Endoscopic Endonasal Resection of Trigeminal Schwannomas

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KEYWORDS

• Trigeminal • Schwannoma • Endoscopic • Skull base • Transpterygoid

KEY POINTS

- Trigeminal schwannomas may appear anywhere along the length of the nerve.
- The endoscopic endonasal transpterygoid approaches provide a direct trajectory with a minimized risk to the trigeminal nerve, abducens nerve, and carotid artery.
- Significant posterior fossa extension or large (>2.5 cm) tumors may be better suited by an alternative or additional approach.
- Complete resection is curative and should be accomplished without causing additional morbidity.

INTRODUCTION: NATURE OF THE PROBLEM

Although only accounting for up to 0.36% of all intracranial neoplasms and often histologically benign lesions, trigeminal schwannomas (TNs) pose significant challenges in their surgical management.[1,2] TNs can occur anywhere along the course of the trigeminal ganglion, root, and nerve branches; consequently, they can exist in the posterior fossa (PPF), middle fossa/Meckel cave, and extend along V1 into the orbit, V2 into the pterygopalatine fossa, and V3 into the infratemporal fossa (ITF). Additionally, they can be intradural, interdural, and extradural. In addition to their involvement of multiple compartments, the surgical resection of TNs can be complicated by an intimate association with surrounding cranial nerves (ie, abducens nerve) and carotid artery depending on their site of origin along the trigeminal nerve system.

Given the benign histology, a gross total resection can be considered curative, providing patients with the best long-term progression-free and overall survival. Hence, the goal of surgery is considered to be a gross total resection as long as this can be done safely with no neurovascular morbidity. However, radiosurgery is also effective in the treatment of TNs and can be included in the treatment algorithm. In some cases, leaving tumor behind for radiosurgery may be acceptable. A spectrum of surgical approaches has been proposed based on the anatomic extent of the tumor.[1,3,4] For the purposes of approach selection, it is best to classify lesions based on their compartmental involvement. For disease involving the Meckel cave and/or the peripheral V2 and V3 trunks, the endoscopic endonasal transpterygoid approaches provide a direct trajectory with a minimized risk to the trigeminal nerve, abducens nerve, and carotid artery. This idea is based on several publications reporting

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the use of endonasal approaches to Meckel cave in addition to the authors' own experience with this technique for the resection of TNs.[5–8]

INDICATIONS/CONTRAINDICATIONS

The indications for surgical intervention

- Demonstrated growth of a diagnosed tumor on surveillance imaging
- A newly diagnosed lesion with associated symptoms, which would include trigeminal neuropathy (sensory or motor), diplopia related to an abducens nerve palsy, compressive optic neuropathy
- The lack of medical comorbidities that would prohibit surgery and anesthesia

The indications for an endoscopic transpterygoid resection

- Tumor involving the trigeminal ganglion (Meckel cave), V2 trunk (pterygopalatine fossa), and V3 trunk (infratemporal fossa)
- Limited posterior fossa involvement (note, this is a relative contraindication; see later discussion)

The relative contraindications for an endoscopic transpterygoid resection

- There is significant disease extension into the posterior fossa; the risk of sixth nerve injury is elevated within the posterior fossa via an expanded endoscopic approach (EEA) because of the relationship of the trigeminal trunk to the abducens nerve proximal to the Gruber ligament.[9] However, it is possible to remove limited posterior fossa intradural disease safely based on the skill and experience of the surgeon.
- There is involvement of the peripheral V1 trunk in the orbit. Disease within the orbit will ultimately lie above the optic nerve within the apex and is difficult to reach safely via an EEA.
- The tumor size is larger than 2.5 cm within the Meckel cave and middle cranial fossa.
- It is contraindicated in patients with preexisting V1 neuropathy. The slightly elevated risk of vidian nerve injury with a transpterygoid approach can place patients at risk for a postoperative corneal keratopathy if they have diminished corneal sensation.[6,7]

SURGICAL TECHNIQUE/PROCEDURE

Preoperative Planning

- A detailed preoperative neurologic examination should be performed with attention to the function of the involved trigeminal nerve and its divisions, including evidence of corneal anesthesia (V1 neuropathy), numbness in the V2 or V3 distribution, or masseter weakness/jaw deviation (V3 motor dysfunction).[5,6,10]
- Preoperative imaging should include an MRI scan with thin cuts through the skull base. Imaging is assessed for the tumor site of origin and which anatomic compartments are involved. With regard to the endoscopic approaches, tumor extension into the posterior fossa and into the orbit becomes difficult to manage with this approach. Additionally, on coronal imaging, the size of the tumor should be studied; tumors with large middle cranial fossa components may be more suitable for a transcranial approach.
- Although not obtained on all patients, on a case-by-case basis, the authors obtain CT angiography to determine the caliber of the adjacent segments of the internal carotid artery (ICA) (paraclival and cavernous segments). Additional information regarding the bony anatomy can be ascertained to provide an idea of the extent of drilling necessary for the surgical approach.

Preparation and Patient Positioning

- After anesthesia induction and before lumbar drain placement and fluorescein injection, patients are premedicated with dexamethasone (10 mg) and diphenhydramine (50 mg). Lumbar drains are generally used for patients in whom a high-flow cerebrospinal fluid (CSF) leak is expected (ie, patients with intradural tumors). Patients receive 0.25 mL of 10% intrathecal fluorescein (AK-Fluor). Fluorescein is diluted with 10 mL of CSF and administered over several minutes.
- Cotton patties with 4% cocaine are placed into the nose to allow for mucosal decongestion and topical anesthesia.
- After rigid fixation of the patients' head in Mayfield pins, the head is slightly extended and rotated to the right and surgery is commenced. The patients' face and abdomen are prepped and draped in a sterile fashion in case a fat graft is needed.

Surgical Approach for Disease Within Meckel Cave and/or Restricted to V2

- Starting with a rigid 0° endoscope, the uncinate process, vertical lamella of the ipsilateral middle turbinate, and sphenopalatine foramen are infiltrated with 1% lidocaine