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HOW I DO IT - TUMOR - OTHER

How I Do It: Endonasal transethmoidal, transcribriform approach for resection of giant olfactory groove meningioma

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Abstract

Background Olfactory groove meningiomas (OGMs) arise from the cribriform plate of the anterior fossa and account for 9–12% of all meningiomas. Giant OGMs are those larger than 6 cm and are technically challenging to resect.

Method Here we present the surgical decision-making and intraoperative details regarding the endonasal endoscopic resection of an OGM using a minimally invasive, endonasal approach in a 68-year-old female patient.

Conclusion Giant OGMs can be safely and effectively removed using an endonasal, transcribriform approach.

Keywords Meningioma · Olfactory groove · Olfactory groove meningioma · Transcribriform · Endonasal

Abbreviations

OGM Olfactory groove meningioma

Relevant surgical anatomy

Olfactory groove meningiomas (OGMs) can attain very large sizes (> 6 cm) with surprisingly few detectable clinical symptoms because of location and slow progression [2]. The presentation can be uniquely insidious and may include anosmia, headache, and visual disturbances [1, 2].

Key anatomical structures include the anterior and posterior ethmoids and sphenoid sinuses (Video 1, Figs. 1, 2, and 3). The lamina papyracea and the associated lamella are key lateral landmarks. It is sometimes helpful to open the maxillary sinus to clearly see the inferior orbital floor as it transitions to the lamina. The anterior dissection involves the frontal sinus which is opened widely to expose the anterior cribriform plate, the lateral lamella, fovea ethmoidalis, and the posterior table of the frontal sinus. The posterior dissection is the planum or tuberculum sphenoidale. Once the sphenoid sinus is opened, the opticocarotid recess and sella identify internal landmarks. The tumor blood supply includes the anterior/posterior ethmoidal arteries. Early identification and management of the arteries prevent retrobulbar hematomas.

Description of surgical technique

Open surgical approaches are still considered the gold standard [3] but can be cosmetically unfavorable and extensively invasive, with a risk of complications [4]. Alternatively, the endonasal endoscopic transcribriform approach may provide adequate access to the anterior cranial fossa through the cribriform plate and fovea ethmoidalis with reduced risk of frontal lobe retraction or other complications (Video 1, Fig. 3) [4]. Traditional and frontal sinus angled endoscopic instrumentation is required. We also utilize endoscopic bovie and bipolars, an Aquamantys, high speed irrigating 3-mm diamond drill, straight-shaft endoscopic microdissectors, and rotatable instruments. A 0- and 30-degree endoscope are sufficient for this approach.

To begin the surgical approach, a left nasal septal flap based off the posterior septal branch of the sphenopalatine

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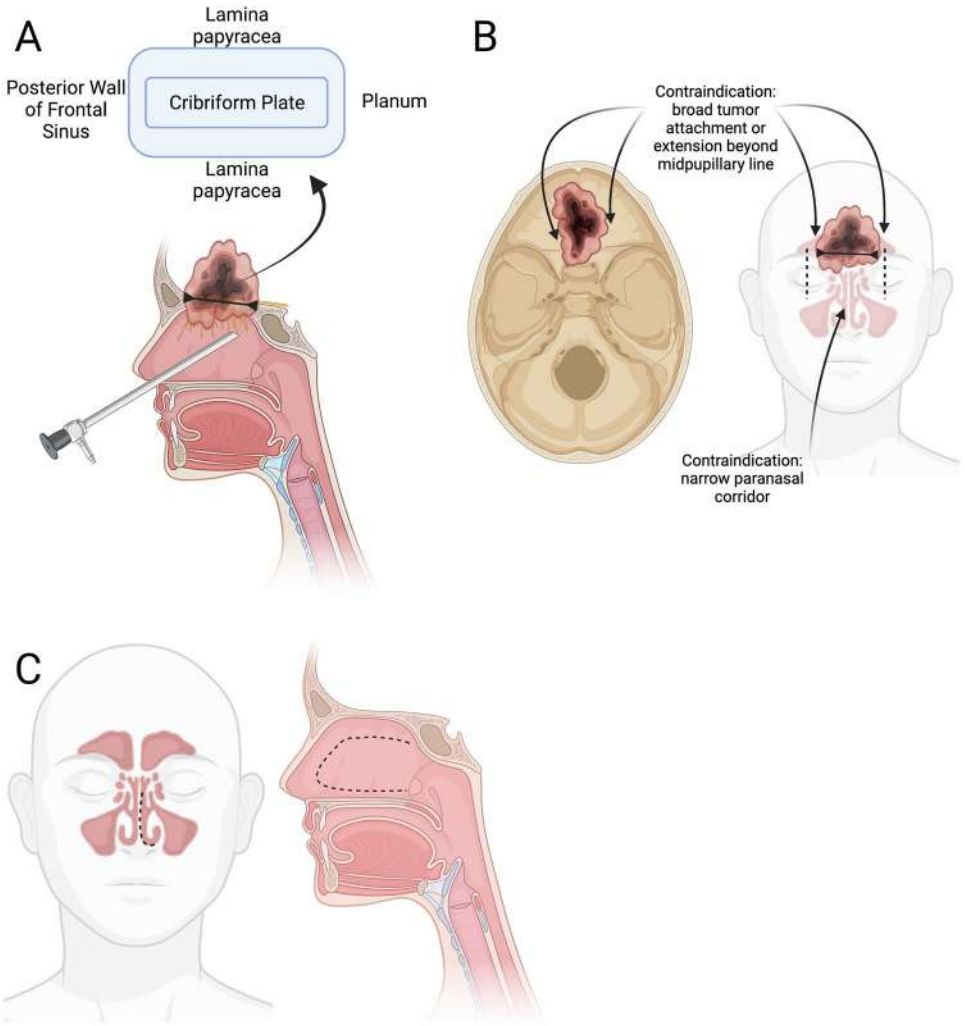

Fig. 1 Endonasal, endoscopic transcribriform approach for resection of an olfactory groove meningioma. **A** A sagittal view with endoscopic approach for an olfactory groove meningioma (OGM) is shown along with a top down schematic (blue rectangle) indicating the borders of the approach. The schematic indicates the borders of surgical exposure required, namely the bilateral lamina papyracea/lateral cribriform plate, posterior wall of the frontal sinus or outflow, and planum/tuberculum sphenoidale. **B** Axial and coronal illustrations demonstrate the main contraindications for an endoscopic approach, namely tumor extension beyond the midpupillary line, tumor extension along a broad lateral base, and a narrow nasal corridor for resection. Not shown is intact smell for a patient. **C** The planned dissection for a nasoseptal flap is shown

artery is raised. Left middle turbinate free mucosal grafts can be harvested. In our case, a left maxillary antrostomy was performed to remove a fungal ball in the left maxillary sinus. Surgical dissection posteriorly though the basal lamella and into the sphenoethmoidal recess exposes the sphenoid sinus face. The sphenoid sinus was entered, and a complete posterior septectomy was performed for wide exposure of the planum and view of bilateral opticocarotid recesses. A total ethmoidectomy is completed from bilaterally from posterior to anterior. A superior septectomy and frontal intersinus septum completes a modified Lothrop procedure. At this point, the entire skull base from the planum to the posterior table of the frontal sinus is visible.

Once the surgical corridor has been prepared, the cribriform plate and fovea ethmoidalis from the frontal sinus to the planum are thinned with a high-speed drill (Figs. 1 and 3). The anterior and posterior ethmoidal arteries are identified and coagulated. In this case, it was noted that the cribriform plate was significantly ossified and sclerotic secondary to tumor invasion. Rongeurs were used to remove the hypertrophied bone and dura laterally until free of tumor.

The tumor invaded through dura and partially protruding through the anterior cranial fossa after bony removal signifying it involved the cribriform dura. The tumor was significantly adherent to the brain bilaterally and medially to the optic nerve where an arachnoid plane could not be identified between the tumor and brain. Microsurgical dissection is used to detach the tumor from the brain as well as the arachnoid bands, enabling the tumor to be mobilized. Engorged veins on the outer surface of the tumor are coagulated and cut sharply whenever possible. The arterial supply to the tumor is nicely devascularized during this approach. Endonasal Aquamantys (Medtronic) electrocautery can be effective in hemostasis. The tumor is then removed piecemeal with sharp dissection and ultrasonic aspiration. Neuronavigation is used throughout the case to ensure adequate extent of resection. After adequately debulking the central portion of the tumor, the attachment sites are identified, and the tumor is mobilized from each

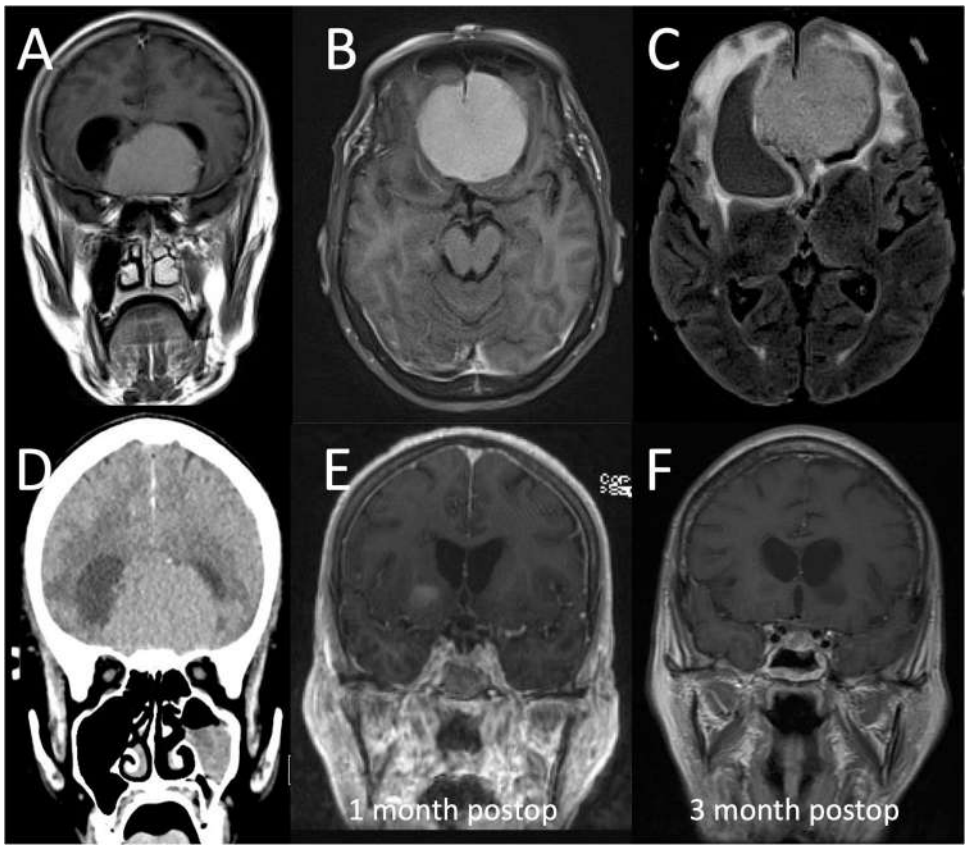

Fig. 2 Imaging demonstrating endonasal transcribriform technique of olfactory groove meningioma (OGM) resection. A 68-year-old female presented with confusion and gait instability after a fall. Imaging revealed a large 5.5 × 5.5 × 4.5-cm anterior fossa tumor suggesting an OGM with significant peritumoral edema and peritumoral cysts. Preoperative **A** coronal and **B** axial T1 MRI scans with contrast demonstrate a large OGM with narrow inferior attachment. **C** T2 MRI scans show significant peritumoral edema in the frontal lobes with associated peritumoral cysts. **D** Coronal CT shows adequate space for endoscopic resection along with left maxillary sinonasal disease. Postoperative **E** 1-month and **F** 3-month coronal T1 MRI scans with contrast show a gross total resection with enhancement along the placed flap. Reduced size of the peritumoral cysts is noted

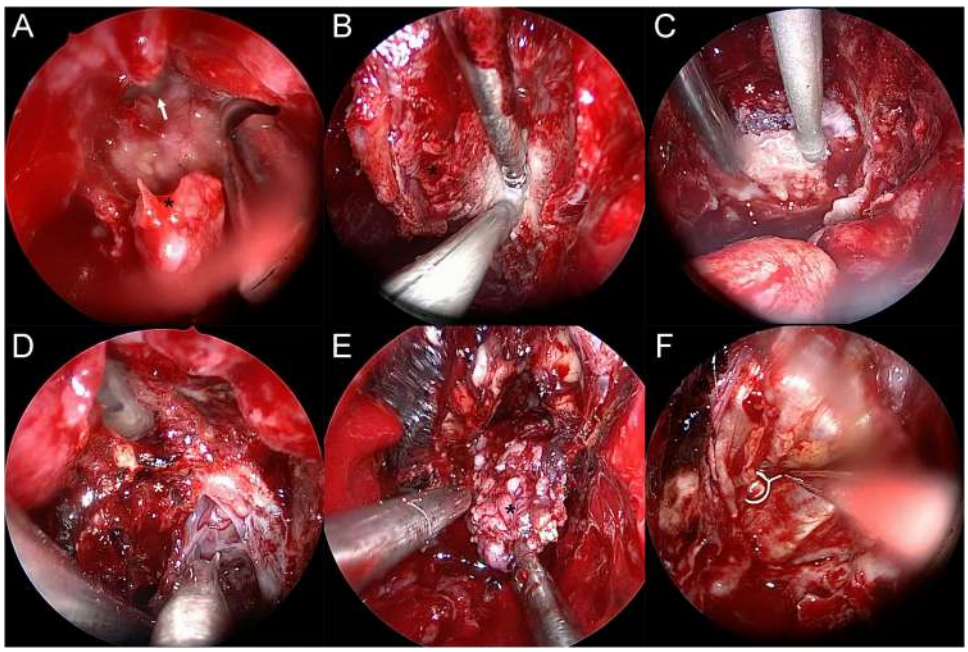

Fig. 3 Intraoperative photos demonstrating the surgical technique of olfactory groove meningioma (OGM) resection. **A** An endoscopic transethemoidal, Draf 3/Lothrup approach is shown with exposure of the frontal outflow (arrow). The anterior aspect of the tumor (*) ends at the posterior wall of the frontal sinus. **B** Dissection of the lateral tumor (*) aspect along the cribiform plate and fovea is shown. **C** Dissection of the posterior margin of tumor (*) along the planum is performed. **D** Sharp microdissection of the tumor away from the infiltrated frontal lobe and debulking are performed until the **E** the tumor (*) can be removed. **F** Fascia lata inlay is shown followed by a nasoseptal flap (not shown)

side while attachments are sharply cut along the plane between the tumor and normal structures. Bimanual and 4 handed techniques are used to traction the tumor away from the brain while it is sharply dissected from critical structures. Cystic portions of the tumor are fenestrated widely. After complete detachment is verified, the tumor is removed en bloc through the nose. Residual tumor along the anterior falx and sagittal sinus are removed. Margins along the lateral attached dura are sent to confirm any potential residual disease.

The defect is repaired using a fascia lata graft as a dural underlay followed by a nasoseptal flap based off the posterior septal branch of the sphenopalatine artery. If the flap does not cover the entire bony defect anteriorly, free mucosal flaps from the middle turbinate can be used. If the frontal sinus mucosa is minimally disrupted and the outflow is not obstructed, it can be left alone and stripping of the mucosa is not required. A combination of fibrin glue and absorbable dressings are used to bolster the flap. If a good repair can be fashioned, we do not use a lumbar drain.

Indications

Approaches used for surgical resection include open and endoscopic techniques [5–9]. Indications for each approach include tumor growth, peritumoral edema, or neurological deficits (e.g., seizures, personality changes, vision dysfunction) (Fig. 2). Because the tumor did not extend beyond the mid-pupilllary line or show significant attachment and the patient lacked a sense of smell, an endonasal approach was suggested.

Limitations

Resection of an OGM during an endoscopic endonasal approach is limited by available lateral access. Giant OGMs extending lateral to the midorbital line on coronal imaging should be carefully reviewed to determine whether an open transcranial/transfacial approach may be more appropriate [4]. Endonasal resection rarely preserves a sense of smell and may be contraindicated in patients with intact sense of smell. The risks/benefits of this approach compared with others should be discussed with a patient [4].

How to avoid complications

Intraoperative navigation and neuromonitoring help avoid critical surgical structures. Early identification and ligation of the anterior and posterior ethmoidal arteries helps minimize blood loss by devascularizing the tumor [4]. CSF leaks remain the most common but occur in < 10% of patients because of modern multilayer reconstruction algorithms [4, 10]. Other complications, including bleeding, infection, and neurovascular injury, may be more common with large OGM [1].

Specific perioperative considerations

Preoperative imaging with MRI and CT is important to aid in resection and patient safety. A full neurological examination should be performed. Postoperatively patients are provided saline nasal irrigations and followed closely to evaluate sinonasal remucosalization.

Specific information for the patient

Counseling of patients involves discussion of the various treatment options, including observation, radiosurgery, and possible surgical approaches. Evaluation of smell and surgical accessibility are key to identify patients in whom an open procedure may be more appropriate. Complications and risks of the procedures should be discussed with the patient.

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Author contribution Conceptualization: Michael Karsy; writing—original draft preparation: Chris Cutler, J. Curran Henson; writing—reviewing and editing: all; supervision: Michael Karsy, Jeremiah Alt.

Declarations

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the (place name of institution and/or national research committee) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication This study was performed in compliance with Institutional Review Board (IRB) and Health Insurance Portability and Accountability Act regulations. Patient consent for publication was not obtained because it is waived per institutional guidelines.

Conflict of interest Michael Karsy receives royalties from Thieme Medical Publishing. Jeremiah Alt is a consultant for GlycoMira, Medtronic, and Optinose and a speaker for GSK. Other authors report no conflict of interest.

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Key points

- Olfactory groove meningiomas are rare and arise from the arachnoid cap cells of the cribriform plate.
- Neuronavigation and intraoperative neuromonitoring are key to safety.
- Endonasal approaches can be used when tumors do not significantly extend laterally along their inferior attachment beyond the pupillary midpoint.
- Open resection results in greater frontal lobe retraction than endonasal approaches; however, endonasal approaches have potentially higher cerebrospinal fluid leak rates.
- Early devascularization of the anterior and posterior ethmoidal arteries aid surgical treatment.
- Dissection of the lateral margin bone/dural area along the cribriform plate, anteriorly to the frontal outflow, and posteriorly to the planum ensure adequate exposure.
- Internal debulking followed by peripheral mobilization and bimanual dissection aids in safe surgical removal.
- A 4-handed technique with 2 surgeons improves resection and safety.
- A multi-part reconstructive algorithm using combinations of fascia lata, nasoseptal flap, free mucosal grafts, and acellular dural substitutes will improve surgical repair and reduce risk of cerebrospinal fluid leak.
- A lumbar drain can be used in situations where only a limited repair could be achieved reduce postoperative cerebrospinal fluid leak rates.