Olfactory Groove Meningioma

Last Updated: October 24, 2020

For general considerations, diagnosis, evaluation, indications, and preoperative considerations, please refer to the [Resection of Olfactory Groove Meningioma](#) chapter exploring the transcranial route.

Endoscopic Versus Transcranial Approach

The characteristics of the tumor, including its size, associated cerebral edema, extent of calcification, vascular encasement, and anterior cranial floor hyperostosis, can affect the choice of operative corridor. Mild vascular encasement or cerebral edema is not a contraindication for the transnasal transcribriform route.

I consider the tumor's size/location and the status of the patient's olfaction to be the most important factors for choosing the final surgical route. Extensive vascular encasement and large meningiomas that span beyond the middle of the orbital roof on the coronal plane are best approached via a pterional craniotomy. Small and medium-size olfactory groove meningiomas (OGMs) may be excised through either endoscopic endonasal transcribriform surgery or an eyebrow supraorbital osteotomy. The former approach provides the most direct route to tumor extraction and

minimizes neurovascular manipulation.

For OGMs, transcranial surgery offers an opportunity for preservation of olfaction, whereas the endoscopic route does not. Therefore, if the patient possesses intact olfaction before surgery, the transcranial route offers the only opportunity for preservation of the senses of taste and smell. These details should be discussed with the patient before surgery. We often underestimate the ramification of anosmia and ageusia (lack of the ability to taste) for the quality of life of the patients.
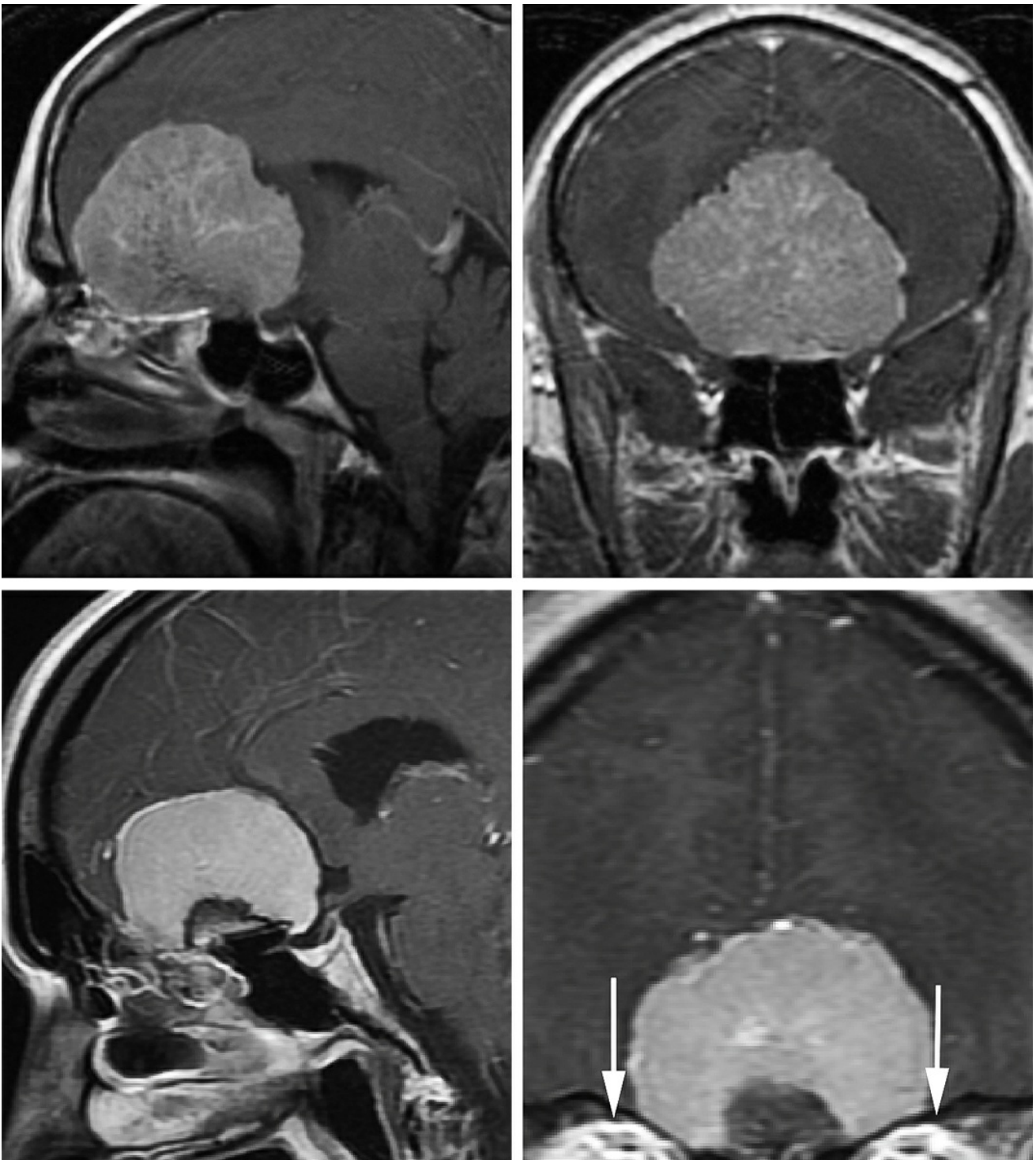
Figure 1: A large OGM (upper photos) extending beyond the optic nerves is best suited for a transcranial approach. If the tumor does not extend significantly beyond the middle of the orbit (midorbital plane, white arrows) or lateral to the optic nerves as shown on coronal MR images (lower photos,) an endonasal route is reasonable.

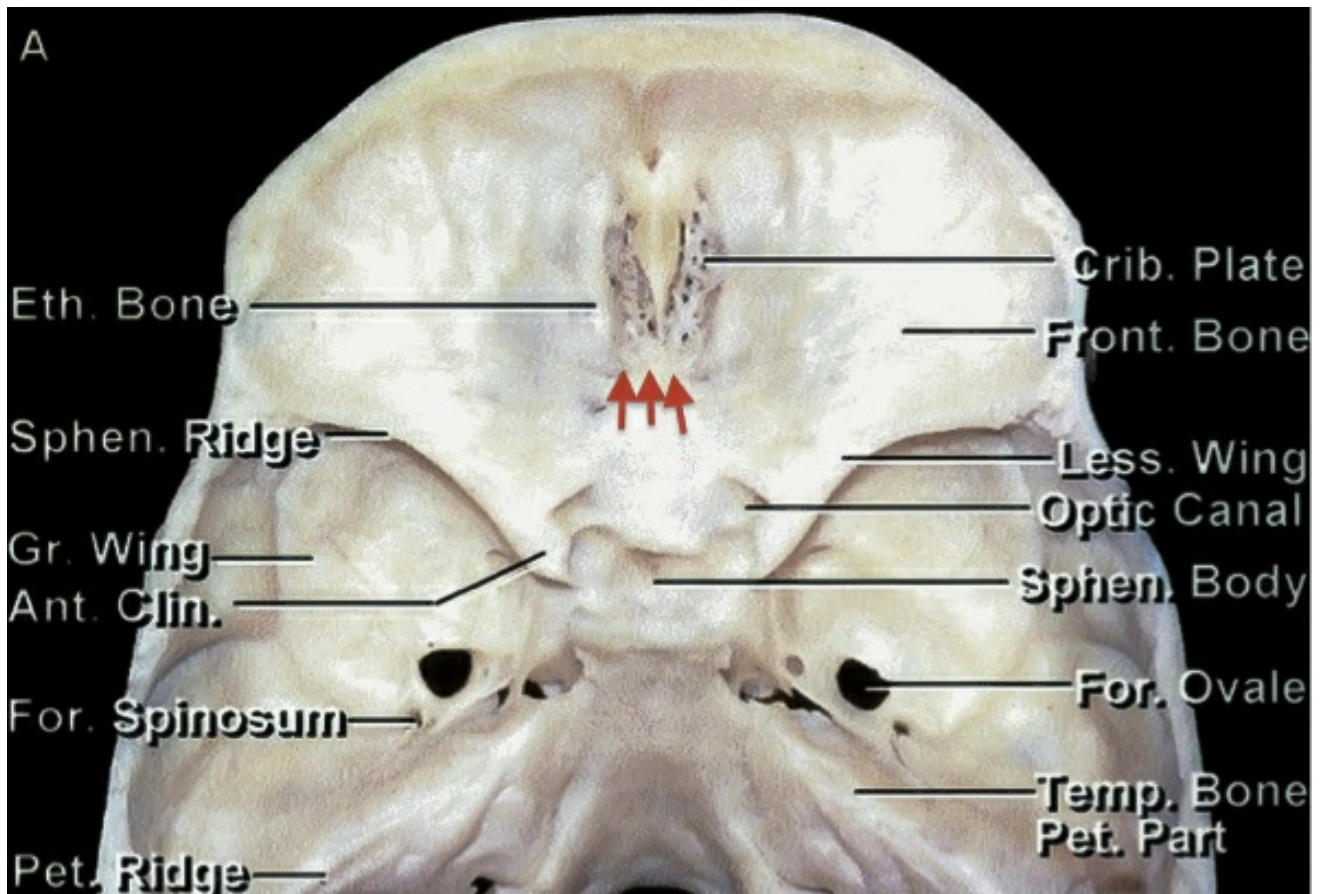If a large portion of the tumor is housed within the nasal

sinuses, surgical planning should consider a bifrontal craniotomy or a staged approach to maximize resection of all the tumor compartments. I usually do not pursue an aggressive resection of small intrasinus tumor components in this slow growing benign tumor.

Resection of giant tumors by means of the endonasal corridor requires long operative sessions even in very experienced hands and therefore demands staging. I do not believe removal of certain large and giant OGMs via staged endonasal approach is in the best interest of the patient. For these tumors, the single-stage pterional route is more appropriate.

Endoscopic Operative Anatomy

The anterior and posterior ethmoidal arteries arising from the ophthalmic artery and the sphenoidal branches originating from the middle meningeal artery supply meningiomas in this region. Pial feeders often parasitize vessels from the anterior cerebral artery branches.
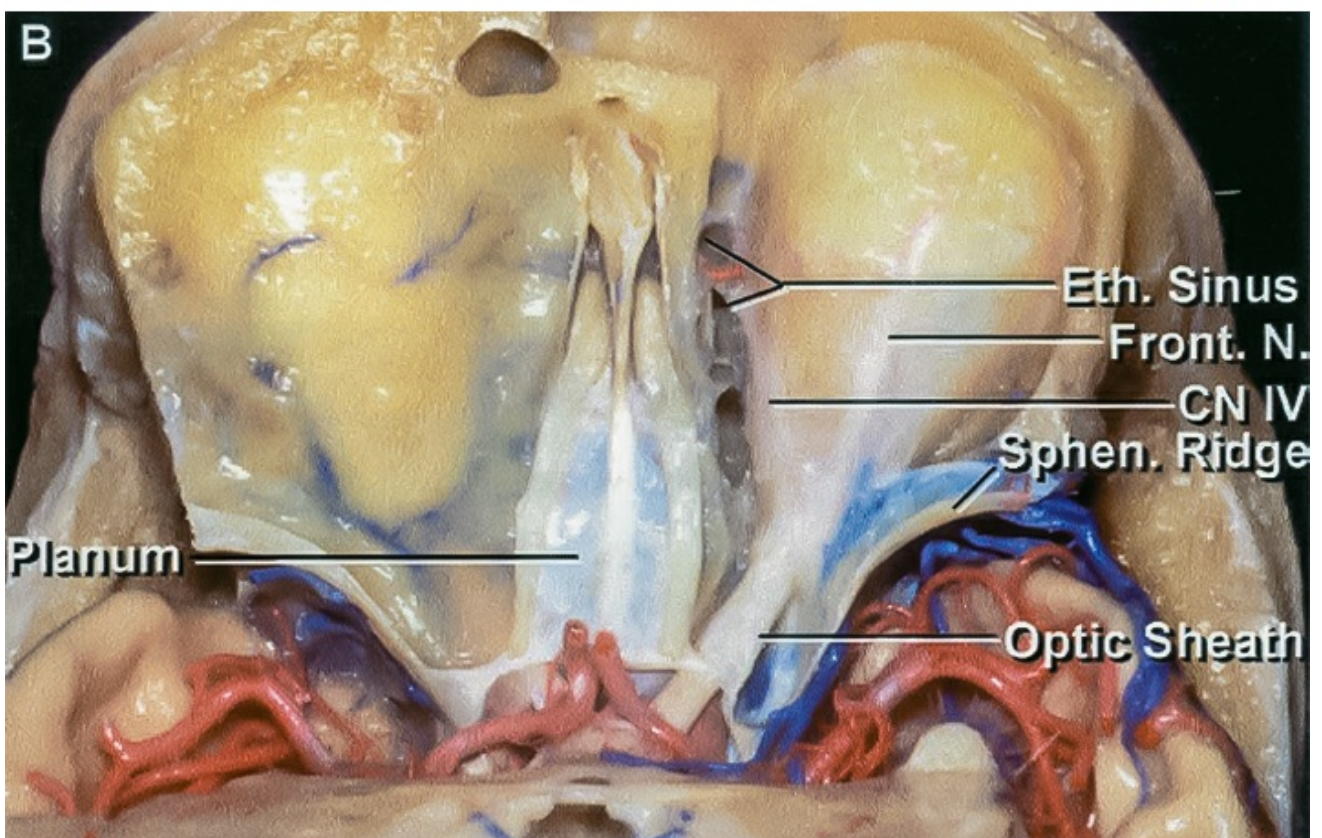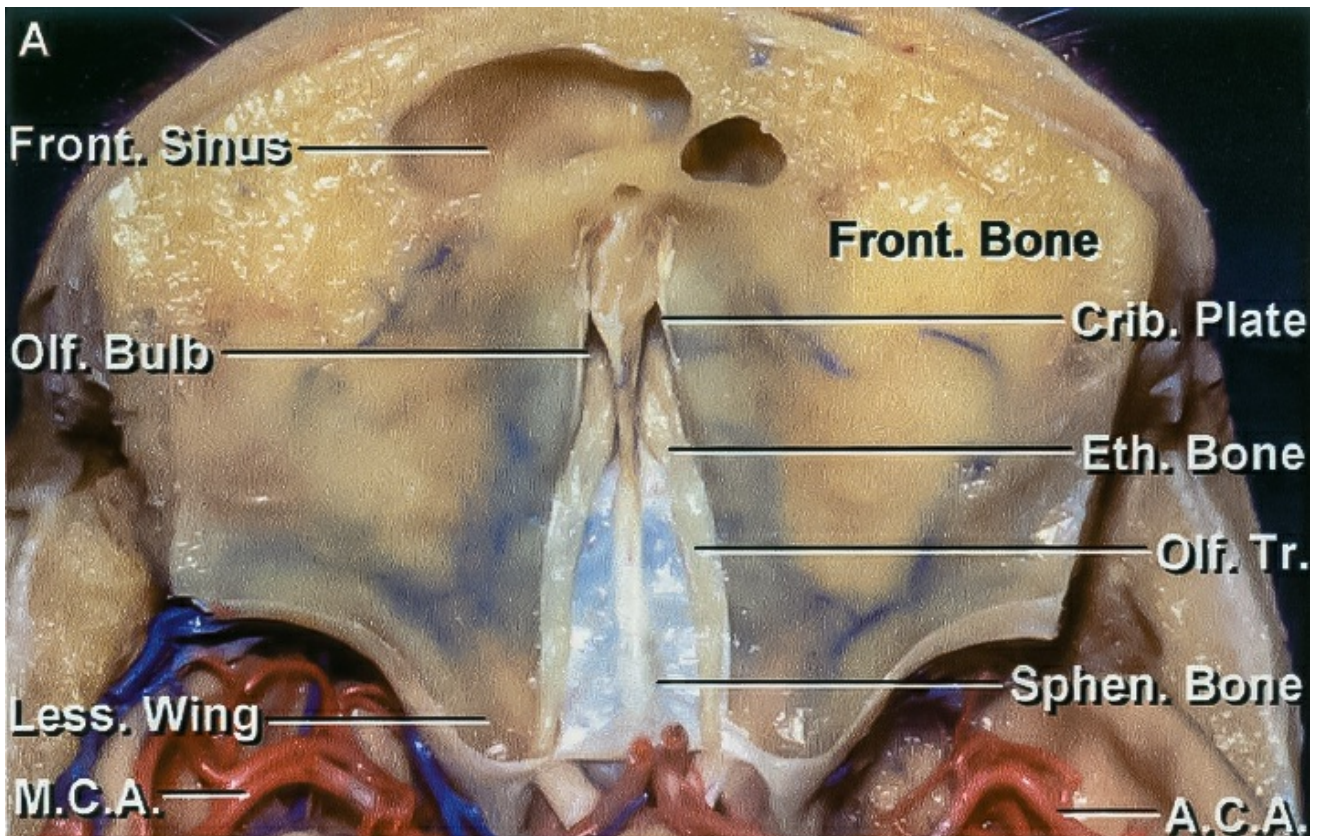
A

Eth. Bone — Crib. Plate — Front. Bone

Sphen. Ridge — Less. Wing — Optic Canal

Gr. Wing — Ant. Clin. — Sphen. Body

For. Spinosum — For. Ovale

Temp. Bone Pet. Part

Pet. Ridge

Figure 2: Bony anatomy of the anterior and middle cranial base is shown. The orange arrows point to the typical origin of olfactory groove meningiomas (image courtesy of AL Rhoton, Jr).

A

Front. Sinus

Front. Bone

Crib. Plate

Olf. Bulb

Eth. Bone

Olf. Tr.

Sphen. Bone

Less. Wing

M.C.A.

A.C.A.

B

Eth. Sinus

Front. N.

CN IV

Sphen. Ridge

Planum

Optic Sheath

Figure 3: Superior view of the olfactory groove and its anatomic relationships to the surrounding structures is

demonstrated. Note the change in the horizontal level of dissection along the midline skull base compared with the roof of the orbits. This anatomic relationship should be kept in mind during devascularization of the tumor along the skull base. Anterior and posterior ethmoidal arteries are the main source of intraoperative blood loss, and their early control at the base of the tumor via the endoscopic transnasal approach can improve the efficiency of the operation (images courtesy of AL Rhoton, Jr).
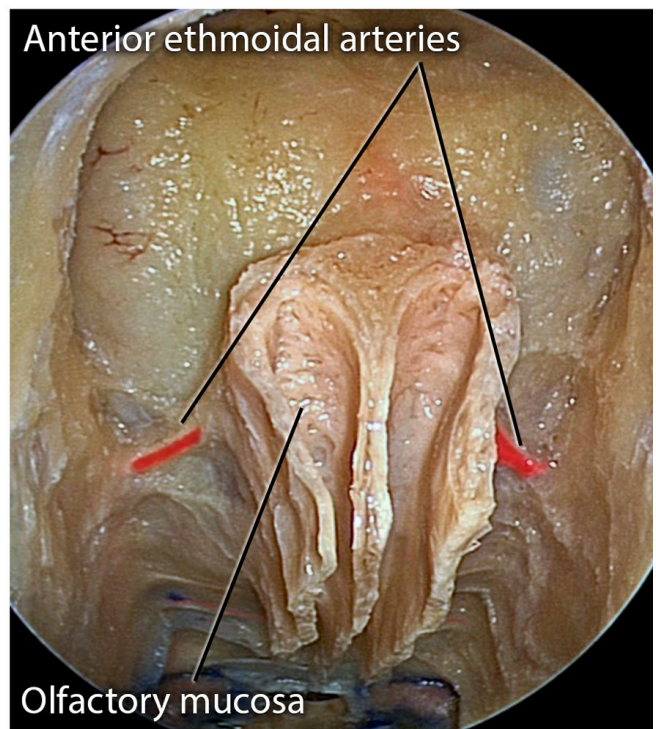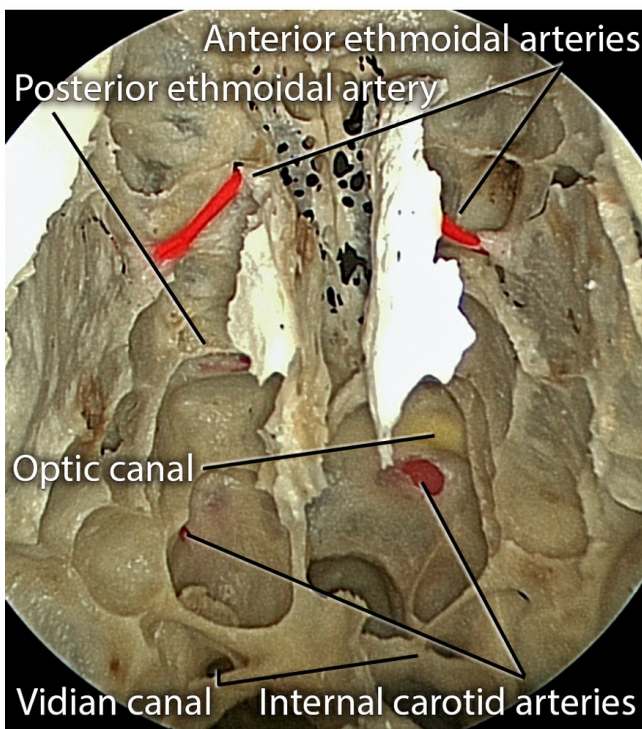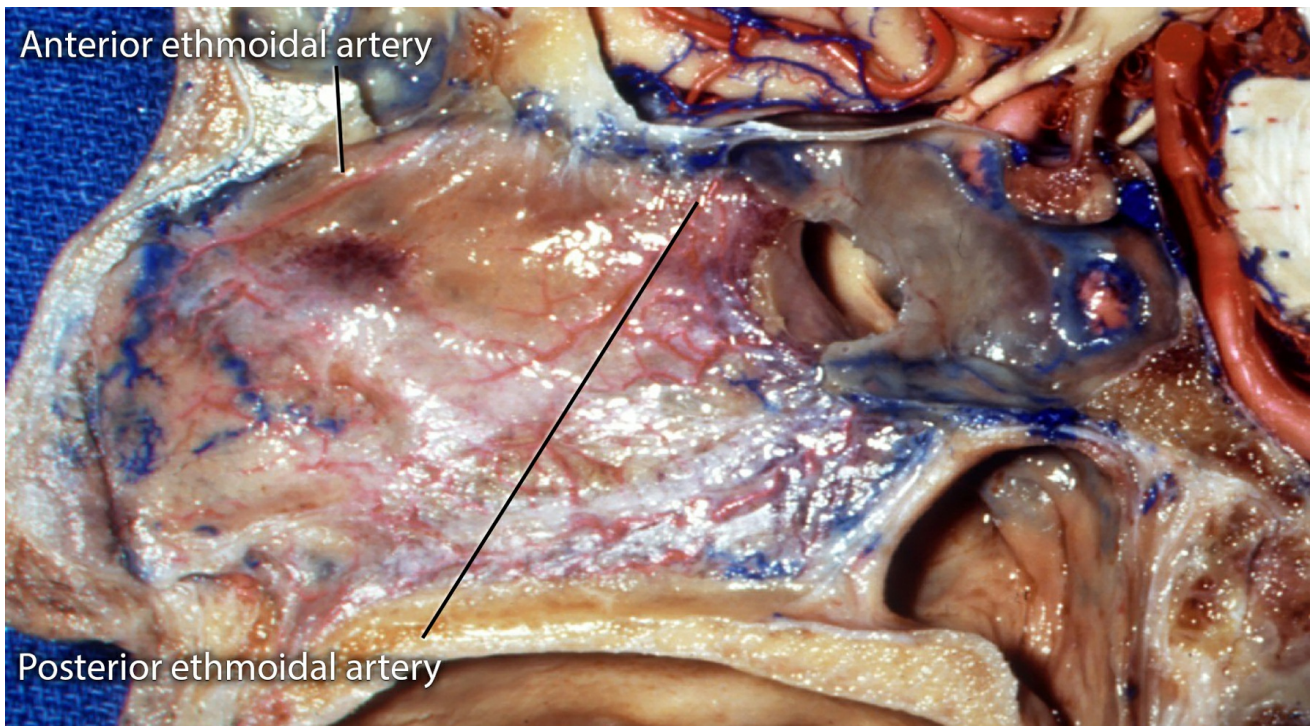
Figure 4: The vascular anatomy to OGMs observed via the endoscopic transnasal approach is shown. Note the location of the anterior and posterior ethmoidal arteries (images courtesy of AL Rhoton, Jr). The final bony exposure is demonstrated in the bottom row.
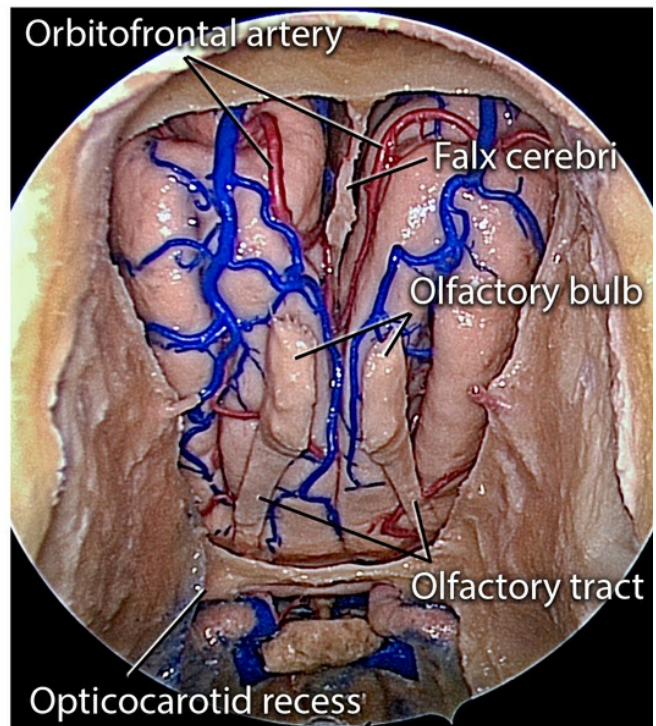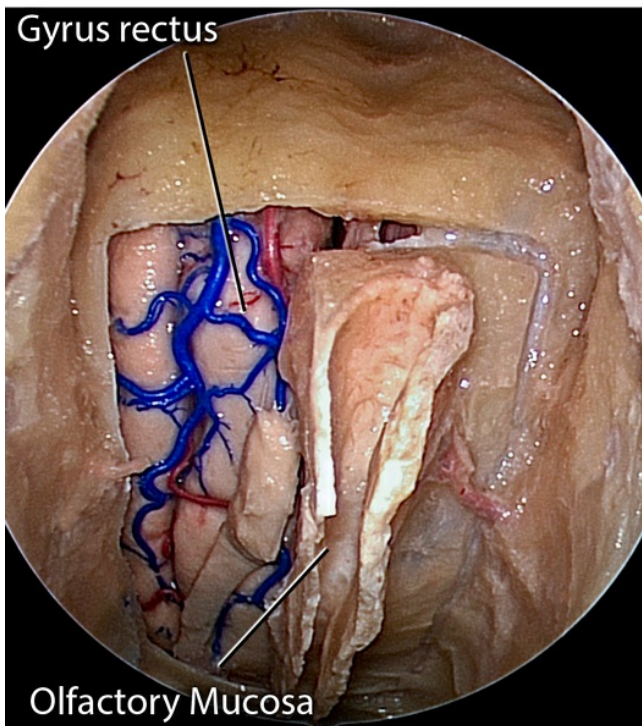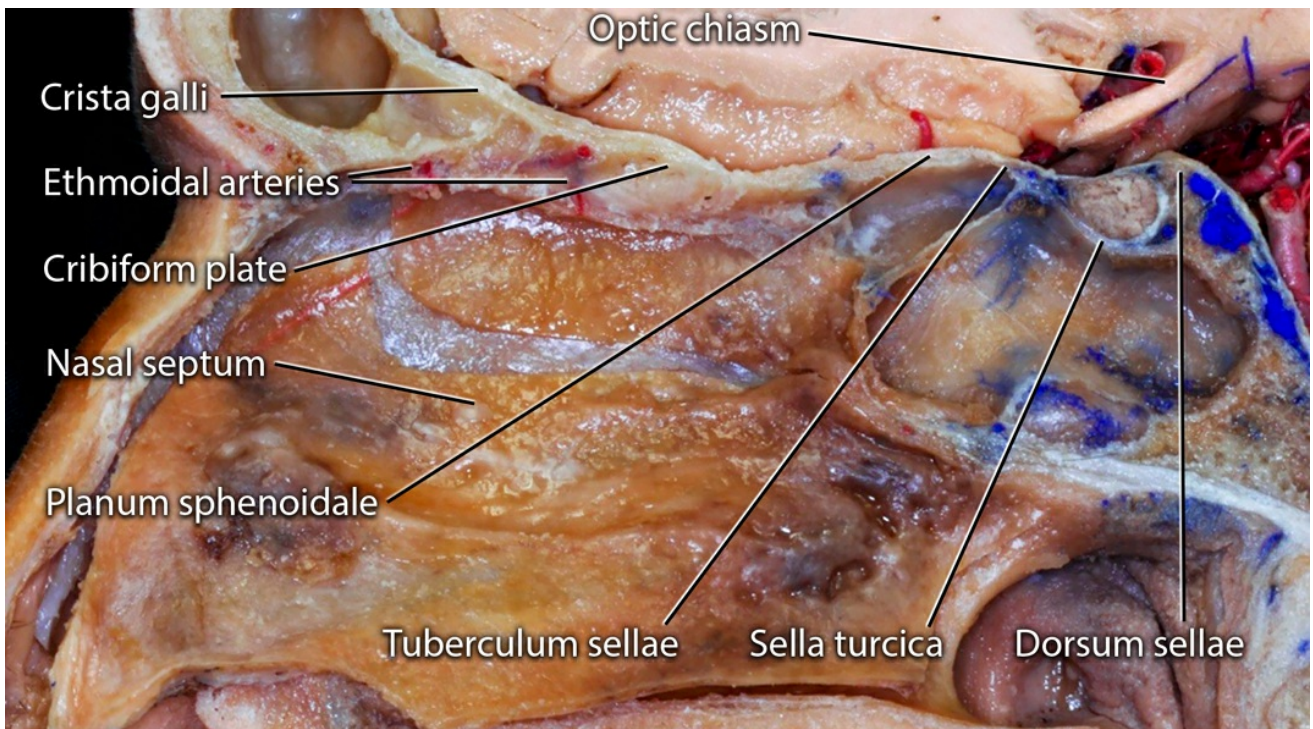
Figure 5: The anatomy of the anterior skull base surgery via the transnasal route is summarized. The sagittal image demonstrates different bony landmarks. The other images illustrate the relevant operative anatomy for transcribriform osteotomy.

ENDOSCOPIC RESECTION OF OLFACTORY GROOVE MENINGIOMA

Exposure

A lumbar drain is installed (and continued for approximately 4 to 5 days after surgery) to facilitate healing of the skull base defect and to decrease the risk of postoperative cerebrospinal fluid (CSF) leakage.

The patient is positioned supine and in 15 degrees of reverse Trendelenburg to facilitate cerebral venous return and clearance of the operative field from blood using gravity during endonasal microsurgery.

Intraoperative navigation using a computed tomography (CT) scan of the skull base and sinuses is important for successfully traversing the anterior skull base and guiding resection of the hyperostotic bone. Although magnetic resonance imaging can optimize parenchymal navigation, I do not believe it is necessary for OGMs. The CT scan's opacity can be readily adjusted to estimate the anterior extent of the tumor.

The nares, nasopharynx, and midface are prepped in standard fashion. I prepare the lateral margin of the thigh if the use of fascia lata autograft for skull base reconstruction is expected. For more information on the basics of transnasal surgery, see the [Principles of Endoscopic Microsurgery](#) chapter.

Almost all meningiomas are resected using the following algorithm of three D's:

1. *Devascularize* the base of the tumor,

2. *Debulk* the tumor, and finally

3. *Dissect* the decompressed and readily mobilizable tumor capsule along the preserved arachnoid planes to protect the adjacent cerebrovascular structures.

The correct order of executing these maneuvers is imperative.

Elevation of the bilateral vascularly pedicled nasoseptal flaps is often necessary so that the wide bony defect along the cribriform plate can be adequately covered at the end of resection. These flaps can be protected within the posterior nasopharynx. Approximately 1.5 to 2 cm segment of the posterior margin of the nasal septum can be removed to facilitate mobility of the instruments. The anterior extent of this resection should be minimized to avoid the risk of an iatrogenic saddle-nose deformity.

To begin, a 0-degree endoscope is used to survey the nasal anatomy and identify bilateral middle and inferior turbinates. A solution of 1% lidocaine with epinephrine is injected to anesthetize and vasoconstrict the nasal mucosa. The inferior and middle turbinates can be retracted laterally to provide a more expanded viewing window to the anterior skull base. Although usually not necessary, for larger tumors, the middle turbinates may be resected to provide additional space for manipulation of instruments during tumor removal through the nose.

Use of instruments is continued with the dissecting tool in the neurosurgeon's right hand, inserted into the patient's left

nares, and the suction device in the left hand, inserted into the patient's right nares along with the endoscope. The rhinologist remains present throughout the resection and guides the endoscope, allowing a pseudo three-dimensional view of the operative field via dynamic motion of the scope. Either a 0-degree or 30-degree endoscope may be used during this approach. The 30-degree endoscope can provide an excellent view of the cribriform plate while moving the endoscope's head out of the operative zone, minimizing "sword fighting" among the instruments.

Following removal of the mucosa overlying the sphenoid, I expose the anterior skull base by localizing the sphenoid ostia and performing a wide bilateral sphenoidotomies. This maneuver should expose the sella turcica, bilateral optic canals, tuberculum sellae, and planum sphenoidale. Tumors with intranasal extension may require initial debulking with a microdebrider before drilling the anterior skull base.

I use the medial and lateral margins of the opticocarotid recess as a landmark to orient myself to the anterior skull base anatomy. This recess underlies the anterior clinoid process. The medial margin of the recess marks the location where the optic nerve interfaces with the middle clinoid process. The optic nerve serves as a marker for the posterior border of the bony exposure.

Bone resection should proceed with bilateral total ethmoidectomies sufficient to expose the confluence of the fovea ethmoidalis and lamina papyracea. The lamina

papyracea represents the lateral border of bone exposure. During the posterior ethmoidectomy, the surgeon must be vigilant for Onodi cells, an anatomical variant, where bony dehiscence occurs medial to the internal carotid arteries and optic nerves.
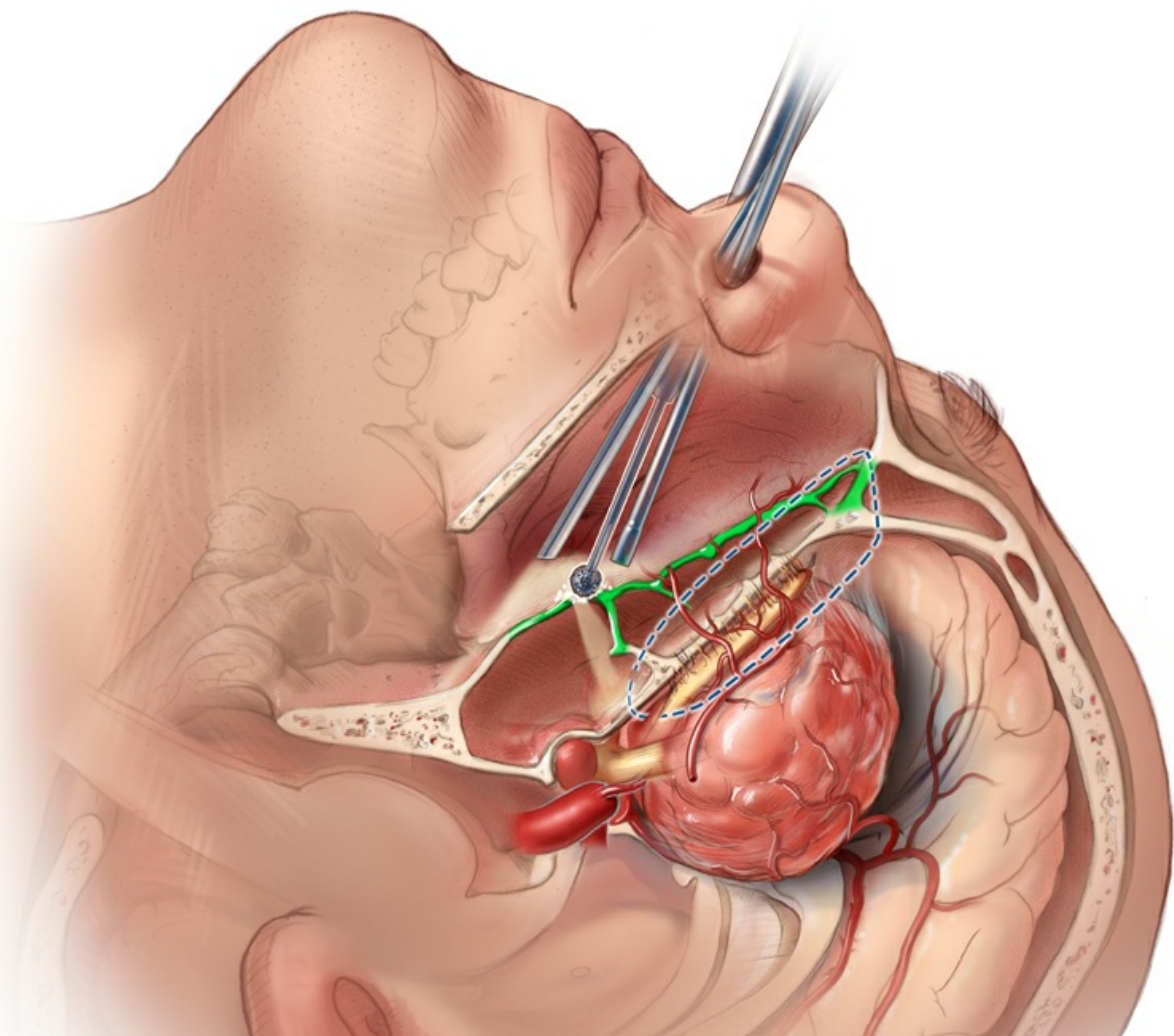
The branches of the posterior ethmoidal arteries are encountered during the posterior ethmoidectomy, and should be cauterized meticulously to avoid excessive hemorrhage. If an uncauterized artery retracts into the orbit, an orbital hematoma may occur. The ethmoidal arteries are commonly the primary blood supply for most OGMs.

Next, the bone exposure is extended anteriorly via frontal sinusotomy, otherwise known as the modified Lothrop procedure. A superior septectomy is completed and joined with the posterosuperior septectomy accomplished during the ethmoidotomy. The Lothrop cavity should be created by removing the septations encountered within the frontal sinus. The posterior table of the frontal sinus should be visible and marks the anterior margin of bone exposure. Following completion of this step, the anterior skull base is visible from the sphenoid sinuses to the level of the frontal sinuses. The anterior ethmoidal arteries are also sacrificed.

The last step in bone exposure involves a transcribriform "keyhole" craniectomy. This step should be performed with a high-speed drill. I remove the bone from the planum sphenoidale toward the posterior wall of the frontal sinus. Next, I complete a wide cribiform osteotomy, using copious
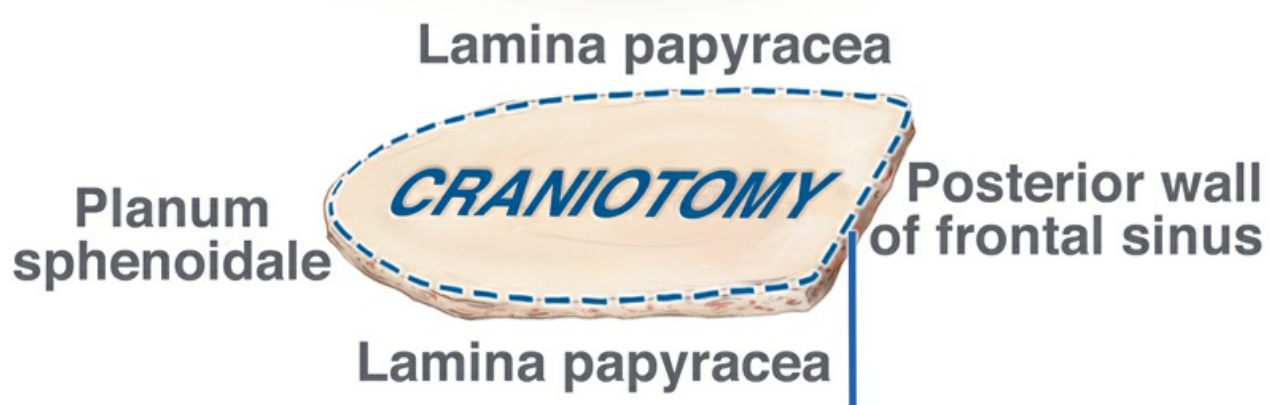
irrigation to avoid overheating the drill in close proximity to the neurovascular structures. This osteotomy accommodates the size and location of the OGM based on intraoperative CT image guidance.

Additional bone removal should extend anteriorly along the cribriform plate to expose the anterior tumor capsule and expand the superior reach of instruments. The surgeon must ensure a shelf of bone at the posterior frontal sinus wall to facilitate closure. The crista galli is removed using the high-speed drill. Complete resection of all involved hyperostotic bone is necessary to avoid tumor recurrence at the cribriform plate or the adjacent paranasal sinuses (particularly the ethmoid sinus).

Lamina papyracea

CRANIOTOMY

Planum sphenoidale

Posterior wall of frontal sinus

Lamina papyracea

Resected sphenoidal, ethmoidal, and frontal sinus walls

Anterior and posterior ethmoidal aa. with feeders

Hyperostotic bone

Meningioma

Frontopolar a. feeders and pial invasion
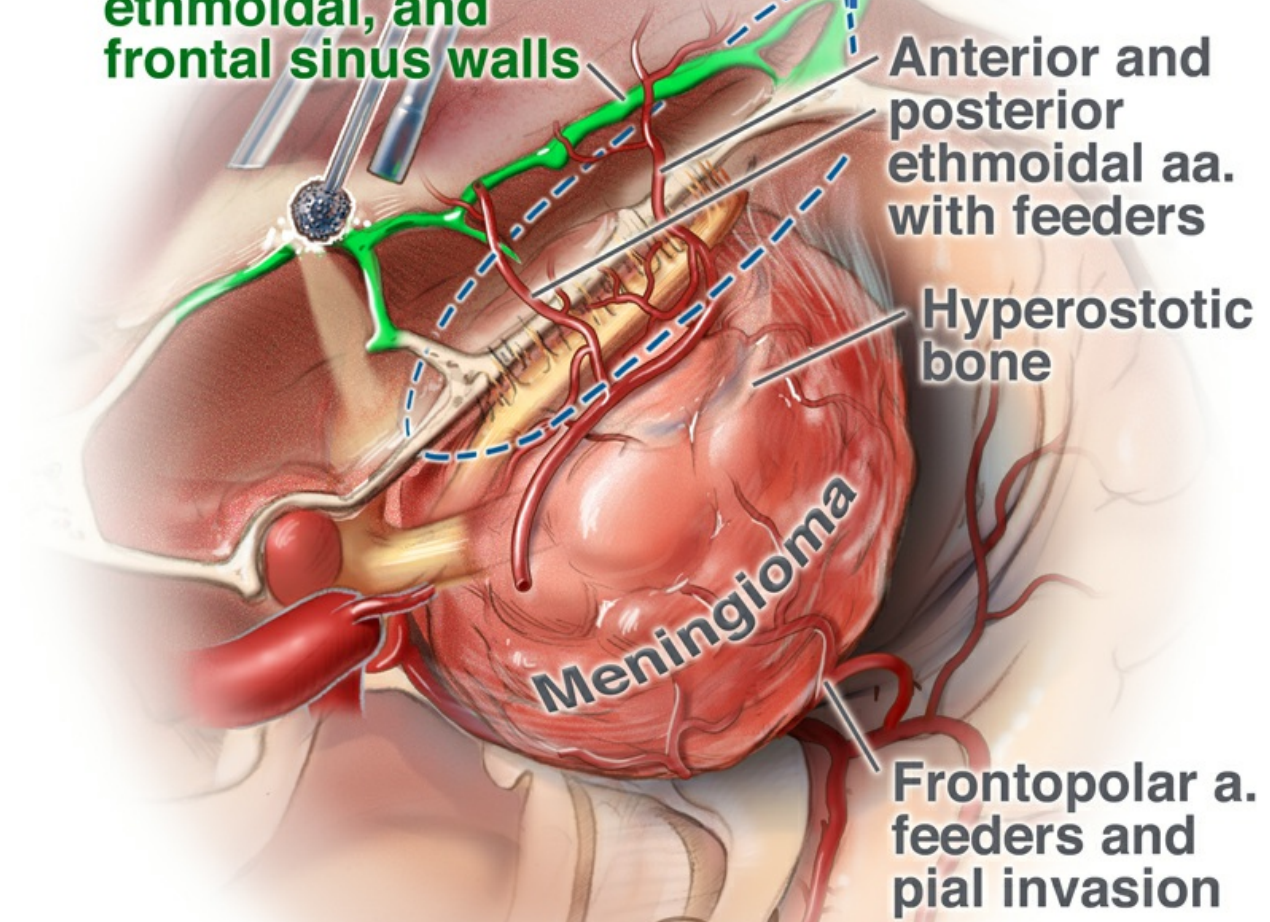
Figure 6: This illustration summarizes the bone work: the ethmoidectomy and sphenoidotomy (green) as well as cribriform osteotomy are shown. Lamina papyracea is resected to allow mobilization of the underlying periorbita so that the operative angles are widened and aggressive removal of the lateral poles of the tumor under direct vision are attempted. The hypertrophied anterior and posterior ethmoidal arteries are sacrificed early to minimize blood loss and devascularize the tumor.
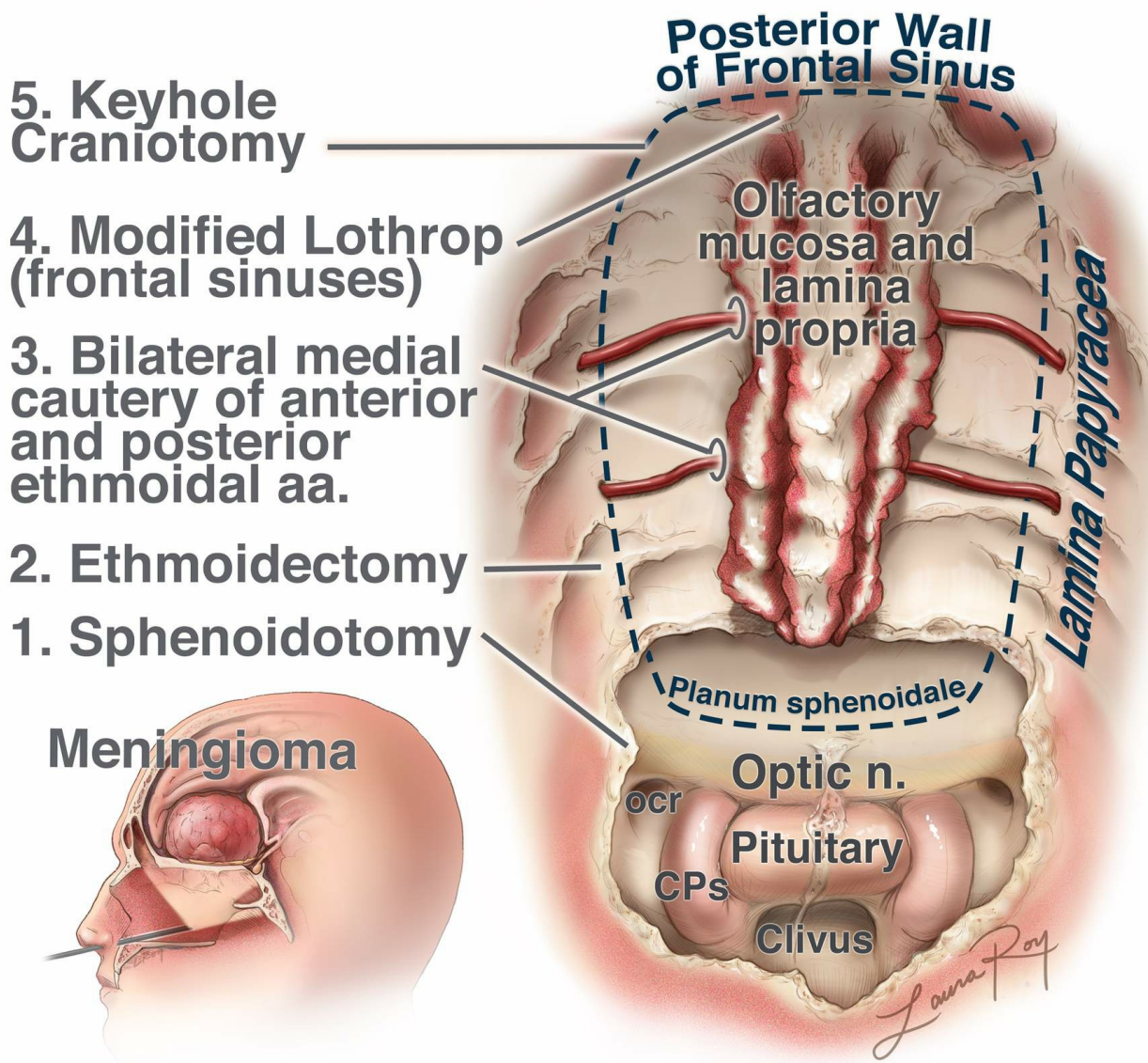
Figure 7: The details of bone work from an operative point of

view are further described. The extent of removal of the lamina papyracea depends on the width of the tumor along the coronal plane.
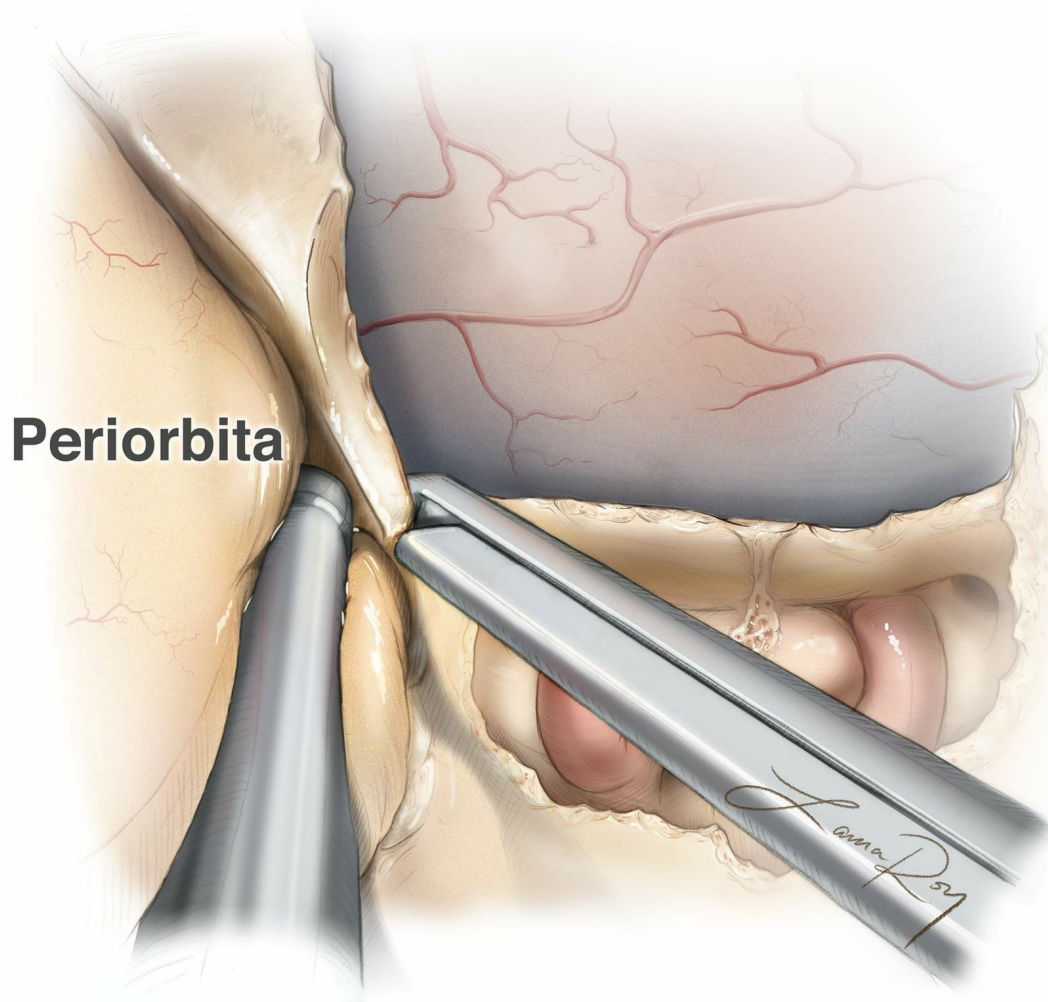
Figure 8: If necessary, the medial part of the orbital roof can be removed via Kerrison rongeurs to expand the lateral reach for wide-based tumors. The periorbita/orbit can be gently mobilized for this purpose.

Before proceeding with the dural opening, the operative field should be inspected meticulously for hemostasis. The dura underlying the tumor is heavily coagulated for tumor devascularization. The anterior falcine artery may be identified and coagulated.

INTRADURAL PROCEDURE

The dura may be incised in the cruciate manner while avoiding injury to the occult lateral neurovascular structures. Microdoppler ultrasound may be used to locate the carotid arteries. The tumor can then be internally debulked with instruments appropriate for the consistency of the tumor; I prefer to use an ultrasonic aspirator.

Maintaining the anterior falcine attachment of the tumor prevents motion of the tumor during the debulking maneuvers and minimizes injury to the surrounding structures. Aggressive debulking of the tumor is necessary for safe and efficient removal of the tumor capsule transnasally. The surgeon must avoid inadvertently violating the tumor capsule over the neurovascular structures. Bone removal may need to be expanded to allow easy identification of the circumference of the base of the tumor so that it is not necessary to "pull on" the tumor capsule forcefully through operative blind spots.

The steps for tumor removal are very similar to those for the transcranial routes. Following intracapsular debulking, the circumferential dural attachments are released microsurgically. Extracapsular arachnoid dissection facilitates collapse of the capsule and its *piecemeal* evacuation through the bony defect in the anterior fossa floor.

Even seemingly large capsules relative to the anterior fossa floor defect can be removed via gentle traction on the

capsule following assurance of its complete circumferential disconnection from the surrounding structures. The intraorbital soft tissues may be gently retracted to expose the most lateral margins of the capsule.
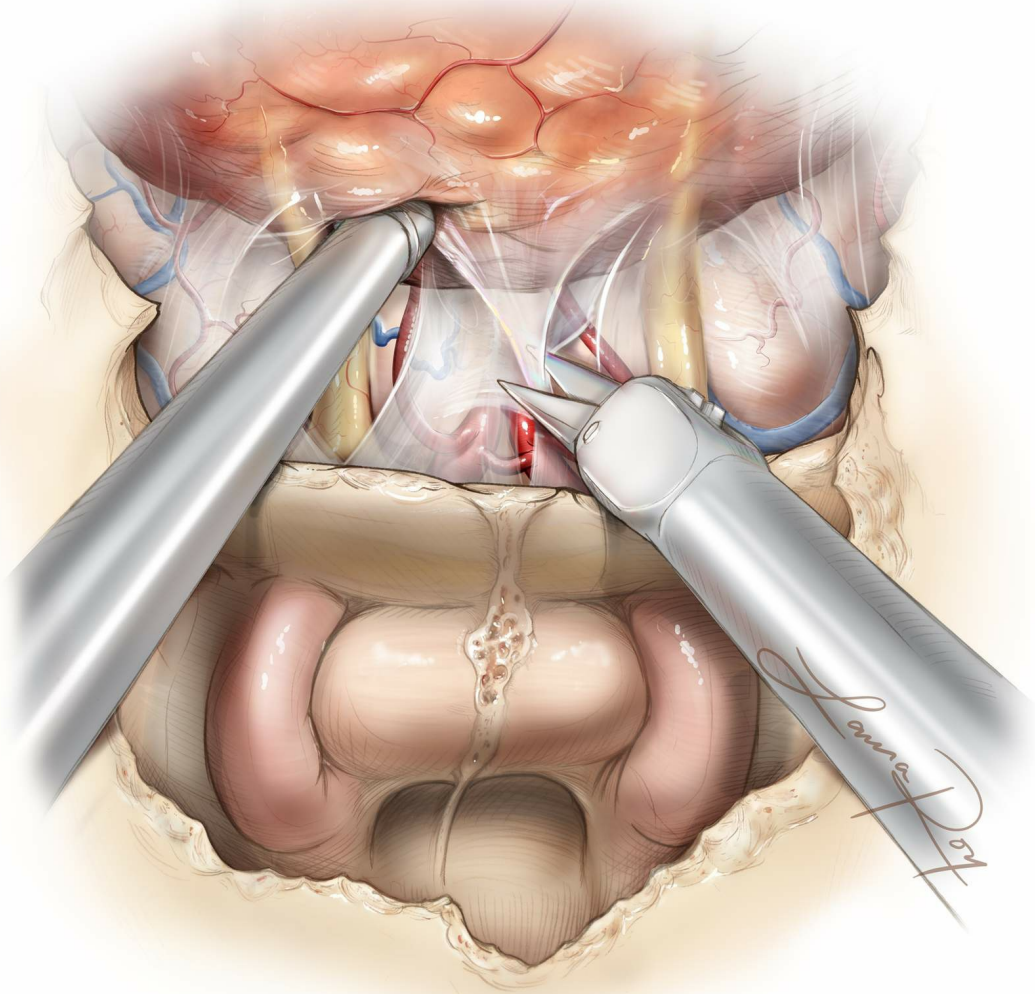

Figure 9: I prefer to mobilize the capsule in the posterior-to-anterior direction so the A1 branches are visualized early in surgery. Meticulous handling of the perforating vessels is crucial for a desirable outcome. There are usually thick arachnoid bands protecting the vascular structures. The engulfed olfactory nerves are coagulated and cut.
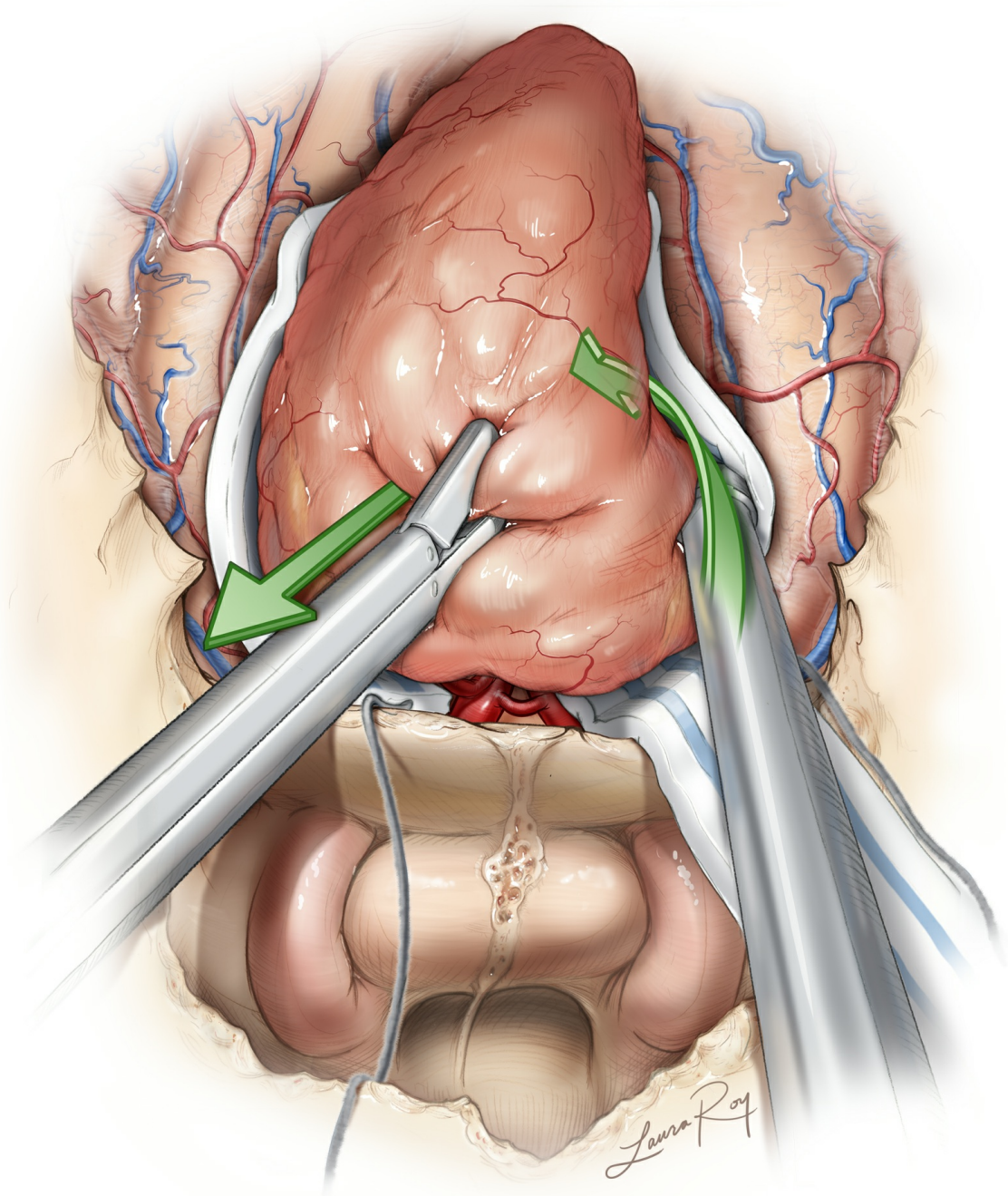
Figure 10: Small cottonoid patties gently wipe the brain away from the tumor capsule while the capsule is mobilized away from the brain. Olfactory tracts and bulbs are sacrificed. Fontoorbital and frontopolar arteries are frequently adherent to the supralateral pole of the capsule (operative blind spot) and can be avulsed inadvertently if the tumor is aggressively pulled upon.
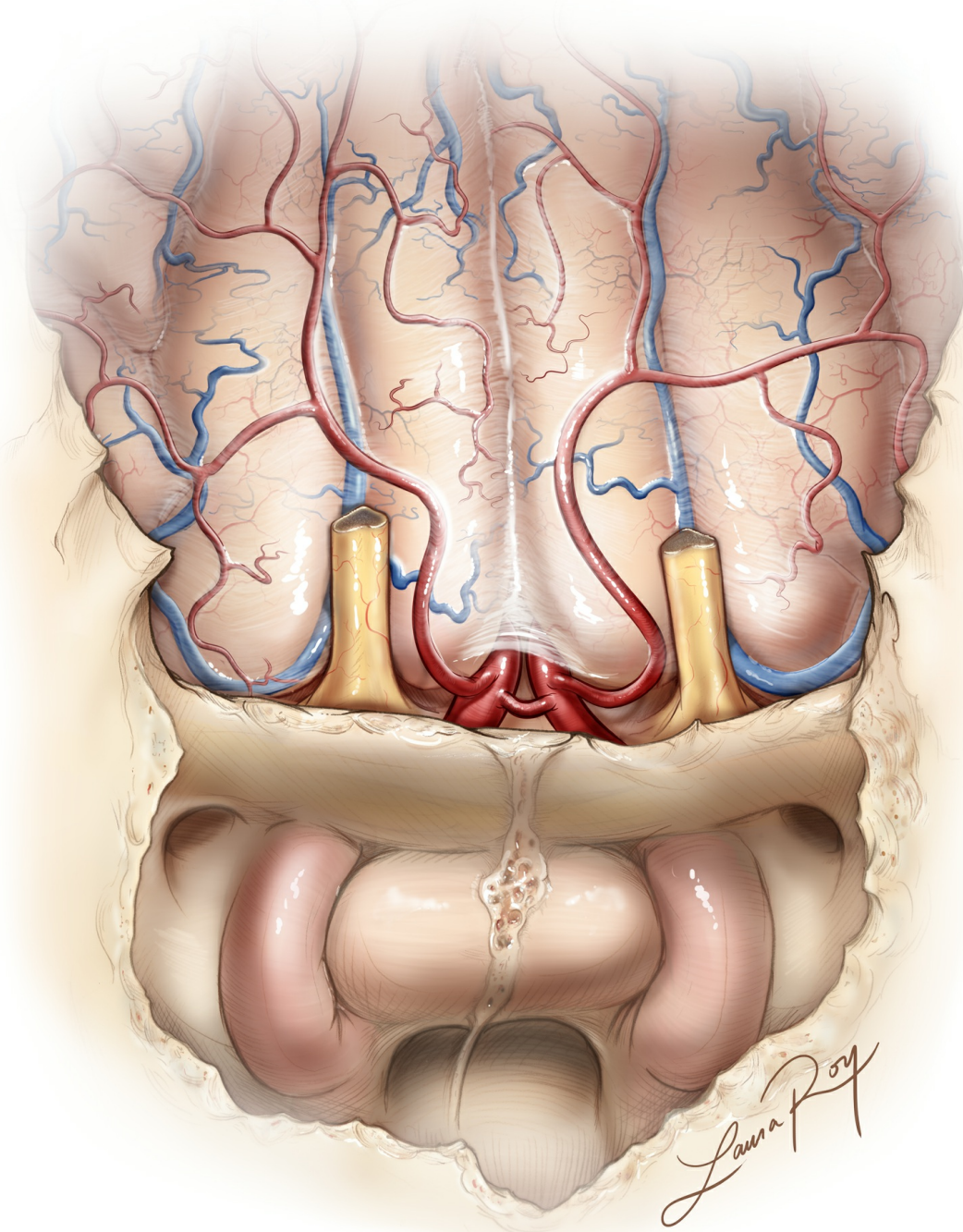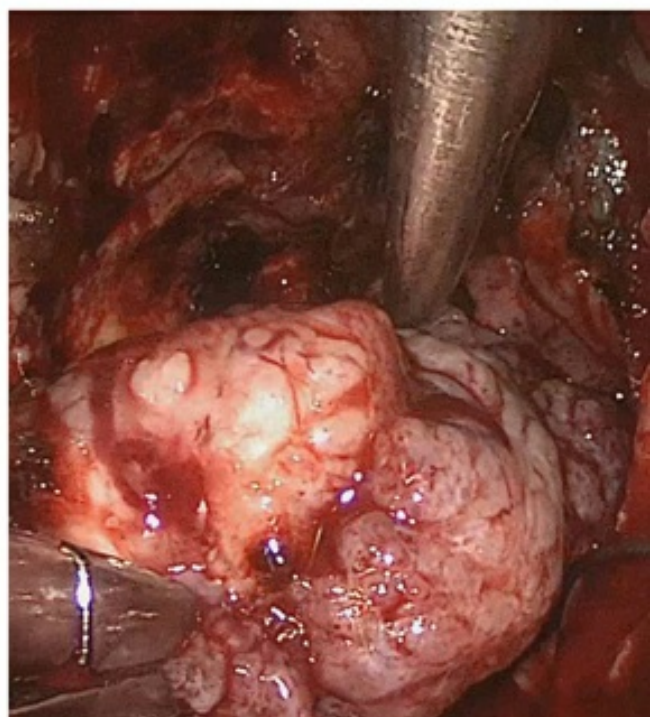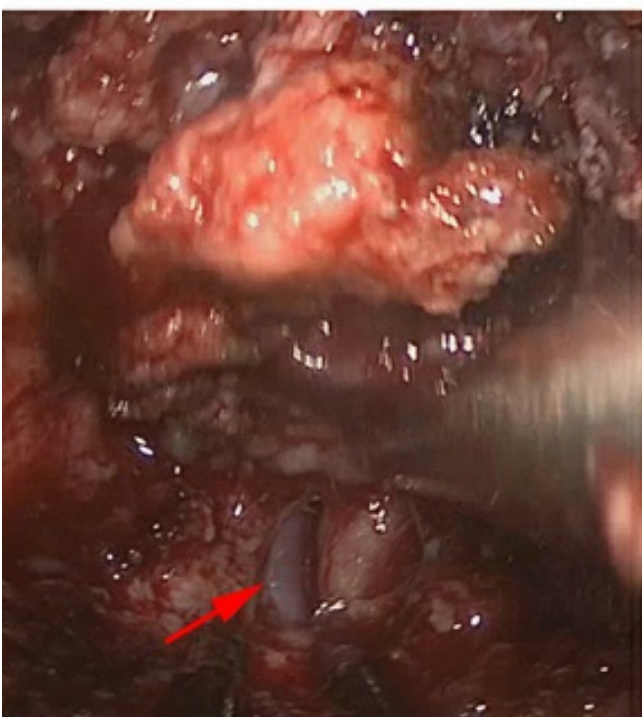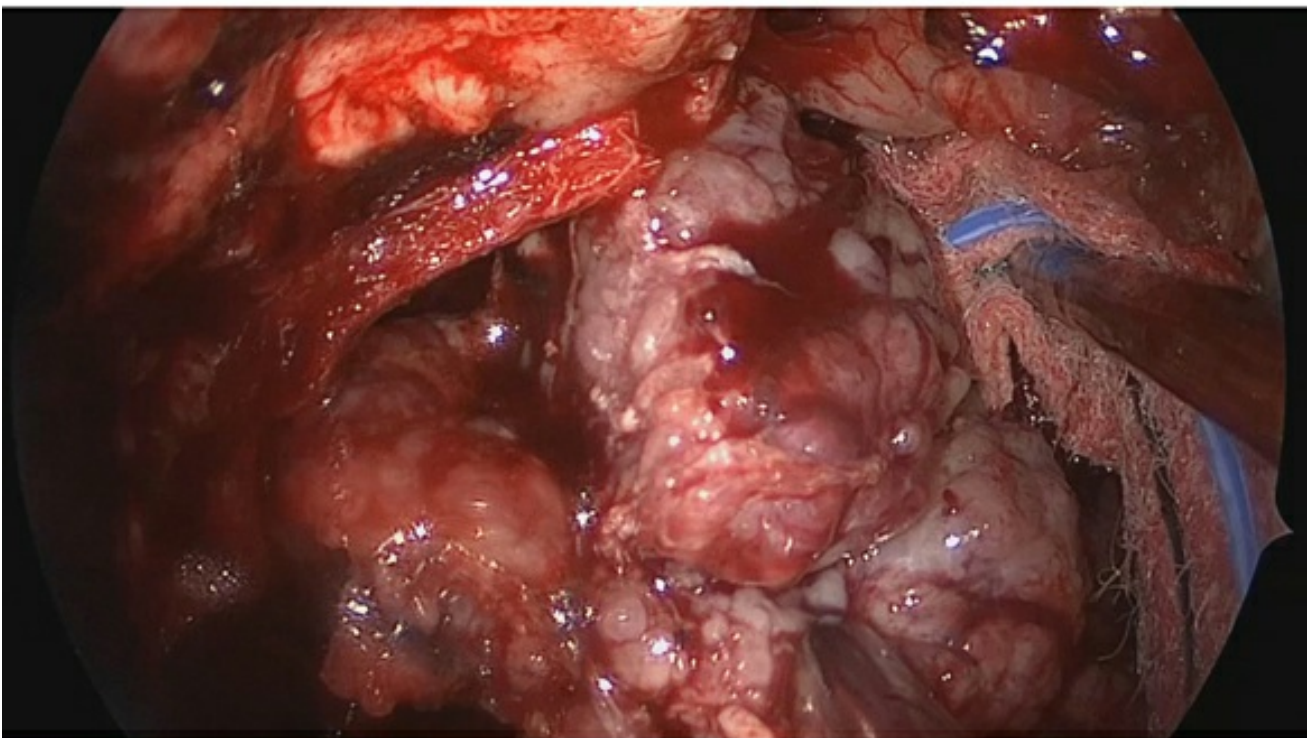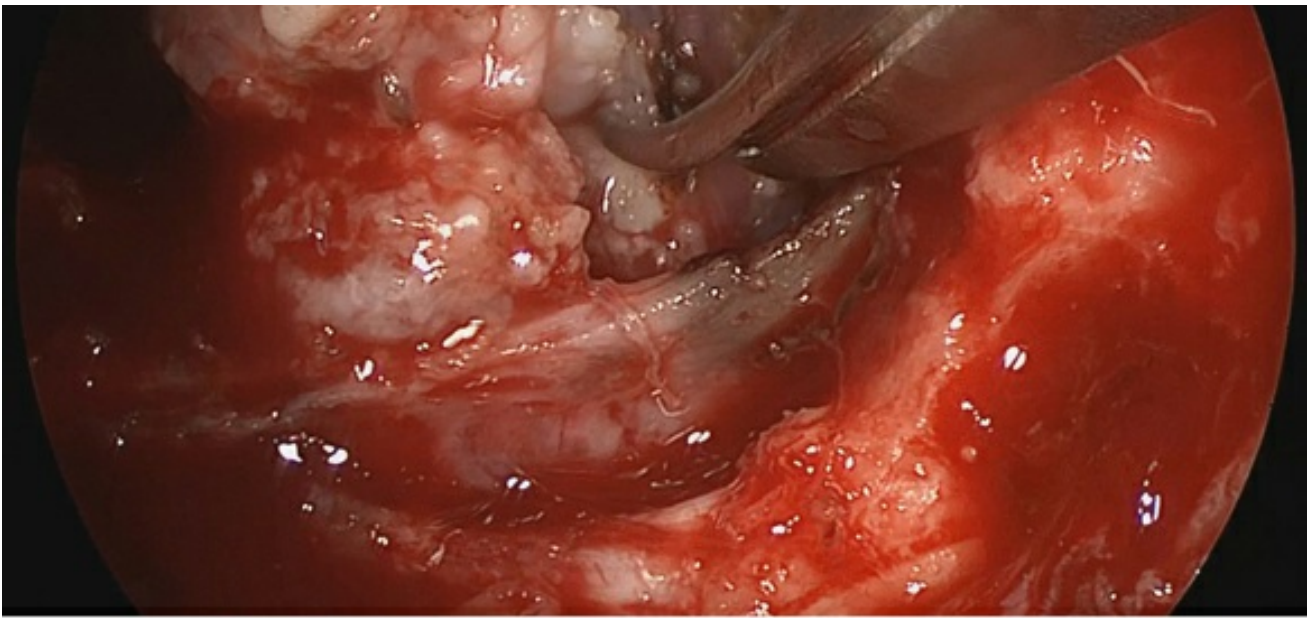
Figure 11: The final view of the resection cavity before reconstruction is shown. I usually inspect the medial optic canals so that I can reliably rule out tumor infiltration there. The 45-degree endoscope is appropriate for this purpose.
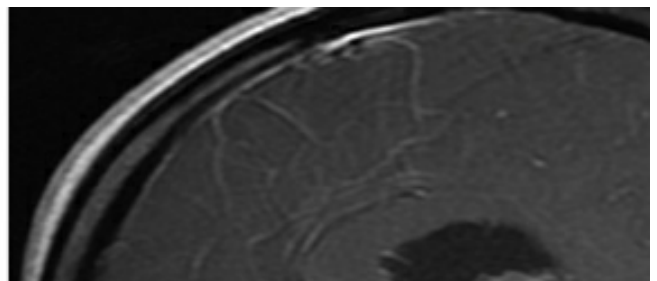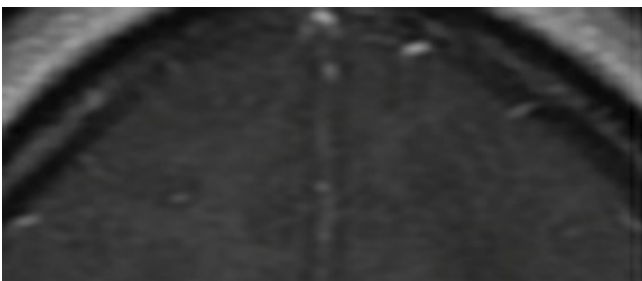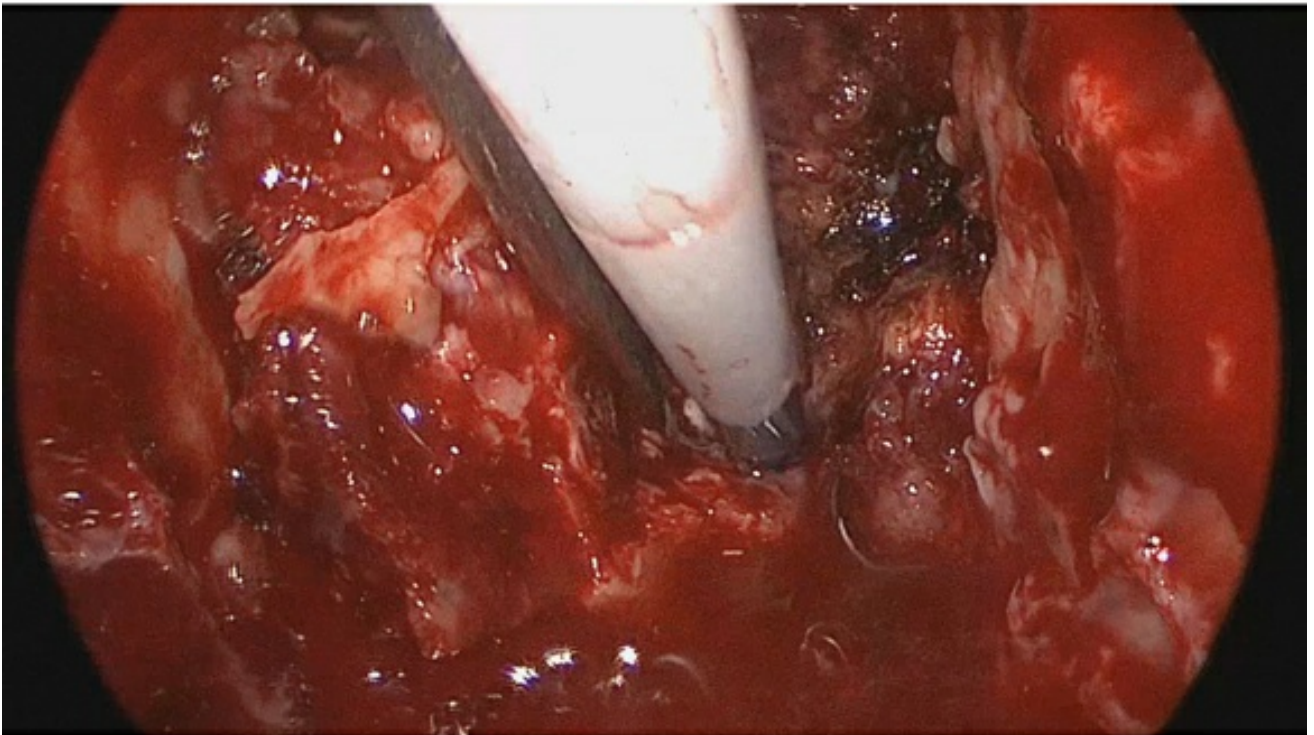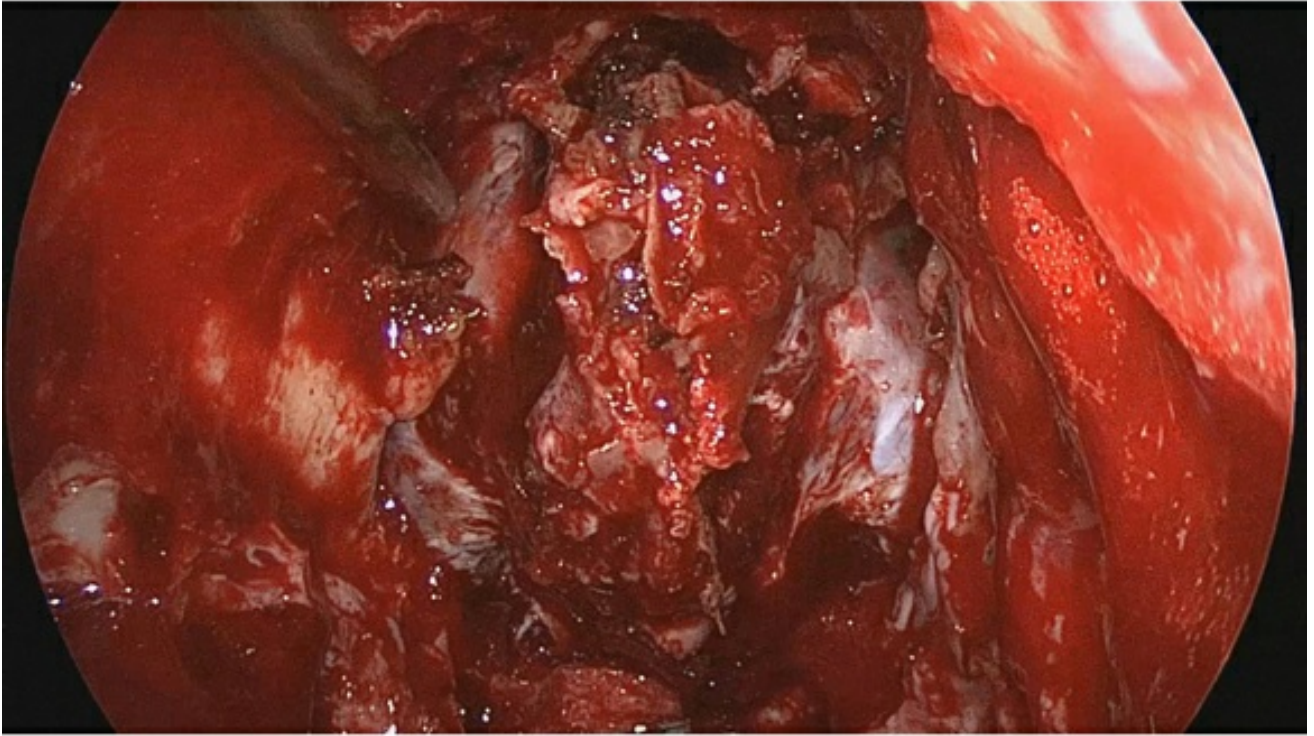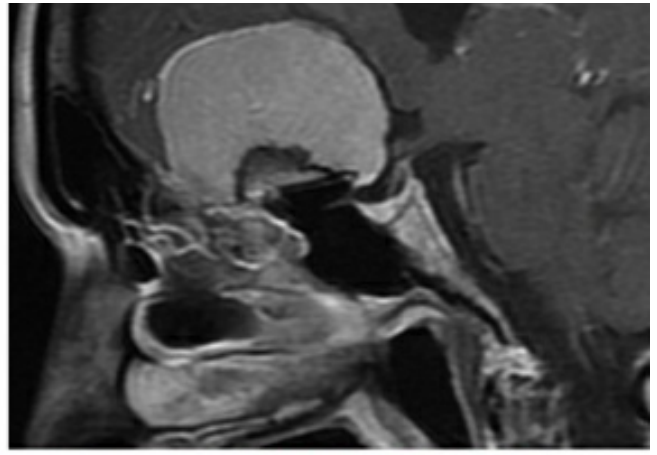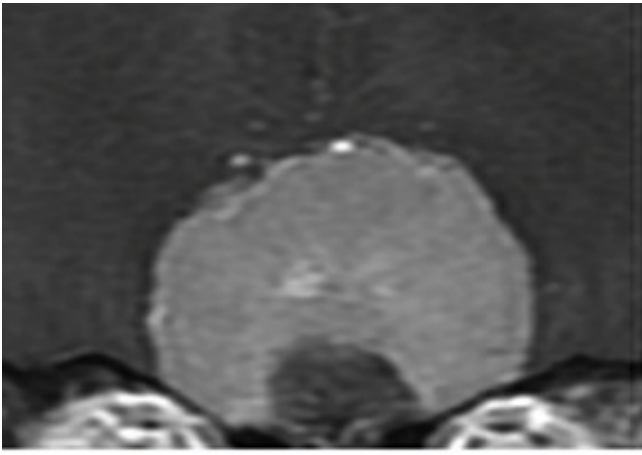
Figure 12: A large olfactory groove meningioma with ethmoidal hyperostosis is shown (first row). The lateral extent of the tumor did not reach beyond the mid portion of the orbit. Partial sphenoidotomy and complete ethmoidectomy were completed (second row). Lamina papyraceas were also removed for access to the lateral poles of the mass. The hyperostotic part of the tumor was resected (third row). The tumor feeding vessels were microsurgically disconnected (fourth row). After the tumor was debulked, the capsule was mobilized away from the invaded pia via cottonoid patties (fifth row). The anterior cerebral artery was found (red arrow) and the tumor was removed (last row).

Closure

The exposure and osteotomy should be conducted with the plans for closure in mind. Cerebrospinal fluid leakage remains one of the unconquered challenges in transnasal skull base surgery.

The anterior skull base defects after removal of an OGM are large, and therefore a number of different methods are necessary to minimize the risk of postoperative CSF leakage. Since the septal mucosa is not invaded by the meningioma and preservation of olfaction is not a consideration, the full extent of the septal mucosa may be elevated and applied for repairing the skull base defect. I often need to supplement the nasoseptal flap with other buttress materials.

Optimally, the large anterior skull base defect is closed using a

multilayered technique. This method involves placement of an intradural fascia lata autograft and an acellular dermal allograft placed between the dura and the bony rim. Free fat graft is used to buttress the edges of the inlay graft. Valsalva maneuvers are used to inspect for any copious CSF leakage before the next step in reconstruction is attempted.

The closure should conclude with rotation and fixation of the bilateral pedicled nasoseptal flaps, stored within the posterior nasopharynx, over the multilayered closure. The flap should extend very anteriorly over the posterior frontal sinus; this need should be considered during elevation of the flap at the start of the procedure. The flap is subsequently held in place with DuraSeal (Covidien, Dublin, Ireland) or fibrin glue to complete the multilayered closure. The surgeon must ensure that none of the sealants flow between the dural closure and the flap because of the risk of loss of flap adhesion.

Postoperative Considerations

The patient is observed in the intensive care unit overnight to allow frequent neurologic evaluations and pain/blood pressure control. The steroid dosage is tapered off within 1 week, depending on the extent of cerebral edema and the patient's neurologic status. Monitoring of urine output and serum sodium allow management of temporary postoperative diabetes insipidus. Standard endonasal precautions are recommended to the patient, including avoiding nose-blowing, use of straws, and unnecessary bearing down.

The lumbar drain is continued for 4-5 days postoperatively. The patient returns to the operating room for further skull base reconstruction if any evidence of CSF leak is suspected.

Pearls and Pitfalls

- Removal of small and medium-size menigniomas via the endonasal route is a reasonable approach, but the procedure is more technically demanding and lengthier than the pterional route. The risk of CSF leakage is significant and appropriate precautions for repair of the skull base defect should be taken.

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DOI: https://doi.org/10.18791/nsatlas.v5.ch06.7

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