Sellar reconstruction after endoscopic transsphenoidal pituitary surgery:

Systematic review and meta-analysis

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Otorhinolaryngology

By

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Abstract

Introduction:

Skull base lesions especially those affect the sellar region as pituitary adenomas, craniopharyngioma and pituitary cysts could be approached by the endoscopic transsphenoidal approach which is favoured more than open approaches due to its minimal invasiveness. But, the resultant sellar defect needs to be be reconstructed to form a tight barrier separating the nasal cavity from the brain.

Methodlogy:

A systematic review and meta-analysis is done to evaluate all articles puplished from aprill 1995 till 2014 and concerned with reconstruction of the sella after endoscopic transsphenoidal pituitary surgery with evaluation of post operative CSF leak and results were analysed with REVMAN 5 a metaanalytic software.

Results:

No one of the three methods of sellar reconstruction is statiscally significant which is due to low number of the patients. But the nasoseptal flap shows the trend to be better than the other two methods.

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Keywords:

Endoscopic Transsphenoidal –Sella- Nasoseptal Flap-Middle Turbinate Flap-Fat- Reconstruction of the Skull Base.

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Aim of the work

The study aims to analyse and evaluate the studies conducted on the different methods of sellar reconstruction especially fat, middle turbinate flap and nasoseptal flap, and to compare their results in order to reach the best way to reconstruct the sella in different situations after endoscopic transsphenoidal pituitary surgery.

During the past decade the popularity of the endoscopic approach for the treatment of sphenoid sinus & the related skull base lesions has been increased because its minimal invasiveness & improvement patient comfort ***(Gibbons M.D & Sillers MJ, 2002).***

The procedure provides a panoramic view, allowing observation of all anatomic structures along the surgical route as well as those on the skull base ***(Nasseria SS et al, 2001).***

The skull base extends from anterior limit of the cranial fossa down to the anterior border of framen magnum.

Lesions of the skull base either originate from within the cranium (e.g pituitary adenoma, meningioma, craniopharyngioma, chordoma) or it may extend from nasal cavity (e.g squamous cell carcinoma, neuroblastoma, nasopharyngeal carcinoma or lymphoma).

Skull base lesion can be reached by several approaches trans-cranial or trans-nasal either microscopic or endoscopic. In this study we will focus on the endoscopic approach to sellar region and the ways to reconsruct the remaining skull base defect. the endoscope must be handled by the non –dominant hand and the surgical instrument by the other hand obviating bimanual manipulation ***(Kassam A et al, 2005).***

Minimally invasive procedures are becoming standard practice in surgeries for the skull base, image guided surgery represents a new technology with applicability to some patients undergoing endoscopic endonasal surgery ***(Olson G. & Citardi M.J, 2000)***.

Undoubtedly, knowledge of the anatomy remains essential for performing safe endoscopic endonasal surgery. However malformation, previous operations, massive lesions may interfere greatly with orientation thus exposing the patient to major risks ,so Image guided surgery is an important aid to surgeons in identifying anatomical landmarks in difficult cases, thus reducing the stress placed on the surgeon and augmenting patient safety by improving surgical accuracy, so it reduce the risk of major intracranial or intra orbital complications, it also offers a saggital reconstruction and 3 dimensional imaging capacity ***(Eliasher R et al 2003).***

Following the endoscopic transnasal pituitary surgery, the resultant sellar defect requires reconstruction to form a watertight barrier separating the intracranial compartment and sinonasal tract and failure to achieve adequate separation can lead to complications, including cerebrospinal fluid (CSF) leak, pneumocephalus and meningitis.

As the complexity of skull base defect size and location has increased, the need for more robust and reliable reconstructive options has also increased ***(Zanation AM et al , 2009).***

Many closure techniques (mucosal flaps, septal cartilage,septal and turbinate bone, fascia lata or fascia temporalis,abdominal fat) either intracranially (inlay) or extracranially (onlay) and fixation techniques (biological glue, silicone coated sheet, resorbable mesh, balloon catheter) have been proposed (***Hegazy HM, et al 2000).***

The current options available for reconstruction have expanded and the decision to reconstruct must take into account the anticipated location, size,and shape of the defect***(Zanation AM et al , 2009).***

Relevant Anatomy

Sphenoid Bone:

The sphenoid bone is located in the center of the cranial base. It resembles a bat with wings outstretched. It has a central portion called the body, two lesser wings which spread outward from the superolateral part of the body, two greater wings which spread upward from the lower part of the body and two pterygoid processes with their medial and lateral pterygoid plates directed downward from the body ***(figure 2).*** The intimate contact of the body of the sphenoid bone with the nasal cavity below and the pituitary gland above has led to the transsphenoidal route being the operative approach of choice for most sellar tumors. ***(Rhoton.A.L, 2002)***.

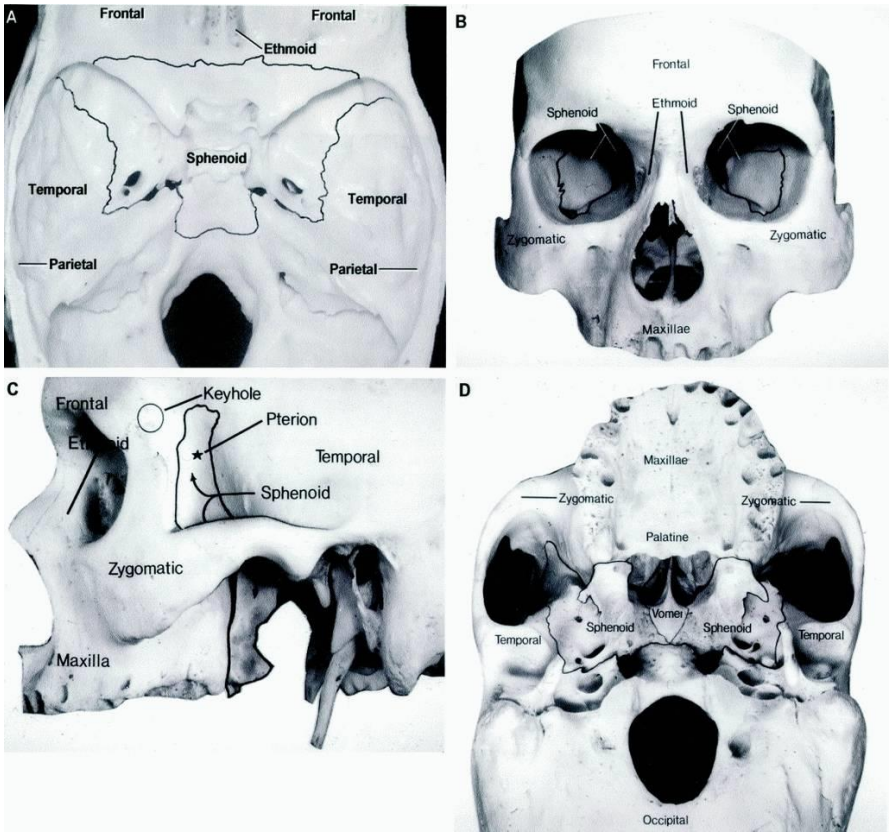

Figure (1)*:** Osseus relationships of the sphenoid bone, the sphenoid bone is outlined in each view, **(A)** superior view **(B)** anterior view **(C)** lateral view **(D)** inferior view ***(Rhoton, 2002).

The neural relationships of the sphenoid bone are among the most complex of any bone. The olfactory tracts, gyrus rectus and the posterior part of the frontal lobe rest against the smooth upper surface of the lesser wing. The temporal lobe rests against the inner surface of the greater wing. The pons and mesencephalon lie posterior to the clival portion. The optic chiasm lies posterior to the chiasmatic sulcus and the second through sixth cranial nerves are intimately related to the sphenoid bone and all exit the cranium through the optic canal, superior orbital fissure, foramen rotundum, or foramen ovale all of these foramina are located in the sphenoid bone ***(Rhoton. A.L, 2002)***.

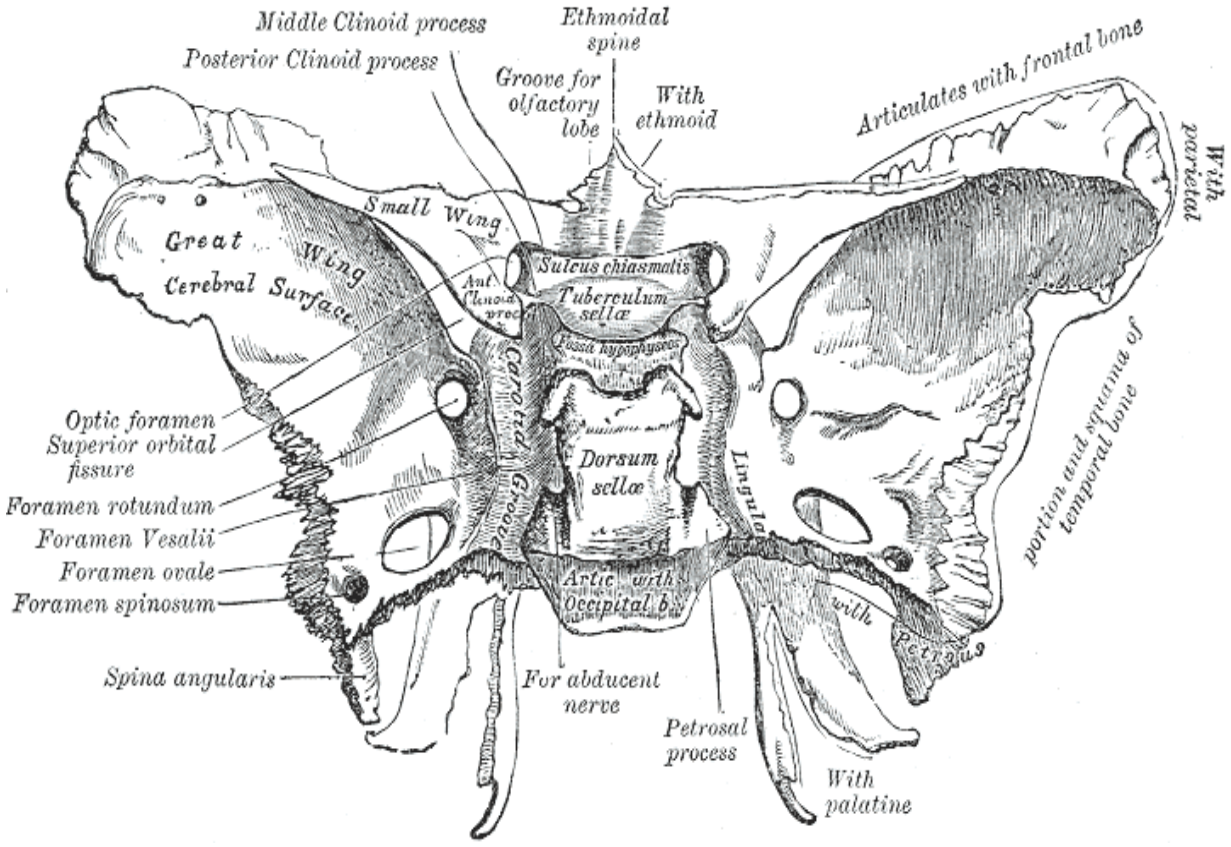

Figure (2): sphenoid bone (posterosuperior view ***)(gray's anatomy 1918)***

The sphenoid bone has many important arterial and venous relationships. The carotid arteries groove each side of the sphenoid bone and often form a

serpiginous prominence in the lateral wall of the sphenoid sinus. The basilar artery rests against its posterior surface, the circle of Willis is located above its central portion and the middle cerebral artery courses parallel to the sphenoid ridge of the lesser wing. The cavernous sinuses rest against the sphenoid bone and intercavernous venous connections line the walls of the pituitary fossa and dorsum sellae ***(Rhoton A.L., 2002)***.

In the superior view ***(figure 2)***, the pituitary fossa occupies the central part of the body and is bounded anteriorly by the tuberculum sellae and posteriorly by the dorsum sellae. The chiasmatic groove (sulcus), a shallow depression between the optic foramina, is bounded posteriorly by the tuberculum sellae and anteriorly by the planum sphenoidale. The frontal lobes and the olfactory tracts rest against the smooth upper surface of the lesser wing and the planum sphenoidale.

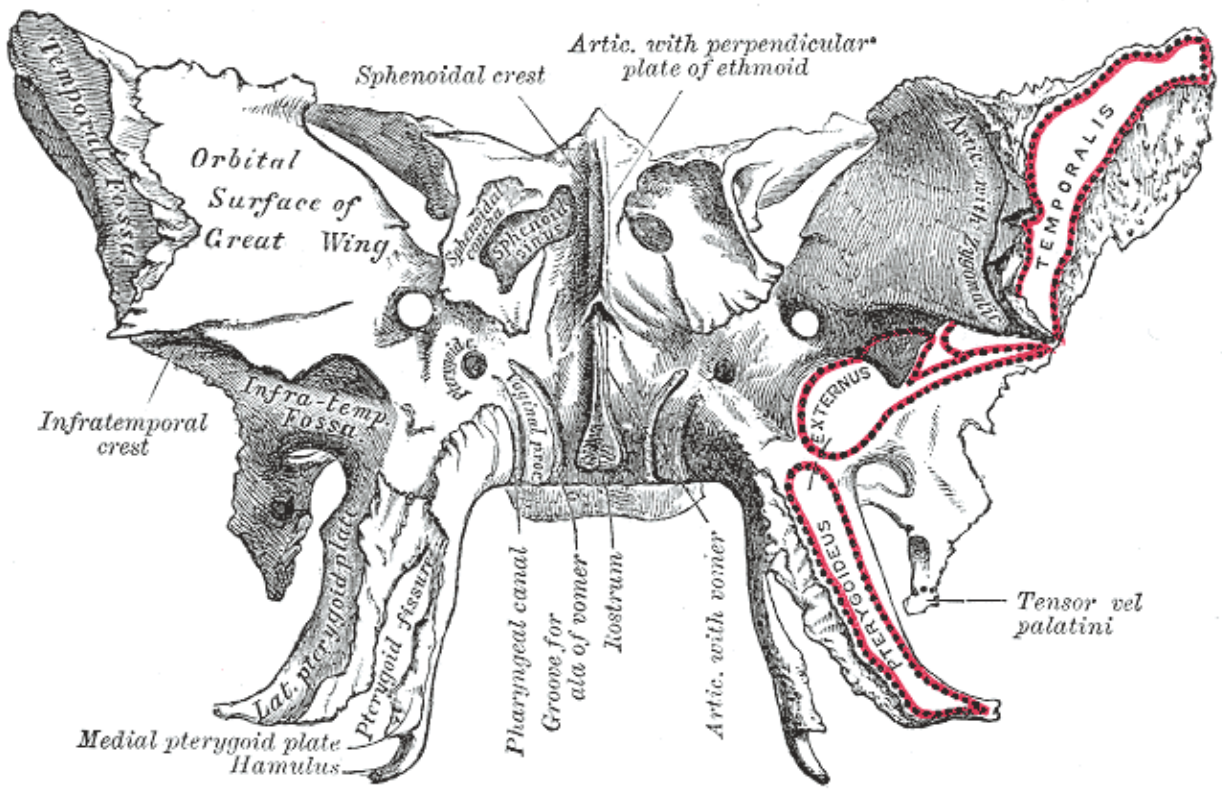

Figure (3): sphenoid bone (anteroinferior view***)(gray's anatomy 1918)***

Sphenoid Sinus:

One of the paranasal sinuses that is located in the sphenoid bone and related to the nose and opens in the lateral wall of the nose in the sphenoethmoidal recess.

It separates the cavernous sinuses, the cavernous segments of the carotid arteries, the optic, extraocular and trigeminal nerves. In addition, it separates the pituitary gland from the nasal cavity. The sphenoid sinus is subject to considerable variation in size and shape and to variation in the degree of pneumatization.

When the sinus is exceptionally large, it extends into the roots of the pterygoid processes or greater wing of the sphenoid bone and may even extend into the basilar part of the occipital bone. Occasionally there are gaps in its bone, with the mucous membrane lying directly against the dura mater ***(Rhoton A.L., 2002)***.

There are three types of sphenoid sinus in the adult ***(figure 4***): conchal, presellar, and postsellar types depending on the extent to which the sphenoid bone is pneumatized. In the conchal type, the area below the sella is a solid block of bone without an air cavity. In the presellar type of sphenoid sinus, the air cavity does not penetrate beyond a vertical plane parallel to the anterior sellar wall. The sellar type of sphenoid sinus is the most common, and here the air cavity extends into the body of sphenoid below the sella and as far posteriorly as the clivus. ***(Rhoton A.L, 2002)***.

Figure (4): Varieties of sphenoid sinus pneumatization ***(Hardy and Maina, 1977)***.

The septae within the sphenoid sinus vary greatly in size, shape, thickness, location, completeness, and relation to the sellar floor. The cavities within the sinus are seldom symmetrical from side to side and are often subdivided by irregular minor septae. Computed tomography imaging of the sella provides the definition of the relationship of the septae to the floor of the sella needed for transsphenoidal surgery ***(Rhoton A.L., 2002)***.

Sphenoid ostium is located in the sphenoethmoidal recess medial to the superior turbinate (***figure 8)*** marked in the upper margin of the superior choana and move vertically approximately 1.5 cm upward within the sphenoethmoidal recess ***(Rhoton A.L., 2002)***.

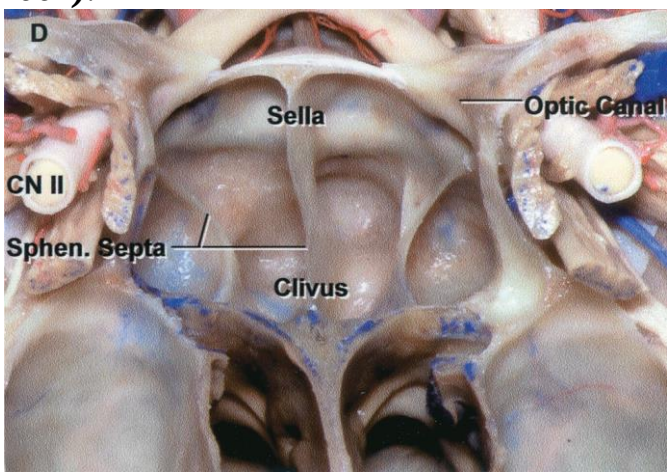

Figure (5): Transnasal route to the sphenoid sinus and sella. The anterior face of the sphenoid has been removed to expose the multiseptated sphenoid sinus and the anterior wall of the sella. The bony prominences over the optic canals are situated in the superolateral. (spehn. = sphenoid***)*** ***(Rhoton A.L., 2002)***.

Anatomical Structures Involved in the Endonasal Approach to the Sella

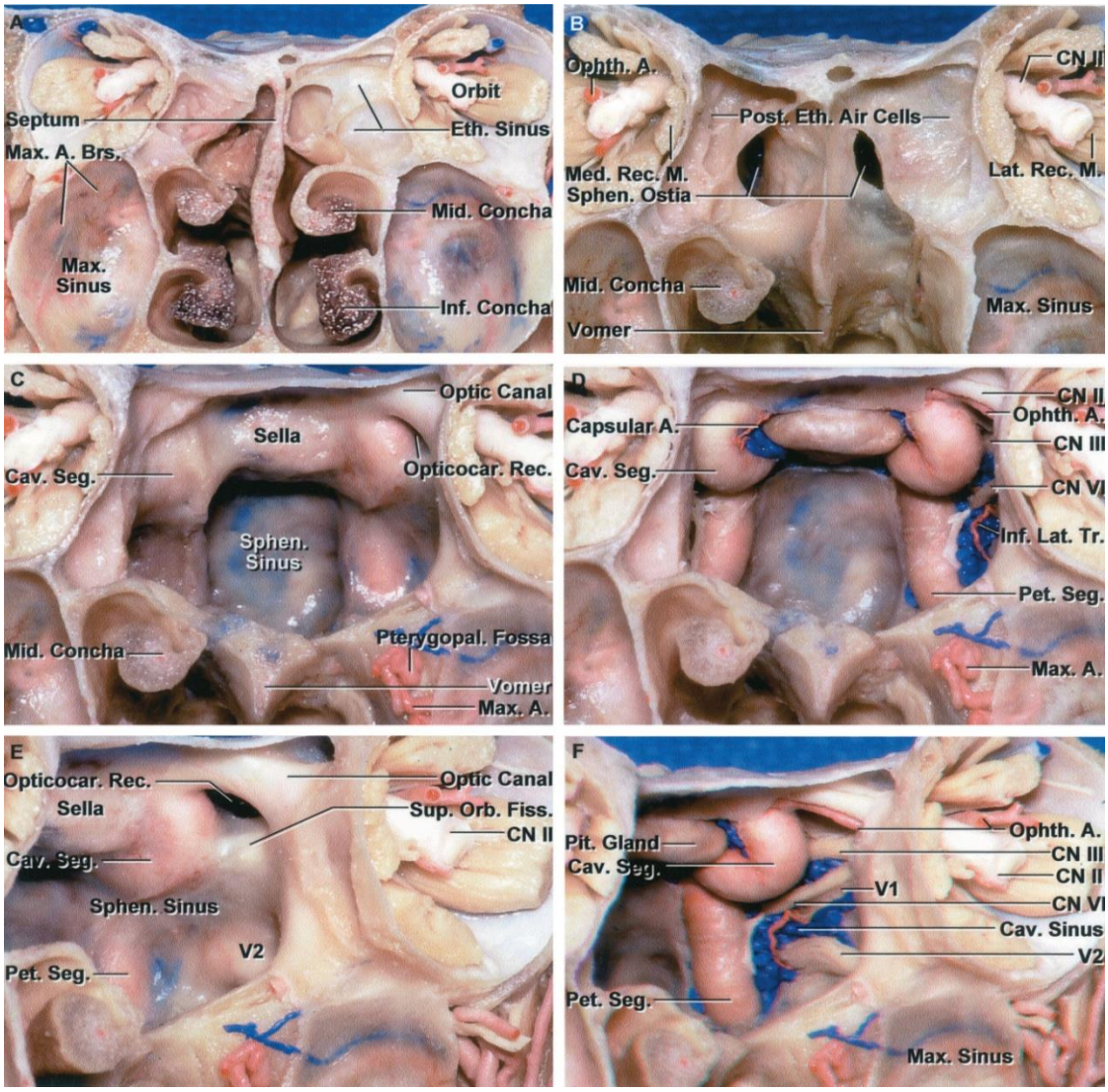

Figure (6): Anterior view of a coronal section in front of the sphenoid sinus, through the nasal cavity, orbits, and ethmoidal and maxillary sinuses. **(A)** the upper part of the nasal cavity is separated from the orbits by the ethmoidal sinuses. **(B)** the middle and inferior nasal conchae on the left side and the nasal septum and the posterior ethmoidal sinuses on both sides have been remove. **(C)** the anterior wall of the sphenoid sinus has been opened and the sphenoid septa has been removed. (D) the pituitary gland, intracavernous carotids, optic nerves, ophthalmic arteries, and cavernous sinuses have been exposed by removing the bone of the sinus wall**.(E)**oblique view. . **(F)** oblique view. The pituitary gland, intracavernous carotid artery, ophthalmicartery, and optic, ophthalmic, maxillary, oculomotor, and abducens nerves have been exposed.The abducens nerve courses medial to the ophthalmic nerve. A., artery; Brs., branches; Cav.,cavernous; CN., cranial nerve; Eth., ethmoid; Fiss., fissure; Inf., inferior; Lat., lateral;M., muscle;Max., maxillary; Med., medial; Mid., middle; Ophth., ophthalmic; Opticocar., opticocarotid;Orb., orbital; Pet., petrous; Pit., pituitary; Post., posterior; Pterygopal., pterygopalatine; Rec., recess, rectus; Seg., segment; Sphen., sphenoid; Sup., superior; Tr., trunk***.(Rhoton A.L., 2002)***.