www.jmscr.igmpublication.org
Impact Factor 5.84
Index Copernicus Value: 71.58
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v5i9.174

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

# Normal Anatomical Variations of Sphenoid Sinus – A Retrospective Radiological Analysis by Cross Sectional Imaging

Authors
**Dr Kavish Kapoor[1], Dr Arun Yadav[2], Dr Meghna Poonia[3]**
[1] DNB (Radiodiagnosis), Department of Radiodiagnosis, Military Hospital, West Bengal, India
[2]MS (ENT), Department of ENT& HNS, Military Hospital, West Bengal, India
[3]MD (Physiology), Neotia Getwel Hospital, Siliguri, West Bengal, India
Corresponding Author
**Dr Arun Yadav**
Address: Department of ENT & HNS, 158 Base Hospital c/o 99 APO
Email: *drarunyadav@gmail.com; Contact: 8768632036*

**Abstract**
*Sphenoid sinus is situated in midline within the sphenoid bone in the base of skull posterior to the ethmoid air cells. This sinus is in close proximity with optic nerve (ON), internal carotid artery (ICA), pitutary gland (PG) and cavernous sinus (CS). Sphenoid sinus approach is commonly used for endoscopic pituitary gland surgery and other skull base procedures too. Radiological evaluation of this sinus is of paramount importance before attempting any such surgical procedures.*
**Aim:** *This study was designed to evaluate sphenoid sinus and surgical structures in sphenoid sinus region in Indian population with help of radiological imaging.*
**Materials and Methods:** *Retrospective analysis of non contrast computed tomograms (NCCT) of 140 patients was performed. Parameters measured were type of pneumatisation, septa number and attachment, presence of lateral recess (LR) and carotico-optic sinus (COS), dehiscence of bony lamella and presence of onodi cell (OC). All scans were reviewed by a team of otorhinolaryngologist and radiologist.*
**Results:** *The study group consist of 140 individuals (85 Males and 35 Females). The mean age of patients was 33.45 year for males and 37.36 year for females. Most common type of septa found was complete single septa and sellar pneumatisation, Lateral recess was present in 48.57% and Carotico-optic recess in 24.28% of cases; onodi cell was least frequently encountered in 5% of NCCT scans only.*
**Conclusion:** *Variation are common in sphenoid sinus and pre operative radiological assessment of complex relations of sphenoid sinus septa with important structures present in vicinity of this sinus is of paramount importance before attempting any endoscopic surgery in this area.*
**Keywords:** *Sphenoid sinus, radiological imaging, computed tomography, endoscopic sinus surgery, internal carotid artery, optic nerve, sella turcica.*

## Introduction

Sphenoid sinus is present in middle of skull base in the body of sphenoid bone. Embryological development of this sinus starts at 3rd month of intrauterine life as a small evagination and progress gradually in childhood to reach floor of sella turcica by 7 yr of age in most of the cases [1,2]. Sphenoid sinus separates nose and nasopharynx

from anterior and middle cranial cavity. It is related to important structures in vicinity like Internal carotid artery (ICA), Optic nerve (ON) and Pitutary Gland (PG); therefore knowledge of this sinus anatomy is indispensable for any surgeon operating in this region.

Sphenoid sinus is pneumatised and dominance depends on attachment of inter sphenoid sinus septa, here asymmetry is the rule than exception [3].

Sphenoid sinus can be divided in following types on basis of extent of pneumatisation –

1. Conchal
2. Presellar
3. Sellar

Two recesses are commonly found in sphenoid sinus –

1. Carotico-optic recess into anterior clinoid process (between ON and ICA).
2. Lateral recess into pterygoid process and the greater wing of sphenoid [between maxillary nerve (MN) and vidian nerve (VN)].

Bony dehiscence over structures like ICA and ON is important specially when associated with sphenoid septa attachment near such dehiscent areas [4,5,6]. Such situations may lead to injury of these structures during removal of sphenoid septa. Therefore knowledge of sphenoid sinus anatomy based on preoperative CT scans is essential with special focus on its relation with ICA, ON, PG, MN and VN.

## Materials and Methods

This retrospective study was carried out in radiology department over a period of 12 months, total 140 sequential pre operative NCCT PNS were studied (excluding traumatic cases, post operative cases, neoplastic disease and invasive disease). Initially patients were examined in ENT OPD and underwent nasal endoscopy; patients with features of chronis rhino-sinusitis (CRS) on endoscopy and planned for endoscopic sinus surgery were taken up for radiological evaluation in pre operative period. NCCT PNS was performed on a 16 slice multi-detector computed tomography scanner (GE Brightspeed scanner) with 3 mm axial sections and multiplanar reformation was done in coronal and sagittal planes. All the scans were evaluated with AW volume share % software on the CT workstation. Data was recorded and analysed on excel worksheet.

**Table-1:** Demographic details of study group

| Sex | Number/Total | Mean Age (Year) | Standard Deviation | Standard Variance | Standard Error of The Mean |
|---|---|---|---|---|---|
| Male | 85/140 | 33.45 | 12.99 | 168.91 | 1.40 |
| Female | 55/140 | 37.36 | 10.35 | 107.19 | 1.39 |

**Table-2:** Frequency of onodi cell, lateral recess and carotico optic recess

| | Number | Percentage |
|---|---|---|
| Onodi cell | | |
| Total | 07 | 05% |
| Unilateral | 06 (Right 04, Left 02) | 4.28% |
| Bilateral | 01 | 0.71% |
| | | |
| Lateral recess (LR) | | |
| Total | 68 | 48.57% |
| Unilateral | 16 (Right 09, Left 07) | 11.42% |
| Bilateral | 52 | 37.14% |
| | | |
| Carotico-optic recess (COR) | | |
| Total | 34 | 24.28% |
| Unilateral | 15 (Right 07, Left 08) | 10.71% |
| Bilateral | 19 | 13.57% |

**Table-3:** sphenoid sinus pneumatisation type

| | Number | Percentage |
|---|---|---|
| Pneumatisation type | | |
| Sellar | 117 | 83.57% |
| Presellar | 20 | 14.28% |
| Conchal | 03 | 2.14% |

**Table-4:** sphenoid sinus septum type and septal attachment

| | Number | Percentage |
|---|---|---|
| Sphenoid sinus septum type | | |
| Single-complete | 67 | 47.85% |
| Single-incomplete | 28 | 20% |
| Double-complete | 01 | 0.71% |
| Double-mixed (Incomplete and complete) | 21 | 15% |
| Triple-mixed (Incomplete and complete) | 23 | 16.42% |
| | | |
| Sphenoid sinus septum attachment | | |
| Internal carotid artery (ICA) | 37 | 26.42% |
| Optic nerve (ON) | 01 | 0.71% |
| Lateral wall (LW) | 20 | 14.28% |
| Sella | 46 | 32.85% |
| ICA + LW | 05 | 3.57% |
| ICA + Sella | 19 | 13.57% |
| LW + Sella | 10 | 7.14% |
| ICA + LW + Sella | 02 | 1.42% |

**Figure-1:** Bilateral onodi cell (white arrow mark)

**Figure-2:** Conchal pneumatisation of sphenoid sinus (white arrow)

**Figure-3:** Pre sellar pneumatisation of sphenoid sinus (white arrow)

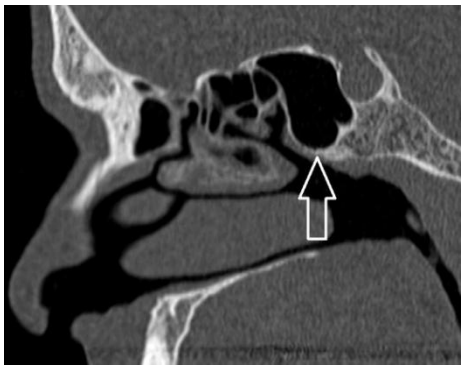


**Figure-4:** Sellar pneumatisation of sphenoid sinus (white arrow)

**Figure-5:** Single septum attaching to left lateral wall (white arrow)

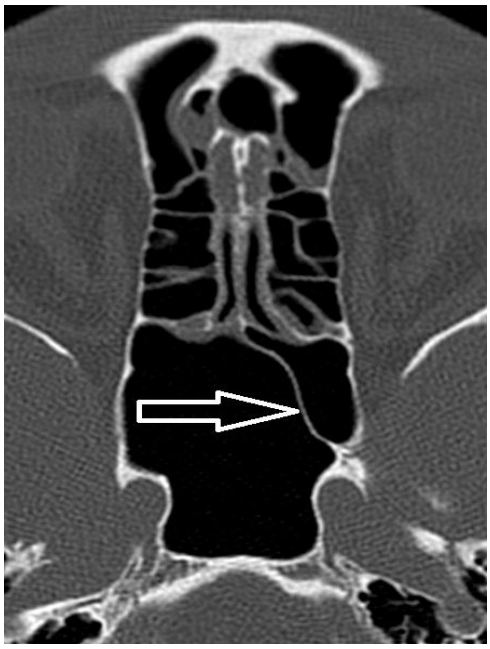


**Figure-6:** Double septum, right complete and left incomplete both attaching to ICA (white arrows)

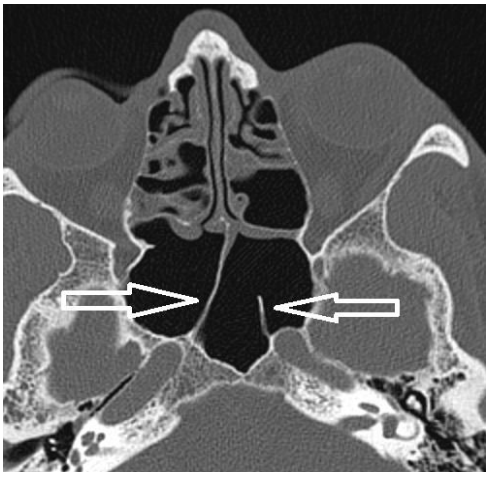


**Figure-7:** Double septum, Right complete attaching to sella and left incomplete attaching to ICA (white arrows)

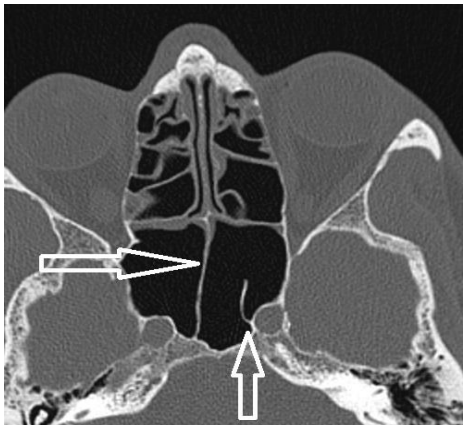


**Figure-8:** Triple septum, Right incomplete attaching to ICA, complete attaching to sella and left incomplete attaching to lateral wall (white arrows)

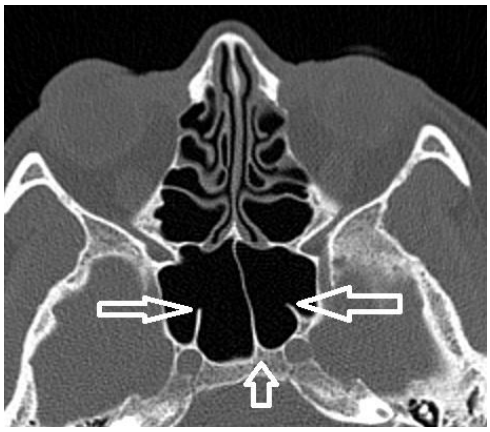


**Figure-9:** Bilateral onodi cell (thick white arrow mark) bilateral lateral recess (thin white arrow mark) Tripal septum middle complete and two lateral incomplete (marked with white oval)

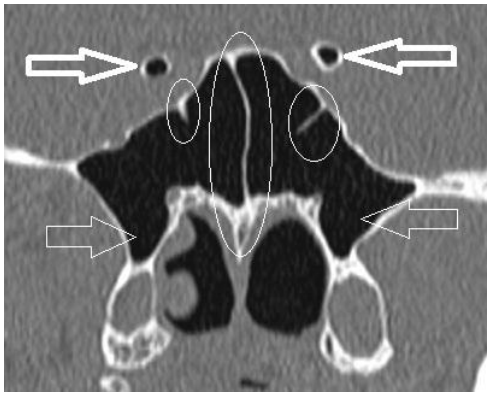
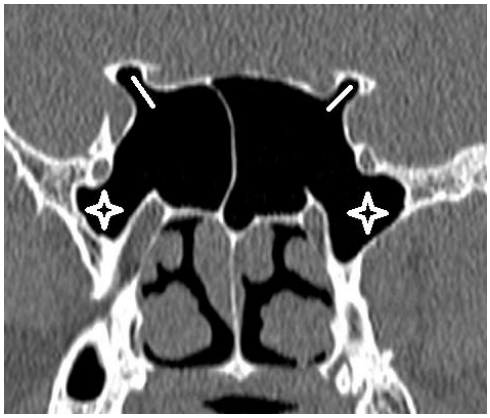


**Figure-10:** Bilateral lateral recess (white star mark) and carotico-optic recess (white straight line)



**Results**

Study group consist of total 140 individuals (85 Male & 55 Female), Demographic details are presented in Table-1. Total 140 NCCT scans were analysed for sphenoid sinus septa number and attachment as well as type of sphenoid sinus. Sex ratio was M:F = 1.5:1, (male 85, females 55). Age distribution was from 15 years to 77 years with mean age of 33.45 year for males and 37.36 year for females. Onodi cell was present in total 7 scans (5%), out of these 06 (4.28%) were unilateral and 01 (0.71%) bilateral (Figure-1 & Table-2). Lateral recess was present in total 68 (48.57%) scans; 52 (37.14%) were bilateral and 16 (11.42%) were unilateral. Carotico-optical recess was also found in 34 (24.28%) scans; 15 (10.71%) were unilateral and 19
(13.57%) were bilateral (Figure-9-10 & Table-2). Most common type of sphenoid sinus pneumatisation was sellar type (83.57%) followed by presellar type (14.28%) and conchal type (2.14%) (Figure-2-3-4 & Table-3). Single sphenoid sinus septum was present in 95 cases [67 (47.85%) were complete and 28 (20%) incomplete]; Double septum was present in 22 cases [01 (0.71%) was complete and 21 (15%) were mixed type]. In 23 cases (16.42%) triple septum was present and all were mixed type (Figure-5-6-7-8 & Table-4). Most common septal attachment was on sella in 46 cases (32.85%) followed by internal carotid artery in 37 cases (26.42%), lateral wall in 20 cases (14.28%) and optic nerve in 01 case (0.71%). In 36 cases septum was attached on more than one site (Table -4).

**Discussion**

A good understanding of radiological anatomy of sphenoid sinus is essential for endoscopic sinus surgery and endoscopic skull-base surgery. Relationship of surrounding structures like ICA,ON,PG,MN,VN, CS with sphenoid sinus depends on type of pneumatisation, sphenoid sinus septa and bony dehiscence if present; all these factors are important for preoperative planning to avoid complications during operation. Sphenoid sinus is known to have a wide variety of anatomical variations but this study was limited in scope to focus on structures important for surgical anatomy of sphenoid sinus in form of bony septa (number and attachment) , type of pneumatisation, presence of recess (COR & LR), onodi cell and bone dehiscence.

Sphenoid sinus is divided into two parts by inter sinus septum which can be single or multiple. In our study 67.85% of scans were having single septum (47.87% complete and 20% incomplete) and multiple septum were present in rest of the scans (15.71% double septum and 16.42% triple septum). In previous studies, single septum was recorded from 61% to as high as 95% and multiple septa were cited between 7% to 95% scans[7,8,9,10]. In this study multiple septa are present in 45 cases (32.14%). Most common pneumatisation pattern was sellar in 117 cases (83.57%).

**Conclusion**

In our study, a lot of variations were observed in sphenoid sinus and related structures (except bony dehiscence). These findings suggest a detailed analysis of radiological images in all the three planes during preoperative evaluation for successful outcome of endoscopic sinus and skull base surgery.

**Funding –** Nil

**Conflict of interest –** None

**References**

1. Janq YJ, Kim SC: Pneumatization of the sphenoid sinus in children evaluated by magnetic resonsnce imaging. Am J Rhinology 2000:14(3): 181-5.
2. Szolar D, Preidler K, Ranner G: The sphenoid sinus during childhood: establishment of normal developmental standards by MRI. Surg Radiol Anat 1994:16(2):193-8.
3. Filho BC, Pinheiro-Neto CD, Weber R: Sphenoid sinus symmetry and differences

between sexes. Rhinology 2008:46(3):195-9

4. Norovaskuler PS, Onemi YBC: Surgical importance of neurovascular relationship of paranasal sinus region. Turkish Neurosurgery 2005: 15(2):93-6
5. Sirikci A, Bayazit YA, Bayram M. Variations of sphenoid and related structures. Eur radiol 2000: 10(5):844-8
6. Unal B, Bademci G, Bilgili YK. Risky anatomical variations of sphenoid sinus for surgery. Surgical and Radiological Anatomy 2006:28(2):195-201
7. Banna M, Olutola PS. Patterns of pneumatisation and septation of the sphenoid sinus. J Can Assoc Radiol 1983:34(4):291-3
8. Hamid O, El Fiky L, Hassan O. Anatomical variation of the sphenoid sinus and their impact on transsphenoid pituitary surgery. Skull Base 2008:18(1):9-15
9. Sareen D, Agarwal AK, Kaul Jm. Study of sphenoid sinus anatomy in relation to endoscopic surgery. Int J Morphol 2005:67(4):279-83
10. Kashyap SK, Purohit JP, Selvaraj S, et al. Anatomical variations of sphenoidal inter-sinus septa in terms of number and attachments – a CT finding. J Evol Med Dent Sci 2017:6(12):955-59.