Endoscopic Transnasal Approach to the Pterygopalatine Fossa

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Objective: To describe an endoscopic transnasal approach to the pterygopalatine fossa (PPF).

Design: Case series of 3 patients.

Setting: An academic medical center.

Patients: One patient presented with an asymptomatic PPF schwannoma. The second patient presented after a sudden onset of complete unilateral vision loss with a complete ipsilateral sphenoid sinus opacification and radiographic signal abnormality in the PPF and inferior orbital fissure. The third patient had a history of adenoid cystic carcinoma of the lacrimal gland, and was found to have new-onset facial numbness.

Intervention: One patient had a complete excision of a schwannoma by means of an endoscopic transnasal approach. The other 2 patients had wide exposure and biopsies of the PPF. One patient had a revision procedure through the same approach with further lateral exposure to the area of the inferior orbital fissure.

Results: All patients had successful endoscopic approaches for tumor removal (case 1) and biopsy (cases 2 and 3) of the PPF. The second patient had a repeat endoscopic biopsy 1 week later to obtain more tissue for diagnostic purposes. None of the patients had any major vascular complications. At follow-up, 2 of 3 patients had persistent sensory deficits.

Conclusions: The endoscopic transnasal approach to the PPF is a safe and effective method for biopsy and removal of PPF masses. The endoscopic approach improves access and visualization, and has the potential to reduce complications compared with open approaches. Image guidance is helpful in these cases.

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Endoscopic surgery has gained universal acceptance as the surgical method of choice for the treatment of inflammatory sinonasal disease. With increasing familiarity with endoscopic techniques, increased understanding of sinus and perisinus anatomy, and advanced technology in the form of instrumentation and image-guided systems, there has been a natural extension of these techniques to include treatment of other disease processes. These include endoscopic treatment of sinus and skull base tumors, repair of cerebrospinal fluid leaks and meningoencephaloceles, orbital decompression, approaches to the orbital apex and clivus, transsphenoidal approaches to the pituitary, and arterial ligations for epistaxis. These approaches allow good visualization of difficult-to-access locations with decreased morbidity and shorter recovery periods when compared with standard open approaches.

The pterygopalatine fossa (PPF) is a difficult-to-access anatomic area. It is located behind the posterior wall of the maxillary sinus, bordered by the pterygoid plates posteriorly and the greater sphenoid wing and middle cranial fossa superiorly. It has connections with the infratemporal fossa laterally through the pterygomaxillary fissure, the posterior nasal cavity medially through the spheno-palatine foramen, the orbit superiorly through the pterygomaxillary fissure, the posterior nasal cavity medially through the sphenopalatine foramen, the orbit superiorly through the inferior orbital fissure, and the palate inferiorly through the palatine foramina. Structures contained within the PPF include the internal maxillary artery and its branches, the maxillary division of the trigeminal nerve (V₂), and the vidian nerve. Tumors of the PPF are uncommon, with the most common being nerve sheath tumors.

Standard approaches to the PPF require transmaxillary techniques that vio-
late the anterior and posterior walls of the maxillary sinus, with the risks of facial edema and pain, infraorbital nerve injury, oroantral fistula, chronic maxillary sinusitis, and vascular injury. An endoscopic approach to the PPF can potentially reduce these risks, along with providing better visualization than headlight- or microscope-directed approaches. Herein we report an endoscopic approach to the PPF for definitive resection of a schwannoma in 1 patient and for biopsy of the PPF in 2 other patients.

REPORT OF CASES

CASE 1

A 33-year-old woman was referred for evaluation of a right PPF mass identified on sinus computed tomographic (CT) scan ordered for evaluation of recurrent nasal congestion. The CT scan showed a well-circumscribed PPF mass that had thinned and anteriorly displaced the posterior wall of the maxillary sinus (Figure 1). Magnetic resonance imaging showed the mass to be well circumscribed and isointense with brain on T2 images, to enhance with gadolinium, and to have a slightly heterogeneous appearance (Figure 2). The patient denied facial paresthesia or pain, and results of neurologic examination were normal. Endoscopic examination showed only fullness in the lateral nasal wall adjacent to the posterior attachment of the right middle turbinate. The mass was presumed to be a nerve sheath tumor on the basis of the clinical and radiologic data.

An endoscopic transnasal approach for resection of the mass was recommended to the patient. Consent was also obtained for a canine fossa approach and possible Caldwell-Luc operation if necessary. The patient was counseled regarding the risk of vascular injury to the internal maxillary artery and the possible need to convert to an open approach.

The procedure was begun with a large maxillary antrostomy, ethmoidectomy, and wide sphenoidotomy to expose the medial and anterior aspects of the tumor (Figure 3). The mucosa of the posterior maxillary sinus was elevated from superomedial to inferolateral. The thinned posterior wall of the maxillary sinus was easily removed from the anterior and superior surfaces of the PPF mass to expose the capsule. The sphenopalatine artery was dissected from the surface and medial aspect of the mass, cauterized, and transected medially to completely free the medial aspect of the tumor. The tumor was then bluntly dissected off of the pterygoid plates posteriorly. Because of the tight confines of the PPF and the dense inferior attachments of the tumor to the vasculature of the PPF, the tumor could not be removed en bloc. The capsule was therefore opened to allow complete removal of the tumor. The inferior portion of the tumor was removed last, after identification and clipping of the main trunk and branches of the internal maxillary artery (Figure 4). After confirmation of complete tumor removal and irrigation of the PPF, the surgical area with exposed pterygoid periosteum was covered with a dissolvable hyaluronic acid pack.

Postoperatively the patient was observed overnight and discharged the following morning. She did develop numbness in the distribution of the maxillary division.
of V2 that minimally improved during the next 12 months. Follow-up CT scan and serial evaluations showed no evidence of recurrence 6 months postoperatively.

**CASE 2**

A 44-year-old woman was referred for evaluation 6 weeks after developing complete vision loss in the right eye that occurred during 36 hours. Her vision did not respond to high-dose oral and intravenous corticosteroids. Ophthalmologic examination showed only minimal light perception in the right eye and no other abnormalities. Results of otolaryngologic examination were normal. No other cranial nerve abnormalities were identified.

A CT scan of the sinuses disclosed right sphenoid opacification with hyperostosis of the sinus walls. The sphenoid contents had a heterogeneous appearance. There was no extension outside of the sinus, and the remainder of the sinuses was clear. No bone erosion was present. There was a subtle asymmetry of the soft-tissue characteristics in the right PPF (Figure 5). Magnetic resonance imaging demonstrated the same asymmetry in the PPF. The soft tissue in the right PPF displayed loss of normal enhancement, and this extended to the inferior orbital fissure and the orbital apex. No discrete mass was identified (Figure 6). The radiologic appearance and clinical history were suggestive of an infiltrative process in the PPF.
The patient underwent endoscopic ethmoidectomy and a large sphenoidotomy with removal of fungal debris (cultures yielded *Aspergillus flavus*). The PPF was then addressed by creating a large maxillary antrostomy with removal of the medial wall of the sinus to the junction with the posterior wall. Further elevation of the mucosa over the lateral nasal wall allowed identification of the sphenopalatine vascular pedicle exiting the sphenopalatine foramen, and dissection was continued superior to this to avoid vascular injury. The mucosa of the posterior maxillary sinus was elevated from medial to lateral. A curved probe was used to palpate the sphenopalatine foramen (between the posterior wall of the maxillary sinus and the body of the sphenoid bone), and the upper portion of the posterior wall of the maxillary sinus was removed with curettes and rongeurs to expose the PPF. No discrete mass was found, and biopsy specimens of the PPF soft tissue showed scattered salivary tissue on frozen section. Final pathological examination showed no tumor or disease process. The patient was returned to the operating room 1 week later for additional biopsies. The PPF was accessed through the same approach and opened up further laterally to the level of the inferior orbital fissure, as identified with the image-guided system (Figure 7). Branches of the maxillary division of V2 were visualized and biopsy specimens were taken from the PPF, including a small specimen of the medial branch of the nerve. The mucosa of the posterior wall of the maxillary sinus was replaced over the bony defect into the PPF.

The patient developed some mild hypesthesia of the nasolabial fold postoperatively. Final pathological examination showed no abnormal tissue. The patient did not regain any vision in the right eye, and the definitive cause of her vision loss was not determined. The surgical site healed well, with remucosalization of the PPF and widely patent sinuses (Figure 8).

**CASE 3**

A 67-year-old man with a history of adenoid cystic carcinoma of the lacrimal gland more than 5 years earlier, treated by orbital exenteration and postoperative radiation therapy, was referred for evaluation of sinusitis and a concern of possible recurrence of his cancer. A CT scan of the sinuses had been obtained and showed left ethmoid soft-tissue thickening and some thickening of the PPF. On examination, the patient was noted to have decreased sensation of the cheek skin. Results of endoscopic examination were consistent with acute sinusitis. Biopsy specimens of the orbital cavity were negative for tumor. The patient was treated with antibiotics for the sinusitis. A magnetic resonance image showed enhancement and thickening of V2 in the PPF, infraorbital fissure, and cavernous sinus (Figure 9).

The patient underwent an endoscopic approach to the PPF with the use of an image-guided surgery system (LandmarX; Medtronic Xomed, Inc, Jacksonville, Fla). A wide maxillary antrostomy and total ethmoidectomy were performed. A sphenoidotomy was performed to define the position of the face of the sphenoid sinus and the body of the sphenoid bone lateral to this. The horizontal portion of the basal lamella was taken down to identify the sphenopalatine vasculature as it exits the sphenopalatine foramen. The mucosa was elevated from medial to lateral off of the posterior wall of the maxillary sinus. Because of the thickness of the bone overlying the PPF, a drill was used to remove the bone from medial to lateral with the sphenopalatine vasculature and foramen used as a guide. This allowed wide exposure of the PPF (Figure 10). Biopsy specimens of the PPF were taken superiorly to avoid the vasculature. Frozen section analysis was positive for adenoid cystic carcinoma. The mucosa of the maxillary sinus was redraped over the exposed PPF.
The PPF is a small area that is difficult to access. Fortunately, tumors of this area are rare. When the PPF needs to be addressed, the standard procedure is through a Caldwell-Luc approach, violating the anterior and posterior walls of the maxillary sinus and exposing the PPF for microscopic or headlight evaluation. This is the method commonly used for internal maxillary artery ligation. This method provides limited exposure with the possibility of neural and vascular injury. It can also result in irreversible changes in the maxillary sinus, with resultant chronic sinusitis and the possibility of an oroantral fistula.

Endoscopic procedures have the advantage of eliminating external and oral incisions, thereby reducing injury to the sinuses and parasinus structures. Endoscopes improve visualization of difficult-to-reach areas such as the PPF compared with conventional open approaches, thereby reducing the risk of neurovascular injury.

This article reports on the endoscopic approach to the PPF in 3 patients. The first patient had a complete resection of a schwannoma. This is only the third reported case of an endoscopic resection of a PPF tumor, to our knowledge, all of which were schwannomas. Klossek et al also described a complete endoscopic removal of a PPF schwannoma through a transnasal approach. Pasquini et al reported on a case of a partial transnasal endoscopic removal of the PPF portion of a schwannoma that extended into the cavernous sinus. In none of these 3 reported cases was there any vascular complication.

The other 2 patients had endoscopic transnasal transmaxillary biopsies of the PPF as part of a workup for suspected tumor in the PPF. One patient also had a revision procedure done endoscopically through the initial surgical approach with further lateral extension that allowed exposure all the way to the inferior orbital fissure. A recent report of 4 cases of transnasal endoscopic biopsy of PPF masses also confirms the safety of this procedure. At least 2 of the patients described in that series appeared to actually have infratemporal fossa tumors rather than PPF tumors, as depicted in their photographs. The authors describe approaching the tumor directly through the posterior wall of the maxillary sinus, which may be better for more laterally positioned tumors in the PPF or infratemporal fossa. The approach used for the PPF biopsy in 2 patients in our series (cases 2 and 3) first identifies the sphenopalatine foramen medially, similar to the approach used for sphenopalatine artery ligation for epistaxis. This allows for identification and preservation of the sphenopalatine vessels and removes the posterior wall of the maxillary sinus from medial to lateral superior to the vessels. This reduces the likelihood of vascular injury to the sphenopalatine vessels, which is one of the main risks of any approach to the PPF. Also, dissection and biopsy in the superior portion of the PPF further reduces the risk to the IMA, since this vessel resides more inferiorly in the PPF. The mucosa of the posterior maxillary sinus is redraped over exposed bone of the PPF at the end of the procedure, allowing for better healing and less crusting of exposed bone.

All patients in this series did have postoperative sensory deficits in portions of the distribution of the maxillary division of V2: the first patient as a result of the schwannoma involving the maxillary division of V2, the second as a result of an intentional biopsy of a small branch of V2, and the third patient as a result of tumor involvement of V2. The neural structures in the PPF were identified endoscopically, and this helped to avoid further unnecessary injury.
CONCLUSIONS

The endoscopic approach to the PPF is a safe and effective surgical procedure. This approach can be used for both diagnostic biopsy and definitive tumor removal where appropriate. The approach described herein proceeds from medial to lateral, allowing for identification of the sphenopalatine vasculature early in the procedure to reduce the risk of vascular injury, which could obscure the endoscopic view. Lateral extension can provide access to the inferior orbital fissure. The use of an image-guided system is a useful adjunct to this surgical approach.

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