Endoscopic approaches to the sphenoid: How I do it?

Tamer A. Youssef

Department of Otorhinolaryngology, Ain Shams University, Cairo, Egypt

Correspondence to Tamer A. Youssef, MD, 36 Ismail Wahaba street District 9, Naser city, 11361 Cairo, Egypt
Tel: +20 100 158 7000; fax: +0224717192;
e-mail: tayoussef@yahoo.com

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Sphenoid sinus disease is recognized as an unusual clinical entity. It is likely that it is under-reported because of its lack of recognition as it has an insidious onset with nonspecific symptoms. Further, optimal physical examination is difficult because of the relative inaccessibility of the sinus. During the past decades, endoscopic sphenoid surgery has been the standard approach worldwide. There are many variables to be considered while selecting the best endoscopic approach to the sphenoid. In this work, the author describes different endoscopic approaches to the sphenoid with their clinical application.

Keywords:
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Introduction

In general, sphenoid sinus disease can be divided into two main categories: neoplastic disease and inflammatory disease. Sphenoid inflammatory diseases represent more than 90% of sphenoid sinus pathologies and can be further subdivided into acute and chronic sphenoiditis, mucoceles, and fungal diseases. These categories represent the most common indications for sphenoid sinus surgery [1].

Regardless of the approach used, the surgical objectives of sphenoid sinus surgery are to open the natural sphenoid ostium and remove mucus, debris, or the tumor, allowing adequate ventilation and drainage of the sinus. Ultimately, the procedure should minimize complications, resulting in a safe sinus with long-term patency [2].

In recent years, endoscopic techniques have gained popularity given their ability to 'look around the corner' and the limited morbidity associated with them [3]. Endoscopic surgical treatment of sphenoid pathology can be safely and successfully performed through a variety of approaches. The anatomic location of the pathologic process can guide the surgeon in selecting the most appropriate technique [4].

Endoscopic approaches are performed either medial to the middle turbinate in a direct manner or lateral to the middle turbinate through the ethmoids (Fig. 1).

Gibbons and Sillers [5] developed an algorithm to assist the endoscopic sinus surgeon in selecting the most appropriate approach to the sphenoid sinus. If the patient has associated posterior ethmoid disease or has undergone a previous ethmoidectomy, endoscopic transethmoidal sphenoidotomy is the best approach. If neither of these circumstances apply, the location of the disease process within the sphenoid is the dominant factor to consider. Isolated paramedian disease, such as a mucocele, should be approached by endoscopic transnasal sphenoidotomy, by going medial to the middle turbinate between the middle turbinate and the septum. Central disease, such as pituitary adenomas, should be approached by endoscopic transeptal sphenoidotomy, which provides excellent bilateral exposure. Extreme lateral disease, such as cerebrospinal fluid (CSF) leak from the lateral recess when the pneumatization of the sphenoid sinus is extended, should be approached by the endoscopic transethmoidal–pterygoidal approach (Fig. 2).

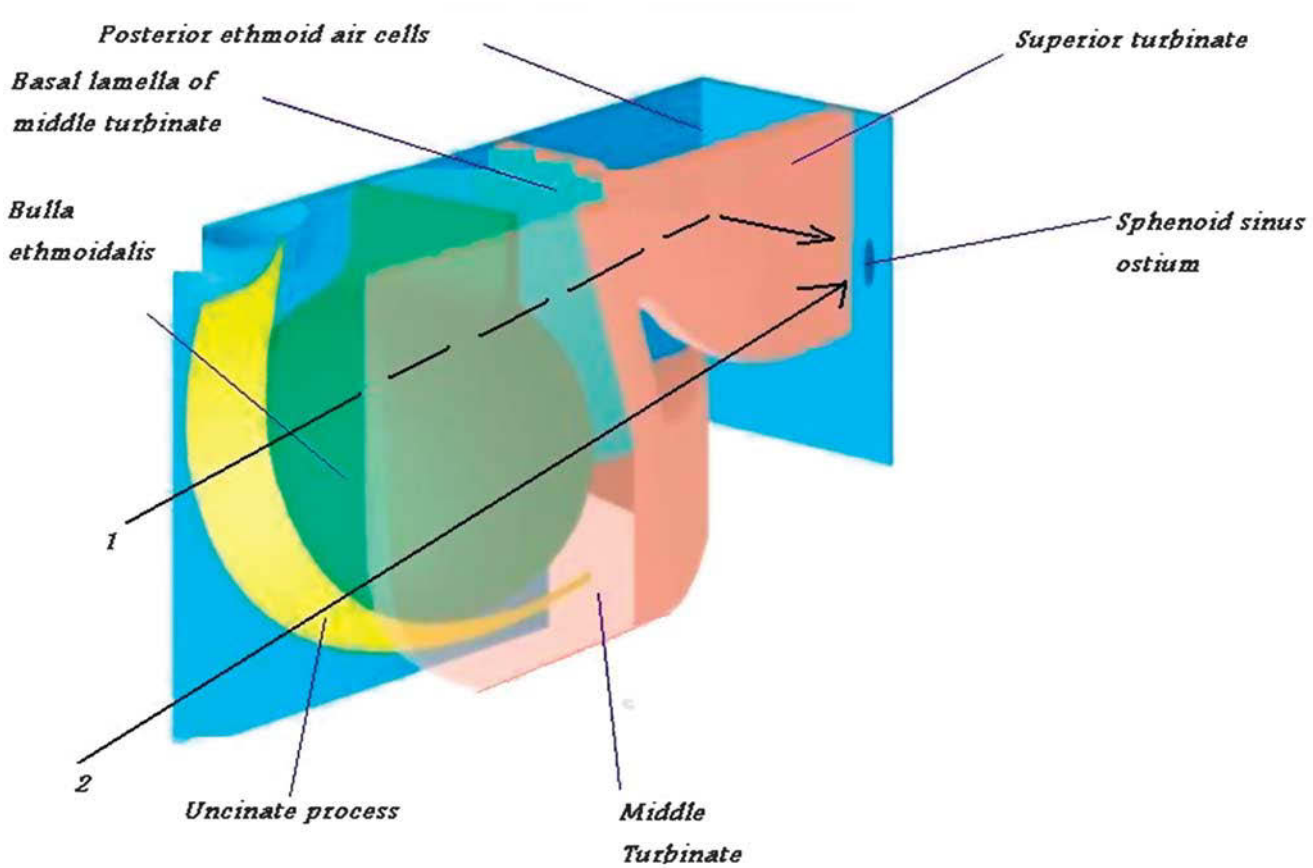
Preoperative radiologic evaluation

Careful preoperative radiological evaluation of relative sinus anatomy in both the coronal and the axial plane (Figs 3 and 4) will help conduct safe sinus surgery and avoid potential disastrous complications. The degree of pneumatization must be assessed with particular attention to the presence of any sphenoethmoidal (Onodi) cells and the course of both the carotid arteries and the optic nerves in the lateral sphenoid wall. The intersinus septum may be attached to the carotid canal, and it should also be remembered that the carotid artery is 'clinically dehiscent' in 23% of sphenoid sinuses, and therefore, the potential for serious complications in this region is significant [2]. We have to identify the location of the superior turbinate in the computed tomography scan, which is a key landmark for the identification of the natural sphenoid ostium.

Anesthesia

The surgery is performed under general anesthesia using total intravenous anesthesia, which has been demonstrated to be associated with less blood loss compared with using inhalation agents. The patient is placed supine with the head elevated on the operating room table. An injection of 1% lidocaine with 1 : 100 000 epinephrine is locally administered to the septum, nasal floor, and middle turbinate, followed by placement of cotton pledges with 1 : 1000 topical adrenaline. A 0° scope works well for sphenoidotomy.

Figure 1



Diagrammatic representation of the endoscopic sphenoidotomy approaches (the right nasal cavity with the nasal septum removed). 1: Going lateral to the middle turbinate through the ethmoids by opening the bulla ethmoidalis, then through the basal lamella of the middle turbinate to the posterior ethmoids, and from it locating the sphenoid ostium by the superior turbinate (transethmoidal sphenoidotomy). 2: Going medial to the middle turbinate between the middle turbinate and the nasal septum in a direct manner (transnasal sphenoidotomy).

Endoscopic transethmoidal sphenoidotomy

After completing the maxillary antrostomy, as well as total ethmoidectomy, and the posterior ethmoid sinuses are entered through the ground lamella, which will then expose the anterior wall of the sphenoid sinus, the critical structure that must be identified is the superior turbinate (Fig. 1). The natural sphenoid ostium is just medial to this structure (Fig. 5a). Once isolated, the lower one half of the superior turbinate is resected using either a biting instrument or a microdebrider. This will allow the identification of the sphenoid ostium. It is important to know that the sphenoid ostium is at the same level as the maxillary sinus roof, and working at this level as you proceed through the posterior ethmoids will help prevent an inadvertent misadventure toward the sloping skull base. Another important hint is to enter the sphenoid medially adjacent to the septum ~1/3 of the way up the anterior wall, 7 cm posterior to the nasal spine at 30°.

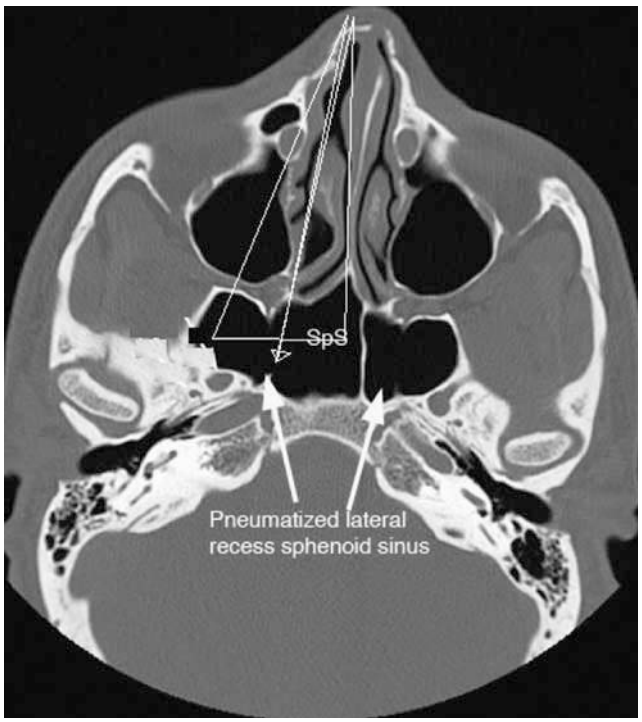
Once the natural ostium is identified, a J curette can be safely used to fracture the anterior sphenoid face inferiorly and laterally (Fig. 5c). It is important not to use the curette superiorly toward the skull base to avoid injury to skull base. The microdebrider can be used to remove polypoid mucosa at the anterior sphenoid wall. To enlarge the sphenoidotomy superiorly, an upturn through pitting instrument is used by first feeling behind the bony partition and then removing the bony lynch sharply. Care should be taken while opening the sinus superiorly, because a CSF leak can result if the thin roof of the sinus is entered. The size of the sphenoidotomy can often depend on the amount of the disease present and the adequacy for postoperative debridement. In patients with fungal disease or extensive polyposis, it is important to open the sphenoid widely toward the skull base and laterally to the medial orbital wall. It is important to know that the skull base inside the sphenoid is one of the safest areas in which we can begin dissection from the posterior to anterior direction.

There are two advantages of approaching the sphenoid through the ethmoid instead of directly: one is the avoidance of a bloody, relatively tighter tunnel of exposure, and the other is the avoidance of lateral force on the middle turbinate after ethmoidectomy, with the potential to disrupt the stability of the turbinate [6].

Endoscopic transnasal sphenoidotomy

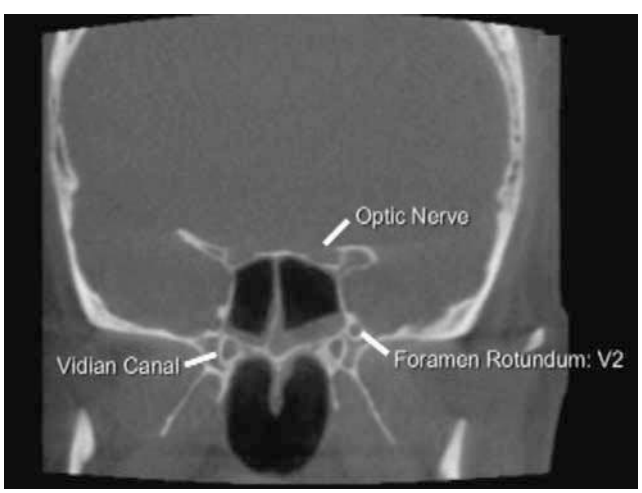
The access to the sphenoid is by going medial to the middle turbinate. The middle turbinate is displaced

Figure 2



Axial computed tomography scan of the sinuses showing pneumatized lateral recess of the sphenoid sinus. The diagrammatic triangle represents the wide access gained by the endoscopic transethmoidal–pterygoidal approach.

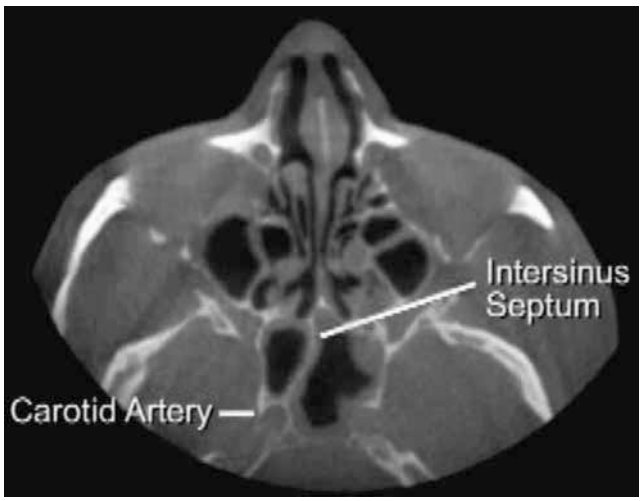
Figure 3



Computed tomography scan coronal cuts, in which we can identify the optic nerve, foramen rotundum (V2 = maxillary nerve), and vidian canal.

laterally with a Freer elevator (KARL STORZ, Tuttlingen, Germany) to identify the superior turbinate alongside the nasal septum. The lower half of the superior turbinate is resected and the transected turbinate is grasped with a Blakesley forceps with displacement of the forceps (KARL STORZ) downward with a gentle twisting motion. The sphenoid ostium (located medial to the superior turbinate remnant at the point at which its course along the face of the sphenoid changes from a vertical to a transverse direction) is identified using a

Figure 4



Axial computed tomography (CT)-scan cuts, in which we can identify the relationship between the carotid canal and the intersinus septum. In this CT scan the intersinus septum is attached to the carotid canal.

spoon curette. The ostium is enlarged in an inferior and medial direction with a spoon curette or microdebrider (Fig. 6), keeping the curette medial to the superior turbinate attachment when the sphenoid ostium is being enlarged to reduce the injury of the skull base, optic nerve, or carotid artery. The use of a microdebrider inside the sphenoid sinus is avoided to avoid injury of the carotid artery or optic nerve in the lateral wall of the sphenoid.

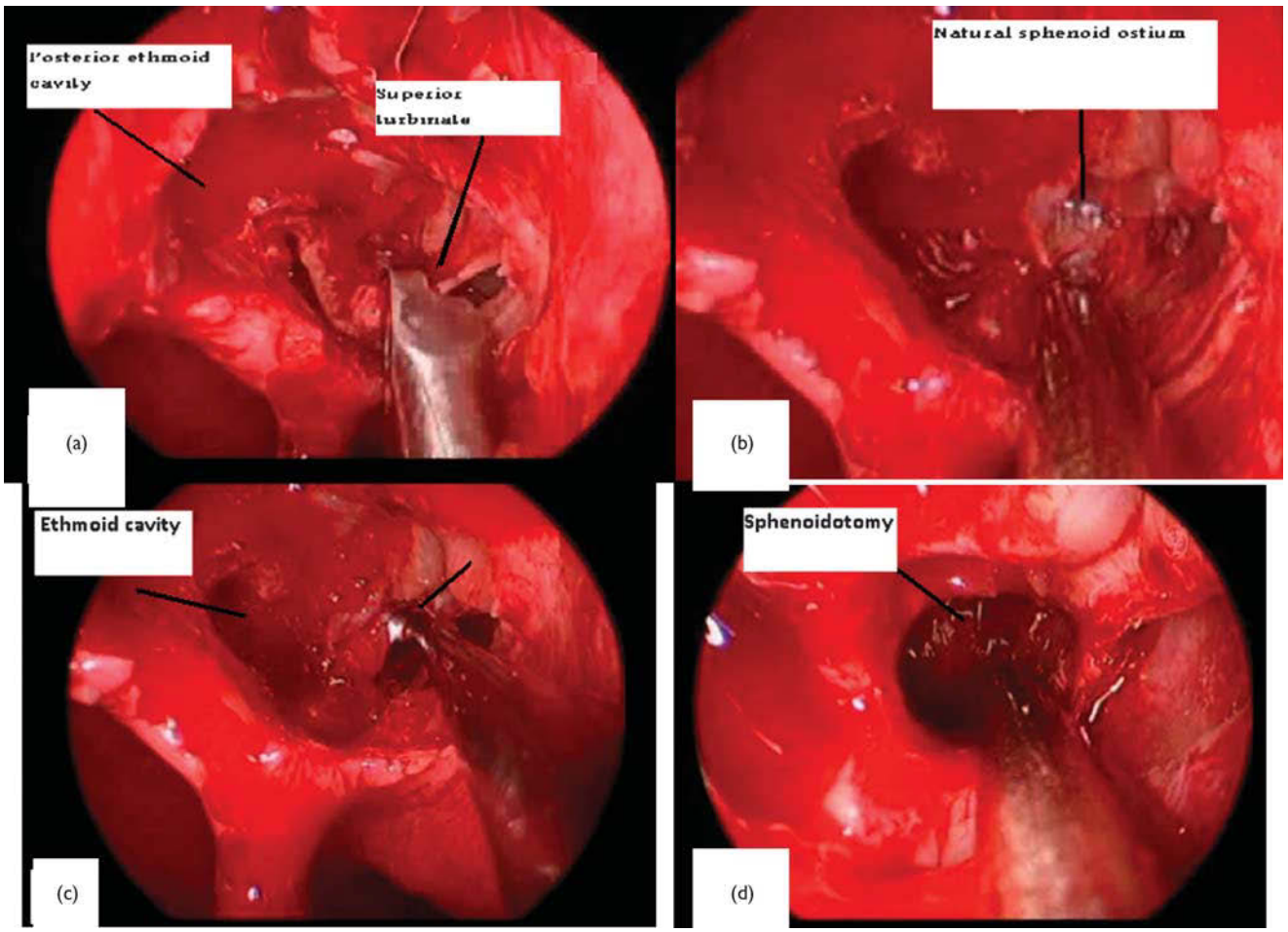
The endoscopic transnasal approach to the sphenoid is the least invasive physiological approach, which is also direct and safe. It is safe as it deals with the medial part of the anterior sphenoid wall, thus avoiding injury of the optic nerve and carotid artery in the lateral sphenoid wall. It is considered to be a physiological approach as it deals directly with the sinus ostium without disruption of the anatomy of the ethmoid sinuses [7].

Endoscopic transseptal sphenoidotomy

This approach uses the same technique as that used in transnasal sphenoidotomy, which involves lateralizing the middle turbinate, thereby exposing the sphenoethmoidal recess and natural ostia of the sphenoid sinuses. A semilunar incision is made posteriorly on the vomer, and mucoperiosteal flaps are elevated bilaterally. The vomer is resected, saving the inferior portion as a landmark for midline. The anterior wall of the sphenoid sinus is removed, starting at the natural ostia. The intersinus septum is removed and the speculum is placed deep between the mucoperiosteal flaps, as far down as the open sinus.

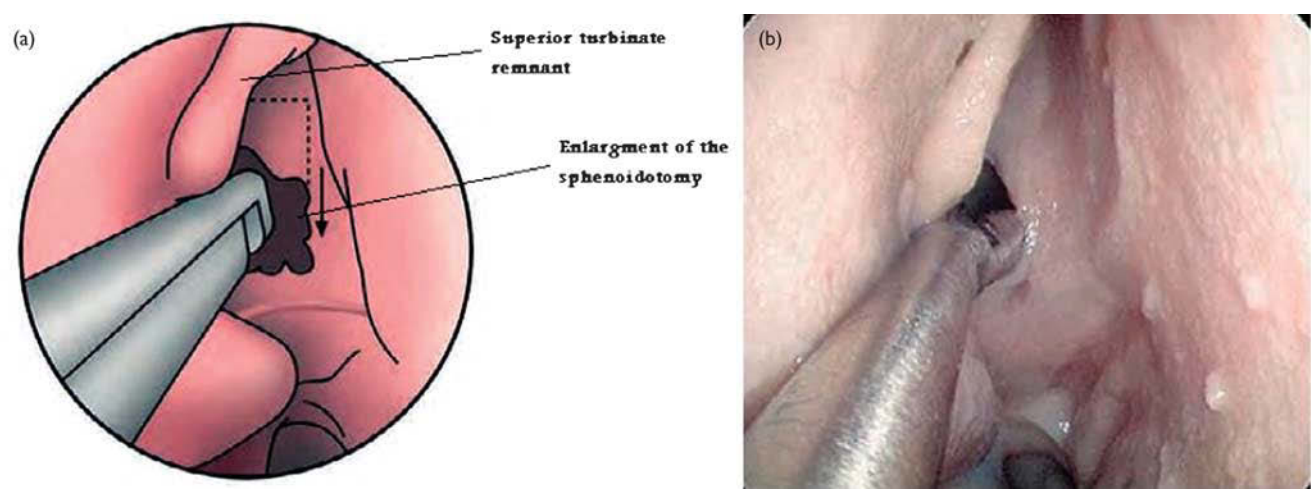
Endoscopic transseptal sphenoidotomy represents the standard approach to the pituitary sellar and parasellar areas. It is more direct and provides a wide and close view of the sphenoid sinus, in addition to being easy, rapid, and yielding cosmetically pleasing results. For surgeons who

Figure 5



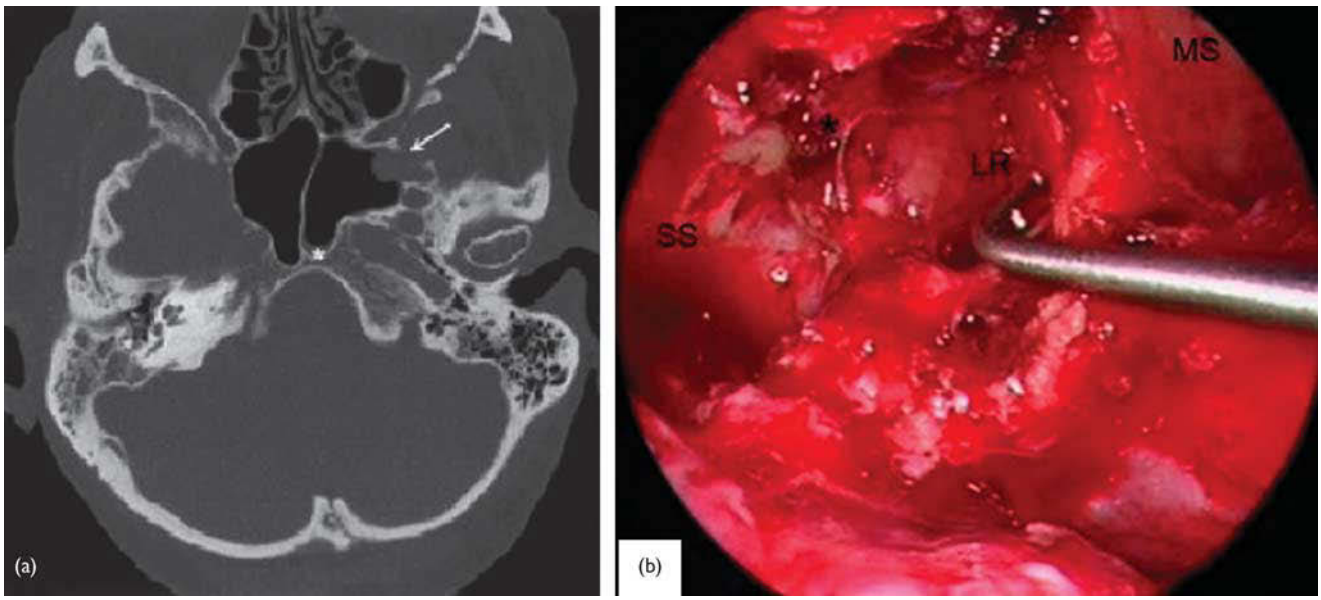
Right transethmoidal sphenoidotomy approach. (a) Resecting the lower half of the superior turbinate. (b) The natural ostium is evident after removal of the resected superior turbinate. (c) The J curette can be safely used to fracture the anterior sphenoid face inferiorly and laterally. (d) Sphenoidotomy after enlargement.

Figure 6



(a) Diagrammatic representation of right-side transnasal sphenoidotomy; we proceed by going medial to the middle turbinate between the middle turbinate and the septum. (b) Endoscopic view of the enlargement of right sphenoidotomy in inferior and medial directions.

Figure 7



(a) Preoperative axial computed tomography scan showing a bony defect at the lateral extension of the sphenoid sinus (arrow). (b) Intraoperative endoscopic view (45° scope). The lateral sphenoid recess (LR), the maxillary sinus (MS), and the sphenoid sinus (SS) are widely exposed after the dissection of the pterygopalatine fossa [8].

do not perform sphenoid sinus procedures often, the transseptal approach is the safest because it is a midline approach in an area anatomically familiar to most otolaryngologists [4].

Transethmoidal–pterygoidal approach

Extreme lateral disease, such as encephalocele and CSF leak from the lateral recess of a well-pneumatized sphenoid is approached by the transethmoidal–pterygoidal approach. The pterygoid process is like a pillar in front of the defect. The removal of the mucosa is impossible because the defect is situated behind this corner.

In the first step, subtotal uncinectomy followed by middle antrostomy, extended posteriorly up to the pterygoid process, was carried out using a 0° telescope until the posterior wall of the sinus was exposed; thereafter, we opened the ethmoid and sphenoid sinuses through classical sphenoethmoidectomy with identification of the optic nerve and the internal carotid artery. After a partial resection of the middle turbinate, we proceeded with cauterization of the sphenopalatine artery. Using a cutting burr, the medial aspect of the pterygoid process, between the roof of the maxillary sinus and the sphenoid foramen, was removed. Thereafter, we opened the anterior wall of the pterygopalatine fossa and dissected the posterior wall of the maxillary sinus partially. In this way, the lateral extension of the sphenoid sinus became visible and we could remove the encephalocele and repair the defect using a 30 or 45° telescope (Fig. 7) [8].

The drawbacks of this approach are that it requires a significant amount of surgical time to perform and the excessive drilling may cause a breach in the medial wall of the cavernous sinus or the paraclival tract of the internal carotid artery, leading to potentially catastrophic consequences [9].

Postoperative care

Postoperative debridement is very important in maintaining the patency of the sphenoidotomy opening. Failure to do so may lead to early reinfection, sustained inflammation, and possible scar tissue formation.

Complications

Complications occur in both the nasal and the neurologic portion of the procedure.

Rhinologic complications

The most common local causes of failure leading to persistent sphenoid disease are inadequate entry and stenosis. The latter may occur as a result of an inadequate sinusotomy or because of scarring from persistent bony osteitis. In the presence of significant bony thickenings on CT scans, wide bony removal of the anterior wall should be performed if stenosis is to be avoided [3].

The incidence of rhinologic complications has been reported to be as high as 50% by some authors but is minimized if careful dissection is performed. Complications include septal perforation, epistaxis, synechiae, and nasal anosmia [5].

Neurovascular complications

The carotid artery may be subjected to trauma, may undergo severe postoperative spasm, or may be lacerated at the time of surgery. Venous hemorrhage may occur from the cavernous sinus. If the head is significantly elevated when the sinus is open, air embolism may occur. The nerves that run through the cavernous sinus,

including the third, fourth, fifth, and sixth cranial nerves, have all been reported to develop palsies following sphenoidal surgery. Intracranial complications include trauma to the optic chiasma. There are also cases of chiasmal compression by fat or muscle that has been packed into the sinus. CSF leaks are not uncommon during hypophysectomy and can lead to meningitis [10].

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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