conchal %
D Sareen[3] (20)	25	-	75	-
O Hamid[4] (surgical)(296)	22	54.7	22.3	2
Levine[5] (30)	12	86	-	2
Manisha S[6](30)	20	14	66	-
N Stokovic[7] (28 dry skull)	24	41.2	33.3	2
Present study	40	33.3	16.6	6.6

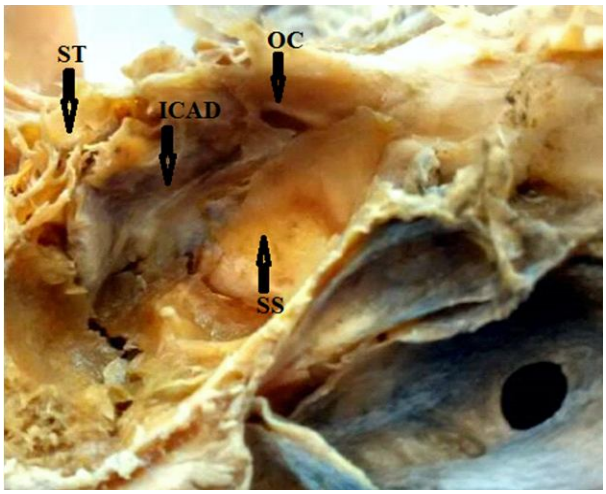

Fig. 4: Sehiscence at the roof of shenoid sinus
OC – Optic canal

Discussion

In one of the study, intersphenoid septum were absent in 32 cases among 296, inter sphenoid septum insertion to ICA – 4.7%, to optic canal – 28.4% and accessory septum in 10.8% and multiple septum in 6.8%. Usually intersphenoid septum deviates to one side and devides the sinus cavity into unequal parts. Sometimes the septum deviates quite laterally and terminates on the carotid artery. In this situation extreme caution should be taken while removing terminal septum to prevent accidental injury to carotid artery [4].

In one study they had mentioned the dehiscence at ICA on lateral wall was present in one case (5%) [3]. When the sinus is well pneumatized, sorrounding structures seen as ridges [5].

Accessory septa found in 11 cases (20%), multiple in 4 cases , out of these 6 were terminating to lateral wall of sinus, 4 to the bony wall covering ICA and 1 to optic nerve. Due to variation in septation intersphenoid septum should never be used as guide for hypophysis [6].

Pneumatization of greater wing of sphenoid, increases inadvertent penetration into middle cranial fossa, hance CSF leakage, Pneumatization of planumsphenoidale increases risk of iatrogenic injury and CSF leakage from anterior cranial fossa, whereas pneumatization of dorsum sellae (postsellar type) increases risk of CSF leakage from posterior cranial fossa. In a series of 350 adults, CT scan images revealed ICA protrusionin 29.2% cases [7].

The most important relations of the sphenoid sinus are on its superior and lateral walls, with the internal carotid artery and optic nerve. The intersphenoid septum being rarely situated on median plane but very often deviated to lateral side. When this happens it inserts on the carotid canal or optic canal [1].

The two sinuses rarely communicate with each other, in 5 cases the septum were deficient also deep projection of optic nerve into the sinus were found in in 7% of specimens [8].

The protruding optic nerve with dehiscence may lead on to surgical trauma, ischaemia or venous congestion of optic nerve because of its least blood nourishment inside the optic canal. Studies had proven that protrusion of optic nerve in the sphenoid sinus as an etiologic factor for optic nerve pathologies following sphenoid sinus surgeries [9]. In a study among 100 sinuses, 40% recognizable projection formed by the optic canal into sphenoid sinus [10].

Conclusion

Knowledge about variations in the floor of sellaturcica and sphenoid sinus helps in the transseptal endoscopic approach to hypophysial lesions. The complex anatomy of sphenoid sinus and its risky anatomical relations with internal carotid artery and optic nerve make it a challenge for the surgeon. Preoperative CT-scans and recognizing anatomical variations, minimizes the risks of surgery. However, the standard clinical radiological techniques might not be able to visualize all elements that may increase the iatrogenic injury, hence gross anatomical study of sphenoid sinus will help to guide the surgical plan and dissection of sinus during transsphenoidal approach to pituitary gland.

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