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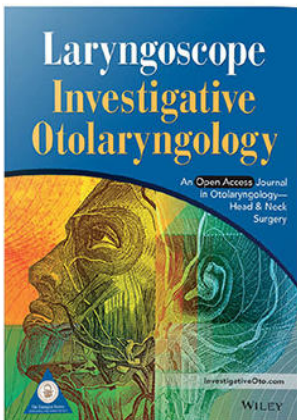


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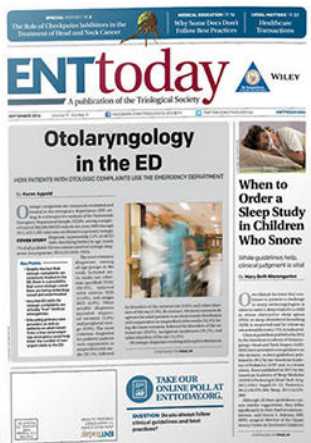
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Endoscopic Transnasal Transpterygopalatine Fossa Approach to the Lateral Recess of the Sphenoid Sinus

Ismail S. Al-Nashar, MD; Ricardo L. Carrau, MD; Alfredo Herrera, MD; Carl H. Snyderman, MD

Objectives: Lesions affecting the lateral recess of the sphenoid sinus are rarely discussed in the literature as a separate entity. This region is difficult to visualize and manipulate through the transnasal routes, especially when extensive pneumatization is present. External approaches to this area involve extensive surgery and are associated with significant morbidity. The objectives of this study are to present our experience with the endoscopic transpterygopalatine fossa approach as a method for exposing and manipulating lesions of the lateral recess of the sphenoid and to illustrate the detailed surgical steps of the procedure. **Study Design:** Retrospective review. **Methods:** Clinical charts of patients who had lesions originating from or extending into the lateral recess of the sphenoid sinus and who were treated at our institutions from September 1995 to June 2002 were retrospectively reviewed. All these patients were managed by the endoscopic transpterygopalatine fossa approach. **Results:** Twelve patients (7 males and 5 females) were included in the study. Lesions included seven cerebrospinal fluid (CSF) leaks and five tumors. One patient with squamous cell carcinoma (SCC) of the sphenoid died of his disease. All CSF leaks were successfully repaired, and benign tumors were removed with good local control through the follow-up period. **Conclusion:** The endoscopic transpterygopalatine fossa approach is an excellent approach for dealing with lesions of the sphenoid lateral recess. **Key Words:** Sphenoid sinus, endoscopic approach, pterygopalatine fossa, cerebrospinal fluid leak.

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INTRODUCTION

The sphenoid sinus presents considerable variations in size, shape, and degree of pneumatization.^{1–4} At birth,

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the sphenoid sinus is merely a recess, but it undergoes pneumatization until it attains its definitive form at puberty. The sinus may fail to pneumatize, or it may expand extensively into the pterygoid plates, the greater and lesser wings of the sphenoid bone, and beyond into the palatine and occipital bones. Its pneumatization may extend laterally over the pterygopalatine fossa, thus creating a lateral (or pterygoid) recess that may be located directly posterior to the maxillary sinus^{2–6} and that may extend to the base of the middle cranial fossa (i.e., infratemporal skull base) (Fig. 1).^{4,7}

Lesions of the sphenoid sinus can be broadly classified into inflammatory, neoplastic, fibroosseous, and miscellaneous groups. The latter group includes developmental, traumatic, and vascular lesions.⁸ A lesion primarily located at a pneumatized lateral recess of the sphenoid bone, regardless of etiology, represents a surgical challenge because of its limited accessibility.⁹ Lesions confined to the lateral recess of sphenoid sinus rarely are discussed separately in the literature. Some have described isolated cases of cerebrospinal fluid (CSF) fistulas and meningoencephaloceles presenting as defects in the lateral recess of sphenoid sinus.^{10–16} Others have described expansile lesions.^{17–19} This study illustrates our experience with a group of patients who presented a variety of lesions at the lateral recess of the sphenoid sinus and who required an endoscopic transnasal transpterygopalatine fossa approach for their management.

MATERIALS AND METHODS

All patients who required an endoscopic transnasal approach to the lateral recess of the sphenoid sinus from September 1995 to June 2002 were included in the study. A retrospective review of their clinical charts was performed to obtain data regarding demographics, nature and extent of the lesions, surgery, and outcome.

Description of Surgery

The nasal cavity is decongested with oxymetazoline 0.5% solution and the middle meatus, middle turbinate, and sphenoid recess are infiltrated with lidocaine 1% and epinephrine 1/100,000. An uncinectomy is performed using back-biting rongeurs or any other preferred instrument. The natural ostium of the maxillary sinus is extended posteriorly to the level of the

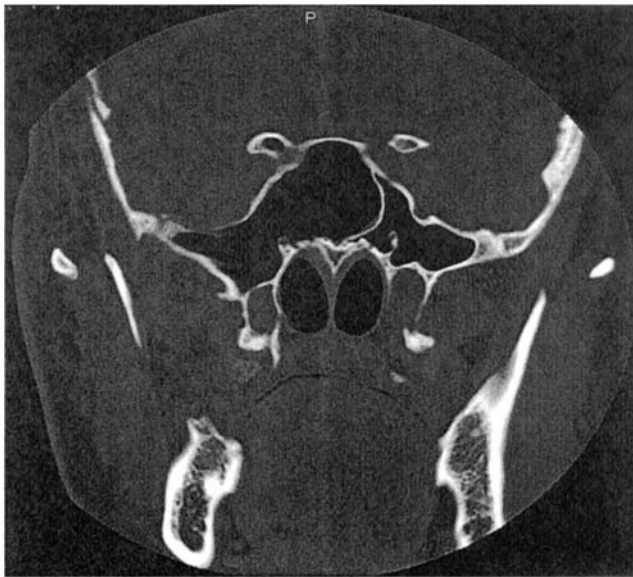


Fig. 1. Coronal computed tomography showing extensive pneumatization of the lateral recess.

posterior wall of the antrum (PWA). Then, using true-cut rongeurs or a microdebrider, the basal lamella is entered, and the posterior ethmoid sinuses are exenterated after identifying the skull base. The anterior ethmoids may be partially or totally exenterated to facilitate the visualization of the posterior ethmoids or to gain access for instrumentation. After this is performed, the inferior half of the superior turbinate is removed to facilitate the visualization of the natural ostium of the sphenoid sinus, which is then enlarged inferiorly and medially using up and down biting Kerrison rongeurs (Fig. 2). Alternatively, the sphenoid sinus is entered at the junction of the nasal septum and the sphenoid rostrum, and the sphenoidotomy is enlarged as previously described. A wide sphenoidotomy allows the passage of 0° and angled endoscopes into the sphenoid sinus to identify anatomic landmarks. The position of the roof and lateral wall, relative to the sphenoidotomy, is established, and then the sphenoidotomy is enlarged superiorly and laterally.

Extension of the sphenoidotomy is usually limited laterally and inferiorly by the pterygoid aspect of the lateral wall of the sphenoid, which forms the posterior aspect of the sphenopalatine foramen, and by the presence of the posterior nasal artery, which will be in a direct line of sight with the inferolateral aspect of the sphenoidotomy. In a pneumatized lateral recess, the only obstacle will be the artery. Therefore, at this point, the surgery is focused at the sphenopalatine foramen. The sphenopalatine foramen is identified posterior to the crista ethmoidalis just posterior to the PWA. The sphenopalatine artery is mobilized out of the foramen after the posterior wall of the maxillary antrum is removed using Kerrison rongeurs or any other angled instrument (i.e., 45° or 90° forceps) or drill. This also gives access to the entire pterygopalatine fossa and, thus, all the other branches of the internal maxillary artery (Fig. 2). The vidian nerve and V₂ may be exposed also. At this point, both the anterior branch of the sphenopalatine artery and the posterior nasal artery are clipped using medium size hemoclips and transected. Then, the sphenoidotomy may be extended laterally toward the pterygopalatine fossa (Fig. 3). Because of anatomic and pneumatization variabilities, exposure of the pterygopalatine fossa is not necessary in all patients. Also, in selected cases, such as those with CSF leaks arising from the roof of the lateral recess, the posterior nasal artery may be spared because the work is performed above its level.

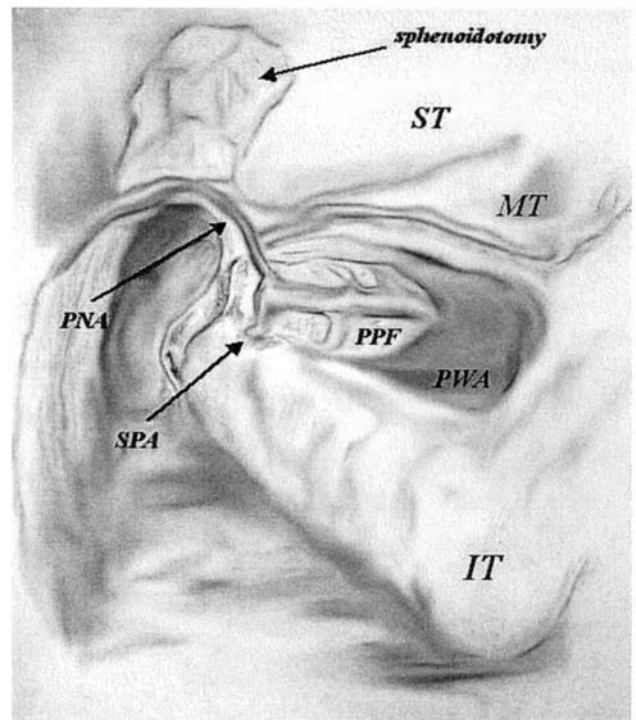


Fig. 2. Schematic view of the left nasal cavity. The middle turbinate (MT) has been resected and a large middle meatus-antral window has allowed the removal of the posterior wall of the antrum (PWA), exposing the pterygopalatine fossa (PPF) and the internal maxillary artery. The intranasal stump of the sphenopalatine artery (SPA) and the posterior nasal artery (PNA) crossing the anterior rostrum of the sphenoid are shown for orientation purposes. A wide sphenoidotomy has been completed, but the lateral recess can not be visualized with a 0° telescope. The superior turbinate (ST) postero-inferior attachments have been removed as part of the sphenoidotomy. IT = inferior turbinate.

Similarly, according to the corresponding anatomic variations and the site of the lesion, the vidian artery and other branches of the internal maxillary artery may be clipped and transected or preserved, and the sphenoidotomy is then extended laterally as needed. The surgery can then proceed in a standard fashion, with the lateral recess of the sphenoid sinus under full visualization (Figs. 3 and 4) even if the recess extends to the infratemporal skull base. At the end of the surgery, the vessels of the pterygopalatine fossa are covered by Gelfoam (Johnson's and Johnson's, Kalamazoo, MI) soaked in antibiotic solution. Postoperative nasal packing is not used electively.

RESULTS

A group of 13 patients, comprising 5 females and 7 males with an age range from 33 to 80 years, were included in the study. The mean follow-up was 2 years (minimum 9 months). Lesions included seven CSF leaks and five tumors. One patient with squamous cell carcinoma (SCC) of the sphenoid extending into the cavernous sinus died from his disease after chemotherapy external radiation treatment. All the CSF leaks were successfully repaired. All the patients with benign tumors were controlled, with no recurrences during the follow-up period. The patients' demographic data and highlights of their clinical presentation are shown in Table I.

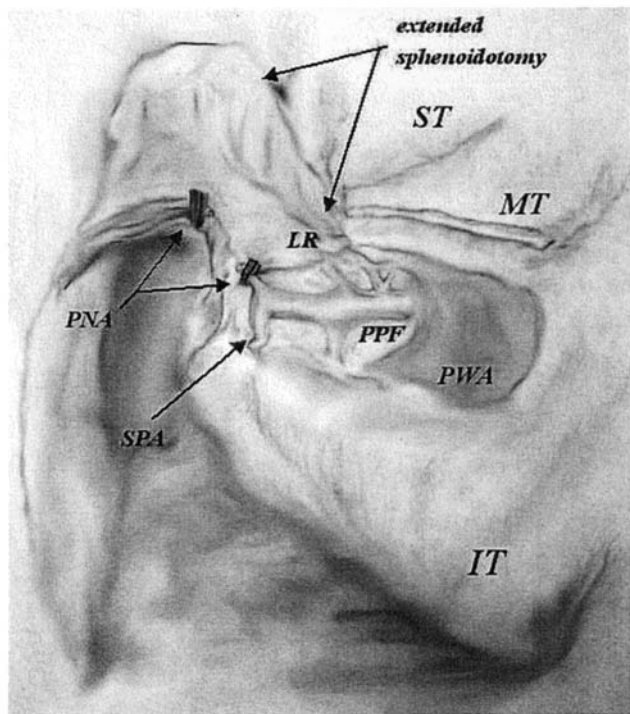


Fig. 3. Schematic view of the left nasal cavity after completion of the surgical approach to the lateral sphenoid recess. The sphenoidotomy shown in Figure 1 has been extended laterally and inferiorly into the pterygopalatine fossa (PPF) area. The posterior nasal artery (PNA) has been clipped and transected to facilitate the mobilization of the soft tissues of the PPF and the extension of the sphenoidotomy laterally and inferiorly to expose the lateral recess (LR). PWA = posterior wall of the atrium; IT = inferior turbinate; ST = superior turbinate; MT = middle turbinate; SPA = sphenopalatine artery.

DISCUSSION

The sphenoid sinus is a developmental outgrowth of the sphenoid bone in the posterosuperior segment of the sphenoid recess. Its pneumatization is variable and can

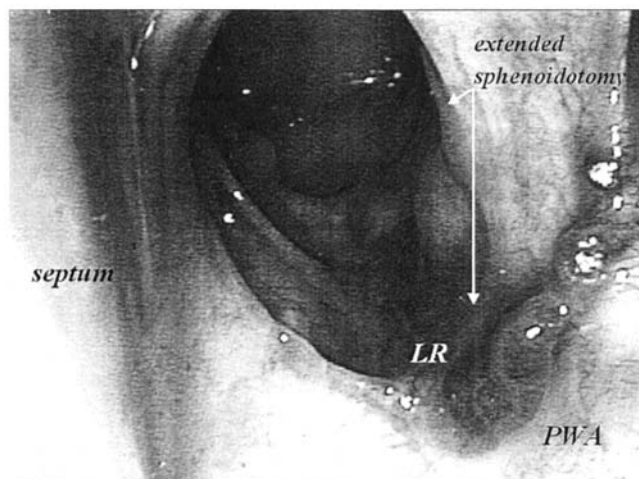


Fig. 4. Postoperative transnasal endoscopic view demonstrates a well-healed left sphenoidotomy extended into the lateral recess (LR). PWA = posterior wall of the antrum.

involve a portion or the entire body of the sphenoid bone and its processes. Pneumatization of the pterygoid process and the greater wing of sphenoid is not uncommon (35–40%).^{2,3} Important structures adjacent to the sphenoid sinus include the dura mater, pituitary gland, optic nerve, cavernous sinus, pterygoid nerve, internal carotid artery, and cranial nerves III, IV, VI, V₁, and V₂, all of which are vulnerable to diseases and injuries that affect sphenoid disease.^{2,5,20}

The pterygopalatine fossa is a narrow space in the shape of an inverted pyramid. It is posterior to the superomedial angle of the maxillary sinus. Its shape, dimensions (width from 1.2–3 cm, height 0.8–1.8 cm, depth from 0.5–1.3 cm), and location varies widely even from one side to the other side in the same person. When the sphenoid sinus is well aerated, there may be sphenoid diverticula into the pterygopalatine fossa.²¹ The pterygopalatine fossa is bound posteriorly by the medial plate of the pterygoid process, posterolaterally by the greater wing of the sphenoid, posteromedially by the sphenoid sinus lateral wall, and anteromedially by the ascending process of the palatine bone. It contains abundant fat surrounding many neurovascular structures and comprises V₂ and the terminal branches of the internal maxillary artery.²²

Many surgical approaches have been advocated to access the sphenoid sinus, including the direct transnasal, transnasal transtethmosphenoidal, external ethmosphenoidal, transeptal, transantral, and transcranial approaches.^{2,23} External transtethmoid sphenoidotomy provides wide surgical exposure and avoids manipulation of the septum, particularly in patients with septal pathology or previous septal surgery. The main disadvantages are the oblique surgical orientation, which increases the risk of injury to the lateral wall and its vital neurovascular structures, and the scar secondary to the external incision.²⁴ Cakmak et al.²⁵ reviewed a large series of isolated sphenoid sinus lesions (182 patients) and advocated the transeptal route. The advantage of the transeptal approach is its midline orientation, which provides excellent median and paramedian exposure, the absence of an external scar, the option of correcting a septal deformity, the possibility of binocular vision,^{25,26} and also the possibility of endoscopic or microscopic magnification.²⁷ The endoscopic approach is a direct transnasal route associated with minimal blood loss, reduced operating time, and decreased morbidity. It is proven to be a safe and effective technique in dealing with sphenoid sinus inflammatory disease, mucocèles, and sellar lesions.^{28–30}

Although many authors have discussed the different approaches to the sphenoid sinus, the literature regarding surgical approaches to the lateral recess proper is sparse. Lesions of the lateral recess include CSF fistulas, meningoencephaloceles, or space occupying lesions of benign or malignant nature. Lesions limited to the lateral recess of the sphenoid sinus are a challenge to the rhinologist because of their limited accessibility when using transnasal approaches.⁹

Rivierez and Valsaint¹² reported a patient with a temporosphenoidal meningoencephalocele that presented with CSF rhinorrhea and a radiologically confirmed defect in the superior wall of the right lateral recess of the

TABLE I.
Patient Demographic Data and Highlights of Clinical Presentation.

Patient/Sex	Age	Preoperative Diagnosis	Symptoms	Radiology	Pathology	Operative	Follow-up
1/F	34	Tumor	Headache, pain, and hypoesthesia left cheek	Lt pterygopalatine and sphenoid wall mass	Fibrous histiocytoma	Debulking of mass	29 months
2/F	46	CSF Leak	Rhinorhea	Defect in inferolateral wall of left sphenoid	Meningocele	Repair of leak	15 months
3/M	80	Tumor	Headache and nasal mass	Nasal and sphenoid sinus space occupying lesion	Nasal mass, inverting papilloma Sph, SCC	Sphenoid mass looked different from nasal mass	21 months postoperative radiation
4/F	68	CSF leak	Rhinorhea	Erosion of MCF with a mass herniating into left sphenoid	Meningocele	Repair with pericardium and fat, lumbar drain	37 months
5/M	73	Tumor	Nasal polyps and ch. sinusitis	Extensive opacification with a polyp in right sphenoid area	Inverting papilloma	Removal of mass	13 months
6/M	35	Tumor	Nasal obstruction, headache	Calcified mass in right sphenoid and posterior septum	Chondrosarcoma	Removal of mass	22 months
7/F	53	CSF Leak	Rhinorhea	Fluid inside sphenoid sinus	Meningocele	Repair with abdominal fat	79 months
8/M	72	SCCa	Headache	Mass extending into cavernous sinus	SCCa	Biopsy	DOD, after 9 months
9/M	42	CSF Leak	Rhinorhea	Defect and meningocele at right lateral recess	Meningocele sphenoid, right	Repair (obliteration)	1 year then LTF
10/M	51	CSF Leak	Rhinorhea	Bony defect and meningocele at left sphenoid	Meningocele sphenoid, left	Repair (Inlay graft)	23 months
11/F	39	CSF Leak	Rhinorhea	Right sphenoid lateral wall defect and meningocele	Meningocele sphenoid, right	Repair (Inlay graft)	17 months
12/F	33	CSF Leak	Rhinorhea	Left lateral wall defect and meningocele	Meningocele	Inlay repair	12 months

CSF = cerebrospinal fluid; SCCa = squamous cell carcinoma; MCF = middle cranial fossa; DOD = dead of disease; LTF = lost to follow-up.

sphenoid. They used a frontotemporal approach with orbitozygomatic osteotomies for accessing this lesion. They also reviewed another 15 cases, only some of which were treated successfully by way of a transsphenoidal route. They attributed the surgical failures of this transsphenoidal route to the lack of control of the lateral recess of the sphenoid sinus. Landreneau et al.,¹⁰ after reporting four cases, recommended the transcranial approach for dealing with CSF fistulas involving the lateral extension of the sphenoid sinus because this approach, despite its higher morbidity, would provide direct visualization for obliteration of the defect. They addressed the importance of developing a new endoscopic technology that would allow direct visualization and repair of such lesions.

On the other hand, Mehandale et al.³¹ reported successful repair of three cases of CSF fistulas involving the

lateral recess of the sphenoid sinus using an endoscopic-assisted sublabial transseptal approach. They tried to explain the high rate of repair failures reported in the literature on the basis of a statistical anomaly, unavailability of instruments that could allow manipulation of lesions at the lateral aspect of the sphenoid cavity, and, finally, the need to preserve part of the rostrum (i.e., opening a small sphenoidotomy) to support the graft, which added more difficulty to the visualization and manipulation of the defect.

Because a pneumatized pterygoid recess can lie directly posterior to the maxillary sinus, an endoscopic approach through the PWA and the pterygopalatine fossa seems to provide adequate and direct access to lesions limited to that area. Yanagisawa et al.⁹ reported a patient with a mucocele of the pterygoid recess of the sphenoid

sinus. Although they planned to remove it through transantral transpterygopalatine space approach, they removed it by way of an endoscopic transnasal transtethmosphenoidotomy approach. Klossek et al.³² reported a patient with a pterygopalatine fossa schwannoma removed through endonasal endoscopic approach. They commented on the problems of this approach, including the difficulty in removing the posterior wall of the maxillary sinus, the risk of vascular injury, and the difficulty of controlling and completely ablating the tumor. Others have reported on the use of the approach to deal with similar lesions.³³ In 1999, Bolger and Osenbach³⁴ reported on the use of an endoscopic transpterygoid approach for repair of one case of middle cranial fossa encephalocele presented with CSF rhinorrhea. A more recent report described the use of this approach for a variety of lesions at the lateral wall of the sphenoid sinus.³⁵

The experience gained during endoscopic sinus surgery for inflammatory disease and the customization of instrumentations developed for skull-base surgery have facilitated endoscopic transnasal procedures, which were very difficult to perform in the past.³⁶ The pterygopalatine fossa approach provides a wide and direct approach to the lateral recess of the sphenoid sinus. It provides better space and visualization for repairing CSF leaks or dealing with space-occupying lesions confined to this region; it also has less morbidity when compared with the transcranial or transfacial routes. However, it requires proper surgical technique and training, familiarity in dealing with vascular elements, and a thorough knowledge of the anatomy of the surrounding structures.

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