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Evaluation of sella trucica by various imaging modalities in relation to their diagnostic advantages: Review of literature

Prajina Khanal[1], Nitish Virmani[2], Suzeen Makroo[3], Shilpi Kumari[4], Tusharika Khatri[5], Tanu Singh[6], Shweta Sharma[7], Bb Sharma[8]

[1, 3, 5] Radiographer, Department of Radio diagnosis, SGT Medical College, Gurugram, Haryana, India
[2] Assistant Professor, Faculty of Allied Health Sciences Department of Radio diagnosis, SGT Medical College, Gurugram, Haryana, India
[4] M Sc Fellow, Department of Allied Health Sciences Department of Radio diagnosis, SGT Medical College, Gurugram, Haryana, India
[6] Assistant Professor, Department of Radio diagnosis, SGT Medical College, Gurugram, Haryana
[7] ENT Specialist Registrar, UHCW, Coventry CV 22DX, United Kingdom
[8] Professor and HOD, Department of Radio diagnosis, SGT Medical College, Gurgaon, Haryana, India

Abstract
Sella turcica is an important indicator in various imaging modalities. This may be enlarged or changed in shape because of different clinical conditions or as variations. This houses pituitary gland and various changes are the result of change in shape and size of the gland. The changes can be seen in cephalometric films, computed tomography (CT) and magnetic resonance imaging (MRI).Plain radiography of the skull may show changes earlier than their clinical appearances.

Keywords: sella turcica; pituitary gland; cephalometry; CT, MRI

Introduction

Sella turcica hosts pituitary gland and it is a form of depression in the sphenoid bone of the skull. This resemble is as the Turkish saddle which has got support on both front and back (Figure 1). This measures 4 to 12 mm in height and 5to 16 mm in front to back [1].

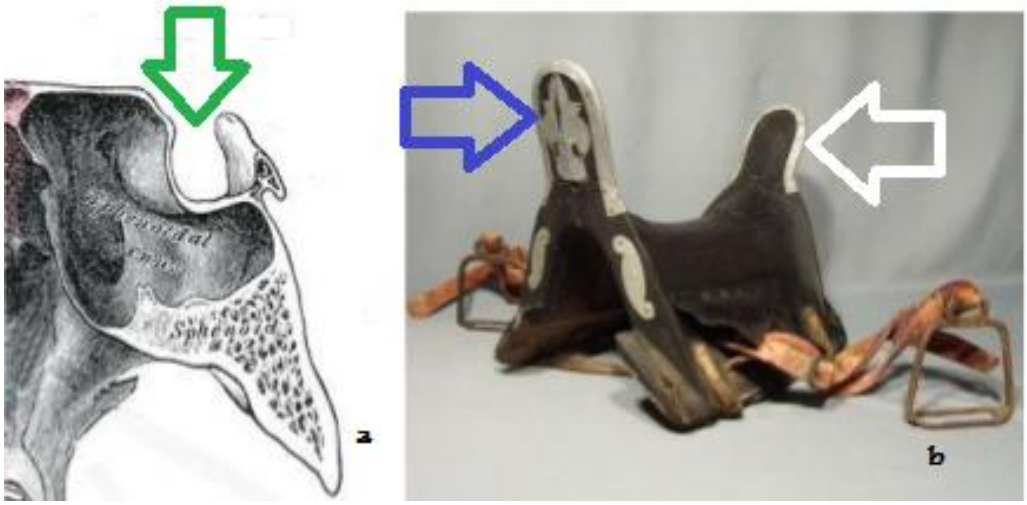

Fig 1: Sella trucica. a) Depression in sphenoid bone above the sphenoid sinus (green arrow).b) Turkish saddle with anterior (blue arrow) and posterior (white arrow) protections.

Discussion

Sella turcica is also called as hypophyseal fossa which lies just above the sphenoid sinus. This is lined by dura. It is very important to know the anatomy of sella trucica before we see the abnormalities and appearance in various imaging modalities [2].

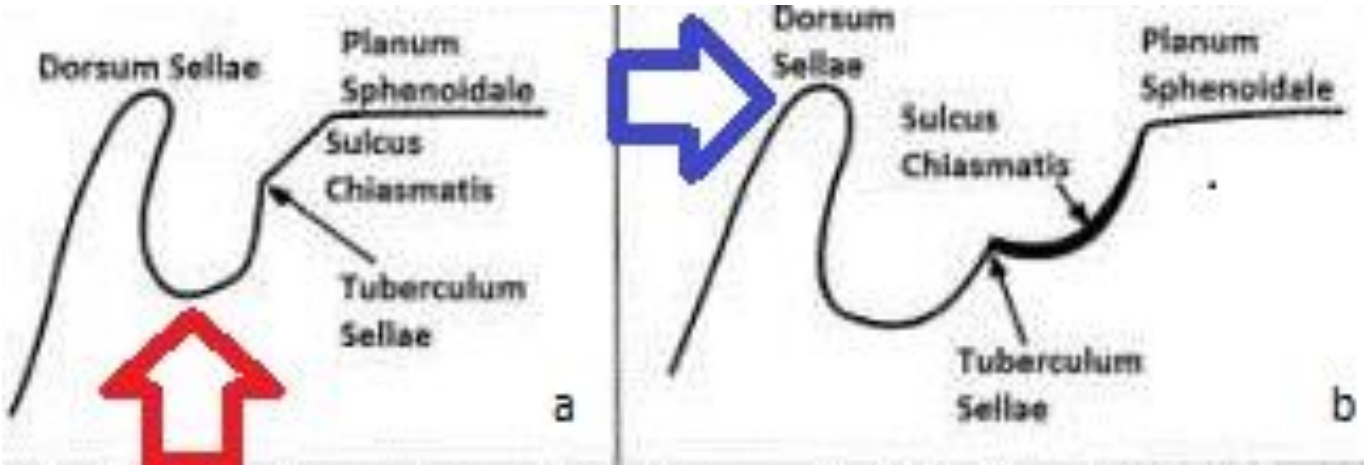

Fig 2: Description of sella trucica. a) normal with different labeling and the base is the lower most point (red arrow).b) J-type variant with the dorsal superior most point as dorsum sella (blue arrow).

The correct lateral view can define the anatomy of the anterior and posterior outlines (Figure 2). The radiograph is taken with the central ray point which is 2 cm anterior and 2 cm superior to the external auditory meatus.The distance of the focal point should be 100 cm.Both the clinoids should be superimposed with sell and clivus in profile (Figure 3)

Fig 3: Skull radiograph for dorsum sella. a) lateral view shows the depressin (black arrow) in the skull bone as sella trucica with the underlying sphenoid sinus (red arrow).b) antero-posterior projection shows the sella trucica (white inverted arrow).

The contents of the fossa are pituitary gland, vessles, intercavernous sinuses and cerebrospinal fluid (CSF).There can be empty sella because of the enlarged fenestrations [3]. On technical aspect posteroanterior, anteroposterior and lateral views are advocated for the evaluation for which different specification and parameters are given in the comparative description (Table 1).

Table 1: Detailed description of all the views for X-rays of pituitary fossa with the technical parameters.

Lateral view	PA view (Caldwell view)	PA Axial View (HASS View)	AP Axial View
Prepare the patient with all the positioning instruction, remove all metallic bodies.	The patient lies in prone position on the table top with frontal part touching the table.	The patient lies in prone position on the table top with frontal part touching the table.	The patient lies in supine position on the table top with occipital part touching the table.

The patient stands against the vertical stand with the lateral part of skull towards the image receptor. The inter-papillary line is perpendicular to the image receptor and mid sagittal plane parallel to the image receptor. The central ray passes at 90° from 2 cm anterior and 2 cm superior to external auditory meatus. FFD is kept 100 cm. Closed collimation is used for better sharpness. TECHNICAL FACTORS: Image receptor: 10" x 12" (cross wise) kVP: 68 MaS: 32	The neck is flexed and chin is down to bring the cantho meatal line perpendicular to the table top. Align the mid sagittal line parallel to the central line of the table. Central ray passes from the occipital protuberance with a cranial angle of 10-15°. Make sure the patient's head is not tilted. Place the image receptor in the bucky. FFD is kept 100 cm. TECHNICAL FACTORS Image receptor: 10" x 12" (lengthwise) kVP: 68 MAs: 40	The neck is flexed and chin is down to bring the cantho meatal line perpendicular to the table top. Align the mid sagittal line parallel to the central line of the table. Central ray passes from the occipital protuberance with a cranial angle of 25°. Make sure the patient's head is not tilted. Place the image receptor in the bucky. FFD is kept 100 cm. TECHNICAL FACTORS Image receptor: 10" x 12" (lengthwise)	The neck is flexed and chin is down to bring the cantho meatal line perpendicular to the table top. Align the mid sagittal line parallel to the central line of the table. Central ray passes 2-3 cm above the supraciliary ridge with a caudal angle of 40°. Make sure the patient's head is not tilted. Place the image receptor in the bucky. FFD is kept 100 cm. TECHNICAL FACTORS Image receptor: 10" x 12" (lengthwise)

Various advantages and disadvantages by radiographic evaluation have been described in Table 2.

Table 2: Advantages and disadvantages of plain radiographic evaluation of sella turcica.

Advantages	Disadvantages
▪ Precision in the diagnosis of the alteration of sella trucica observed in lateral film of skull have been earlier presented, now the sagittal view of the sella-antero-posterior and postero- anterior presents great value to the diagnosis. ▪ A lateral cephalogram is used to measure segments and areas of sella trucica. ▪ The sella trucica morphology was analyzed and of different morphological aberration like oblique, anterior wall, bridging of sella trucica, double contour floor, irregular surface in aspect of dorsum sella pyramid like shape. ▪ Before the advancement in imaging modalities, lateral cephalometric studies were done.	▪ It is difficult to find a radiologist who is experienced in reading the lateral coned down view. ▪ At the posterior aspect of the sella outline was an extensive overlap due to the cephalometric stud ▪ Cephalometric studies have given inaccurate values such as superimposition of structure and possible geometric unsharpness with resultant 2D imaging system. ▪ Detail pathologies cannot be ruled out.

It is difficult to evaluate on plain radiography regarding the pneumatisation of sphenoid sinus with the septal variations within it. The sellar floor could be either concave, flat or convex. There can be thinning of the floor of the sella where the lesion exert pressure Computerized tomography (CT) scores in evaluation of sella trucica because of the capability of 3D formation and post processing (Figure 4). These images can be visualized in different windows depending upon the need [4]. The advantage and disadvantages are tabulated below in Table3.

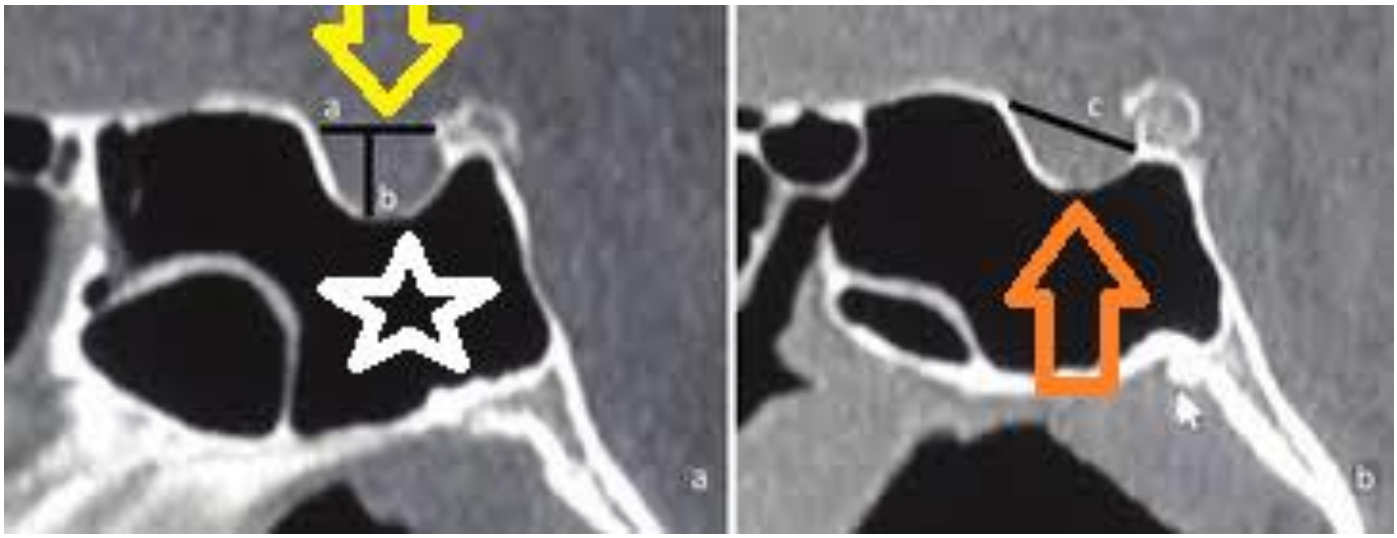

Fig 4: Reformatted CT of sella turcica. a) normal appearance shows aerated sphenoid sinus (white star) and superior sellar bridge (yellow arrow).b) base of the sella (red arrow) shows comparatively thin radio density with normal adjoining both clinoid processes

Table 3: Advantages and disadvantages of CT in evaluation of sella turcica evaluation.

Advantages	Disadvantages
▪ Cross sectional images of Sella trucica are acquired with a slice thickness of 1.5-3 mm. It acquires images at different depths from several angles. ▪ In CT, images of the sella trucica can be reconstructed in multiple planes. (sagittal, coronal, axial) ▪ Optimal contrast enhancement has made advancement in visualization of lesions in the sellar region. ▪ CT gives an increased bonny resolution that helps in acquiring the measurement of bone length or diameter of sellar regions and evaluates soft tissue, calcification and bone destruction. ▪ Comparing with x-ray imaging, CT scan overcomes the problem of superimposition of bones.	▪ CT does not provide an optimum soft tissue resolution for the visualization of pathologies. ▪ Ionizing radiation: It is energetic enough that directly affects the DNA which increases the risk of cancer due to exposure over a long period of time.

As sella trucica anatomy is quite complicated and has got relation to many surrounding structures, so the evaluation of these structures and soft tissue is of paramount important. Magnetic resonance (MR) gives the best tissue characterization. The main advantages of this modality are the capability of multiplanar and multi sectional images.MRI shows the different sequences which can further highlight the pathology part (Figure 5). There is also capability of dynamic imaging study which is very important as we all know the enhancement pattern of pituitary gland. The most common sequences for the evaluation are T1WI,T2WI,DWI and contrast T1WI with fat suppression [5].Various advantages and disadvantages have been given in Table 4.

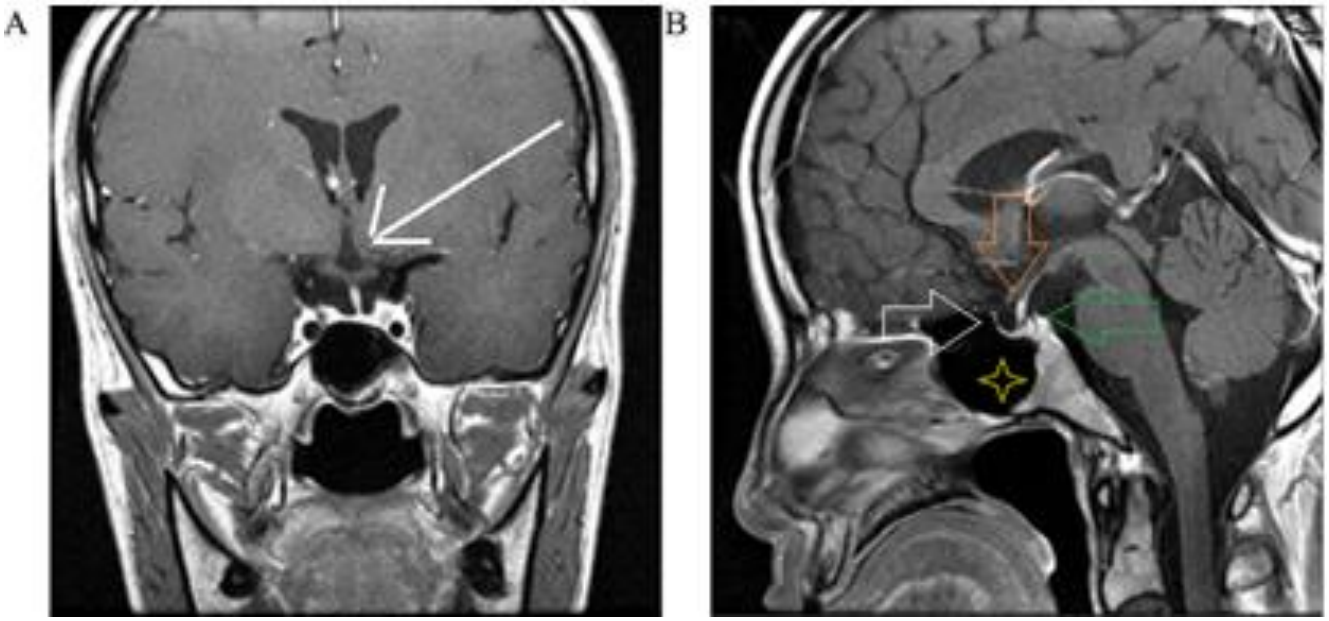

Fig 5: MRI images of dorsum sella. A) Coronal section shows the sellar relation to sphenoid sinus and pituitary stalk (white arrow). B) Sagittal section of dorsum sella with sphenoid sinus inferiorly (white star), anterior edge of anterior clinoid (white arrow), superior covering by diaphragm sella (red arrow) and posterior limit by dorsum sella of posterior clinoid (green arrow).

The contents of the sella turcica can further be delineated by contrast studies. Dynamic contrast MR imaging studies will exactly highlight the pathology because of inherent quick enhancement of the pituitary gland. This is because of the portal circulation in the gland. This also differentiates between the adeno-hypophysis and neuro-hypophysis.The tumor arising from any of the portion will affect the corresponding portion of the sella turcica. This can range from minor thinning to the gross erosion of the underlying bones. There can be invasion to the sella by multiple surrounding structures and can either be of vascular, neural, bony, soft tissue or that of simply CSF (cerebrospinal fluid) in nature. Sometimes empty sella can be visualized when there is either hypoplastic pituitary gland or of displaced in nature. The enlarged sphenoid sinus can also cause in the variation of the shape and size of the sella trucica.

Table 4: Advantages and disadvantages of MRI in evaluation of sella trucica.

Advantages	Disadvantages
▪ MRI is the primary modality for pituitary imaging replacing computed tomography. ▪ The MR technique is optimized to create thin section high resolution images in sagittal, coronal and axial planes. ▪ MR demonstrates the extent of larger tumors, lesions in the sellar regions. It is of the superior value in characterization and accurate diagnosis of sella. ▪ Most cases benefit from utilization of gadolinium as contrast agent, because most pathologies enhance more slowly than normal glandular tissue. ▪ Dynamic contrast enhanced MRI study of sellar region provides fine details of the pathology. ▪ It is accurate in differentiating the sellar and parasellar pathologies.	▪ MRI is contraindicated to patients who have metallic foreign body or implant and the cardiac implantable electronic device such as pacemaker, implantable cardiovascular defibrillator due to strong static magnetic field of MRI scanners which can accelerate ferromagnetic substances and turn them into dangerous projectile. ▪ Patient with claustrophobia (fear of closed spaces) face difficulty to undergo MRI scan. ▪ MRI contrast agent gadolinium is relatively very safe, however it rarely might cause allergic reaction in patients who have risk for nephrogenic systemic fibrosis or who had a previous anaphylactic reaction to gadolinium. ▪ MRI scan is relatively costly than other imaging examinations.

The variations of morphological characteristics have given clue to many pathologies starting from embryonic state. The children having myelomeningocele have different shapes of sella during fetal life [6]. J-shaped sella was termed by Davidoff and Epstein (1950)and "omega" was named by Fournier and Denizet later on in 1965.The shape further varies as per the clinoid processes and contour of tuberculum sella and the fusion of both is coined as 'sella turcica bridge'. Only two third subjects show normal morphological features of sella turcica and rest one third show dysmorphological features. So as per this observation there can be misleading morphological features which can lead to the wrong diagnosis or evaluation [7].

Conclusion

The evaluation of sella turcica requires a very precise selection of imaging modalities as this carries many advantages and disadvantages. Plain radiographic evaluation to cross sectional imaging plays different roles as per the characteristic of imaging modality. The sella may be looking normal but can be associated with some accompanying disease and other way appearance is also applicable. The confusion still exists because of many normal variations.

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Conflict of interest

Nil

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