

Review Article

The non-invasive assessment of the sphenoid sinus: a review

Manish Munjal^{1*}, Suneet Sethi¹, Hitant Vohra², Shubham Munjal², Anu Prabhakar²,
Seema Garg², Navreen Pooni³, Angad Singh Gill¹, Karan Dhillon¹

¹Department of ENTNS, ²Department of Anatomy, ³Department of Radiology, Dayanand Medical College, Ludhiana, Punjab, India

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*Correspondence:

Dr. Manish Munjal,

E-mail: manishmunjaldr@yahoo.com

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ABSTRACT

The sphenoid sinus with its peculiar mucociliary drainage effected by pathology at the spheno-ethmoidal recess necessitates an intervention, medical or surgical. Role of basic imaging in pre-treatment evaluation is elaborated upon.

Keywords: Sphenoid sinus, Computed tomography, Magnetic resonance imaging

INTRODUCTION

The diagnosis of sphenoid sinuses disease is primarily radiological imaging with computed tomographic (CT) scanning is the gold standard. Magnetic resonance imaging (MRI) is an essential adjunct in the diagnosis and management of many lesions of the sphenoid sinuses.¹

RADIOLOGY OF SPHENOID SINUS

The physical findings in cases of sphenoid sinuses disease are usually minimal, compelling the physician to rely on radiographic studies, which have optimally visualized this sinus only recently.¹

RADIOGRAPHS OF THE SKULL

Plane radiography has been utilized to visualize the sinuses in the vicinity of the nose as the early as the 1900s.²

Mosher in 1912, ventured to perform a lateral radiograph assisted probing of the frontal sinus.³ Cushing 1914 evaluated the sphenoid sinus and the sella turcica.⁴

Hammer and Radberg 1964 published anatomic and roentgenologic studies of the sphenoid sinus with emphasis on the sella turcica.⁵

Lee in 1978, Kern et al in 1979 and Stankiewicz in 1995 suggested the use of lateral radiographs intra-operatively to facilitate localization of the front wall of the sphenoid sinuses and the anterior wall of sella turcica.⁶⁻⁸

Mosher outlined intra-operative guidelines by measuring the distance from the pyriform aperture to the fovea ethmoidalis, the spheno-ethmoidal junction and the anterior wall of the sphenoid sinuses.⁴



Figure 1: Lateral radiograph of the skull.

Lateral radiograph of the skull (Figure 1).

On the lateral projection, the paired sinuses are superimposed on one another but the extent of pneumatization can be assessed, especially in their vertical and horizontal directions.⁹

The utility of plain lateral sinus radiographs is limited as both right and left sides are superimposed and cannot, therefore be distinguished. Mackay et al.¹⁰ Role of plain sinus radiographs is very controversial as false positive and false negative interpretations can be made, particularly in infants and children (McAlistar et al). Moreover, crucial surgical features such as prominent or dehiscence optic or carotid canals cannot be clearly delineated plain lateral sinus radiographs.¹¹



Figure 2: Antero posterior view of the skull.

Antero posterior view of the skull (Figure 2)

On antero posterior view of the skull, the sphenoid sinuses are clearly visible below and in front of the hypophyseal fossa. Normal sinuses are radiolucent whereas diseased sinuses show varying degrees of opacity/ air fluid level (Gray's Anatomy 37th edition).¹²



Figure 3: Occipitomental view / water's view.

Occipitomental view / Water's view (Figure 3)

On Occipitomental view / Water's projection, with mouth open the sphenoid sinus can be assessed.¹³

Lazar et al and Burke et al concluded that sinus radiographs are not reliable enough to be integral component of clinical decision-making process.^{14,15} Submento-vertical view/ Skull base view (Figure 4) In this view the two sphenoid sinuses can be assessed individually.

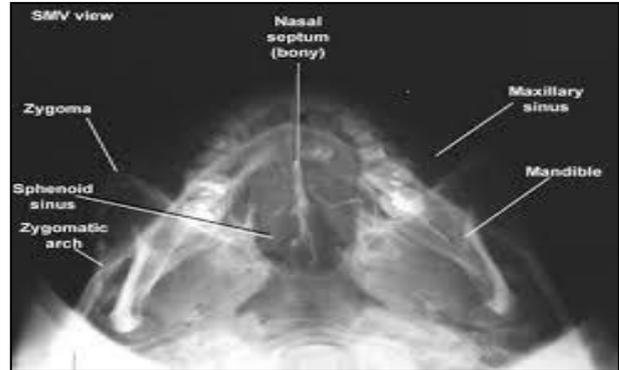


Figure 4: Submento-vertical view/ skull base view.

Plain radiographs and examination with a headlight offer little diagnostic information on the sphenoid pathology (Sethi).¹⁶

CT AND MRI

CT

CT imaging is the most practical cost-effective means to study the paranasal sinuses and assists in preventing complications.¹⁷

Over the years, it has established its place as the "investigation of choice" for evaluation of involvement of the paranasal sinuses. In addition to evaluating the bony passages it also helps to demonstrate mucosal thickening, fluid or calcification in the sinuses. Soft tissues of the orbit and anterior cranial fossa can also be visualized.¹⁸

Computed tomography of the sphenoid sinus is used to assess its:

- Anatomical status i.e., normal anatomy and anatomical variations, extent of pneumatization, presence of congenital/ bony dehiscence, presence of abnormal cells (onodi cells) and its relation with vital structures.
- Pathological status i.e., delineation of pathology, site and extent, depth on invasion, details of mucosal abnormalities, possible cause for pathology and probable cause of failure of surgical intervention.

It is considered ideal to have computed tomography cuts in all the planes, coronal, axial and sagittal. Though technically it is difficult to get cuts in the sagittal plane, therefore formatted images are utilized.

Axial plane study of the sphenoid sinus (Figure 5).

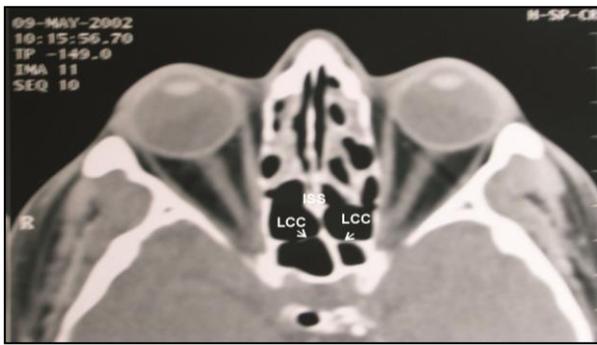


Figure 5: Axial plane study of the sphenoid sinus.

It provides adequate information of certain areas particularly the sphenoidal recess and onodi cells. In case onodi cells are present, the anterior wall of the sphenoid sinuses may not be the posterior wall of posterior ethmoid air cells.

Driben et al in 1998 analyzed the reliability of computed tomography in the detection of onodi cells and documented that the computed tomography identified these cells in 7% of sphenoidal complexes, however anatomic dissection found the same in 39% complexes in the American population.¹⁹

Axial sections at lower or mid ethmoid level delineate the onodi cells, sphenoidal recess and ostium of sphenoid sinuses. Other structures demonstrated by axial sections are the extent of pneumatization, relationship of optic nerve and the internal carotid artery, presence or absence of dehiscence of the walls of the sinus, size of the sinus, number and position of septa, anatomical variations and sinus pathology if any.

Coronal plane study of the sphenoid sinus. (Figure 6)

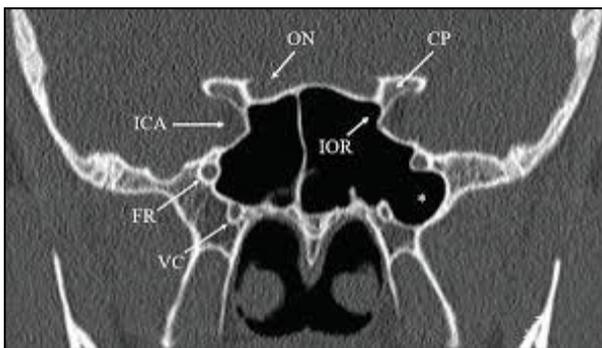


Figure 6: Coronal plane study of the sphenoid sinus.

It is the preferred plane for computed tomographic imaging prior to functional endoscopic sinus surgery as being synchronized with the surgical steps, it acts as a guide or a “road map” for the surgeon.

Posterior coronal cuts at level of posterior ethmoids show the superior turbinate and its meatus, the sphenoidal recess and the onodi cells (if present).

At the level of the face of sphenoid the structures seen are ostium of sphenoid sinus, choanae and any anatomical variants.

At the middle of sphenoid sinuses, one can make out the inter-sinus septa, prominence of the optic nerve, bulge of the internal carotid artery, anterior clinoid process and any anatomical variations (example: excessive pneumatization).

Sagittal plane study of the sphenoid sinus.

A lateral scan is vital to know the distance and angle of sphenoid from the anterior nasal spine. One can also have an idea of pneumatization of the sphenoid sinus (Presellar, sellar and postsellar).

Ideally, a postoperative patient should be followed with coronal computed tomography to establish the type and extent of surgical intervention. The sinus boundaries and important anatomic relationship should be inspected particularly for any bony dehiscence or development of any cephalocele.

Computed tomography scan is very reliable in demonstrating bony sinus wall erosion or perisinus extension.²⁰

Bone erosion is generally produced by malignant tumors but can also be seen with large expansile mucocoeles. Extracranial extension is a hallmark of malignant disease. It may represent a primary sinus tumor, a metastatic lesion or extension of an intracranial or a nasopharyngeal neoplasm.¹

Contrast enhanced computed tomography scans

Contrast enhanced computed tomography scans are required if intracranial extension is suspected or if a vascular tumor example: meningioma or juvenile angiofibroma is suspected.^{9,21}

Disadvantages of computed tomography scanning include higher expenses, higher radiation dose and interference by artifacts such as extensive dental fillings.²¹

MRI (Figure 7)

In MRI, T1 weighted images assess anatomy and T2 weighted images assess disease.²¹

The bony margins of the sinuses appear as a plane of absent signal on magnetic resonance imaging and this limits the usefulness of the technique in examination of the sphenoid sinus. Moreover, the high fat content of bone marrow in the basi-sphenoid and petrous apex gives

intense signals, which can be very confusing, especially since the retained fluid in the sinuses also gives a similar intense signal.⁹



Figure 7: MRI coronal plane study of the sphenoid sinus.

Oliverio et al 1998 discouraged using MRI as a reliable operative road during functional endoscopic sinus surgery.²²

The vital contribution of magnetic resonance imaging is that the signal from various parts of the biological specimen is characteristic not only of the physical property (density) of the specimen but also depends on the biochemical nature of the specimen. This has a great potential for identification or characterization of the pathologic entities.¹⁷

MRI VERSUS CT

MRI compared to the computed tomographic scanning can differentiate inflammatory pathology from neoplastic lesions. In complications of sinusitis or a neoplasm is suspected, the study of choice is contrast enhanced MRI

Other advantages of MRI are: multiplanar capability, superior soft tissue contrast, lack of ionizing radiations.

The standard protocol for magnetic resonance imaging of paranasal sinuses is T1-weighted images in the sagittal, axial, and coronal planes and T2- weighted images in the axial plane. T1- weighted images assess anatomy; T2-weighted images assess disease. Brighter signal is produced by fluid containing structures whereas a lower signal is produced by malignant tumors.

Disadvantages of magnetic resonance imaging are; time consumed in scanning is about 30-45 minutes as compared to CT scan, which takes approximately 15 mins, more-noisy and confining than CT scan and therefore claustrophobic patients are difficult to assess.²³

The bony margins of the sinuses appear as a plane of absent signal on MRI.^{9,23} Therefore, it is not a reliable road map to guide the surgeon during functional endoscopic sinus surgery.²²

CONCLUSION

Vis a vis imaging is the road map to the functional endoscopic sinus surgery of the maxillary sinus.

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