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Technical notes & surgical techniques

# Endoscopic transpterygoid approach for resection of trigeminal neurotropic melanoma: Case report and technical note

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ABSTRACT

*Background:* The endoscopic transpterygoid approach to Meckel's cave is an established technique for resection of trigeminal schwannomas. Modern endoscopes provide excellent intraoperative visualization of anatomic structures and relevant pathology while the minimally-invasive nature of the procedure allows for rapid postoperative recovery. Neurotropic melanoma is a rare clinical entity that often involves the head and neck and can lead to cranial neuropathies when nerve invasion occurs. Pathological diagnosis of this lesion can be challenging due to its rarity and lack of classic melanoma markers such as Melan-A and HMB-45.

*Case description:* In this article, the authors describe the endoscopic transpterygoid approach to a neurotropic melanoma involving the maxillary and infraorbital nerves. To our knowledge, this is the first use of this surgical approach for resection of neurotropic melanoma.

*Conclusions:* Endoscopic approaches to the trigeminal nerve allow for safe and effective resection of these lesions. However, a strong understanding of the microsurgical anatomy is necessary prior to such an undertaking.

## 1. Introduction

Neurotropic melanoma is a rare, malignant variant of melanoma that has a propensity for sun-exposed regions of the head and neck. These lesions histologically demonstrate intraneural or perineural invasion and are frequently amelanotic, which can lead to a delay in diagnosis and treatment [1]. Following resection, neurotropic melanoma has a higher rate of local recurrence than other forms of melanoma [1,2]. The facial and trigeminal nerves can be affected by neurotropic melanoma, leading to cranial neuropathies [3–5]. Several cases of melanoma involving metastases to or direct neural invasion of the trigeminal nerve have been described in the literature [3,6–8]. Wide local excision with clear margins is the treatment of choice for neurotropic melanoma [1]. Adjuvant radiotherapy can be required secondary to the difficulty of obtaining wide local margins in the head and neck [5]. Chemotherapy is not routinely used in localized neurotropic melanoma [1].

Minimally-invasive endoscopic approaches to address skull base pathologies have gained favor in recent years. Endoscopy can offer improved intraoperative visualization and less postoperative discomfort for patients. Endoscopic approaches to the trigeminal nerve have previously been described for resection of trigeminal schwannomas [9,10]. In this report, we describe the use of the endoscopic transpterygoid approach for resection of a neurotropic melanoma involving the maxillary division of the trigeminal nerve. To our knowledge, the use of this technique has not been described for resection of this rare pathology.

## 2. Case report

A 73-year-old female without a significant oncological history presented to our neurosurgery clinic with a 6-month history of paresthesias involving the infraorbital, maxillary and nasolabial region on the right and a 3-day history of diplopia. Multiple dental practitioners had evaluated the patient as well as an otolaryngologist who recommended an MRI of the brain, that demonstrated a lesion extending from Meckel's cave on the right into the pterygopalatine fossa and through the inferior

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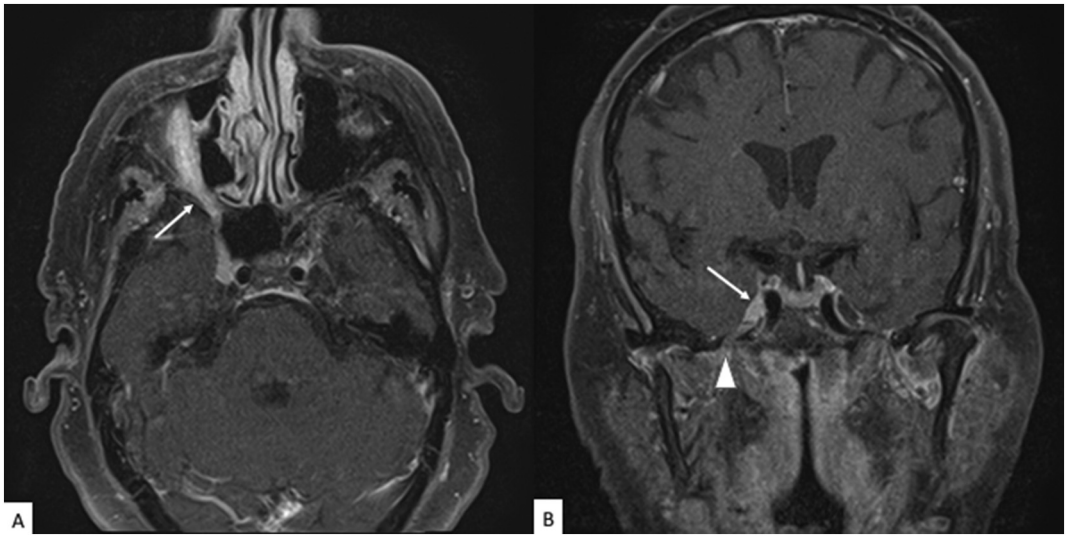


**Fig. 1.** Axial (A) and coronal (B) T1-weighted preoperative MRI images with contrast demonstrating an enhancing lesion along the course of the maxillary and infraorbital nerves (arrows). Careful examination of the coronal image demonstrates additional enhancement through foramen ovale (arrowhead).

orbital fissure. There also appeared to be enhancement extending through foramen rotundum (Fig. 1). On exam, the patient's extraocular muscles were intact and her diplopia resolved with closure of either eye. Facial sensation was diminished in a maxillary distribution on the right. The remainder of her neurological exam was normal. The patient was believed to have a schwannoma of the maxillary and infraorbital nerve but an excisional biopsy was recommended to make a formal diagnosis.

### 2.1. Patient positioning

After general anesthesia was induced, the patient was placed in the supine position on a standard operating table. The patient's head was turned approximately 180 degrees from anesthesia and was placed on a horseshoe. The patient's back was elevated 15 degrees and the head was turned slightly to the right—facing the patient directly towards the surgeons. The bridge of the nose was set parallel to the floor and the operative table was turned to place the patient's ears orthogonal to the surgeon. These maneuvers were performed to maximize surgeon comfort by producing an ideal angle of approach with both surgeons (ENT and neurosurgery) working from the patient's right. The image-guided navigational system was registered and calibrated. This system was used throughout the procedure to confirm known anatomical landmarks as an added measure of safety. Afrin and epinephrine-soaked pledgets were introduced during positioning for decongestion and vasoconstriction to improve hemostasis in the nares bilaterally.

### 2.2. Endoscopic approach to Meckel's cave and tumor resection

Our approach began through the right nare. The inferior turbinate, middle turbinate and nasal septum were anesthetized. The inferior turbinate was fractured and lateralized and the middle turbinate was medialized, providing access to the uncinate process. An uncinectomy was performed and the os of the maxillary sinus was identified. A maxillary antrostomy was performed, followed by an ethmoidectomy. The inferior aspect of the superior turbinate was then removed and the sphenoid os was identified and widened. Finally, a middle turbinectomy was performed to complete the right-sided exposure.

On the left, the inferior and middle turbinates were lateralized and a nasoseptal flap was prepared after the sphenoid os was identified. The sphenoid sinus was opened and a posterior septectomy was performed. Attention was then turned to the right-sided pterygopalatine fossa. The right sphenopalatine artery was identified just posterior to the crista ethmoidalis. This was dissected to the sphenopalatine foramen and ligated. The foramen was widened to open the pterygopalatine fossa. The posterior wall of the maxillary sinus was removed to complete the exposure.

Once in the pterygopalatine fossa, the vidian nerve was identified along the medial pterygoid plate. This was followed to the vidian canal, a reliable marker of the internal carotid artery. The maxillary nerve was noted to be enlarged within the pterygopalatine fossa. The lesion was followed posteriorly to the foramen rotundum and anterosuperiorly to the inferior orbital fissure. After widening the foramen rotundum, continued dissection along the lesion (and the floor of the middle cranial fossa) led to the Gasserian ganglion. The ophthalmic and maxillary divisions of the trigeminal nerve were visualized, and the maxillary nerve was cauterized and divided. The nerve was then dissected free through the inferior orbital fissure using a 70-degree endoscope. Finally, an endoscopic transmaxillary approach (modified Denker's procedure) was performed to free the distal aspect of the lesion. A small incision was made at the level of the piriform aperture to expose the infraorbital foramen, which was noted to be enlarged. The distal branches of the infraorbital nerve were carefully dissected and clipped. The distal nerve was transected and passed back into the antrostomy, and the entire nerve was removed and sent to pathology. (See video)

### 2.3. Postoperative course

The patient's postoperative course was uncomplicated and she was discharged to home on postoperative day number two. Immediately following surgery, the patient noted subjective improvement of her double vision. As expected, she noted new facial paresthesias in a maxillary distribution. Frozen sectioning was performed intraoperatively and the findings were concerning for a metastatic lesion, as such a CT scan of the chest, abdomen, and pelvis was performed, revealing a left adrenal mass, thickening of the appendix and subacute diverticulitis with a possible colonic fistula. Finally, several small lung nodules of uncertain significance were identified. A postoperative MRI was obtained prior to discharge, revealing continued enhancement within Meckel's cave at the level of the Gasserian ganglion, as expected (Fig. 2). Final pathological diagnosis was amelanotic malignant melanoma. A dermatological exam was performed and no primary lesion was identified. The patient received adjuvant fractionated radiotherapy after a final diagnosis was made (30 Gy in 10 fractions).

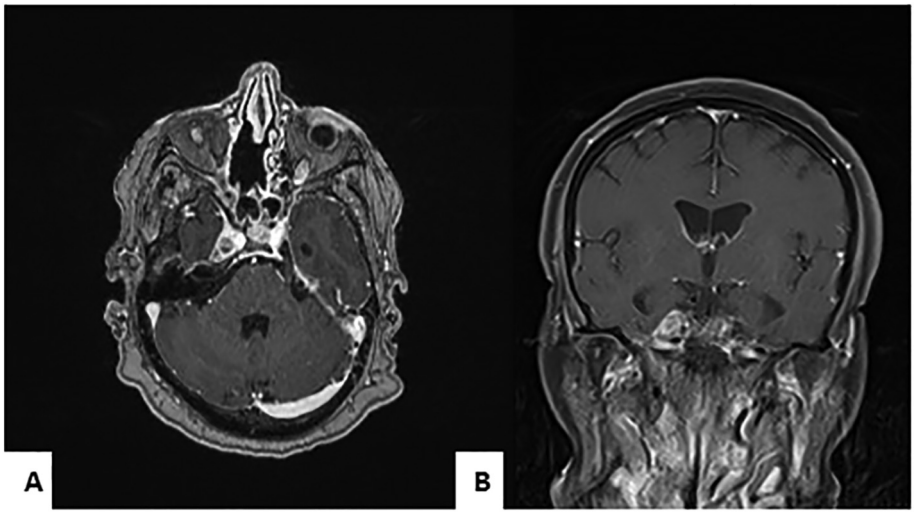


**Fig. 2.** Axial (A) and coronal (B) T1-weighted postoperative MRI demonstrating continued enhancement within Meckel's cave and expected postoperative changes.

### *2.4. Neuropathology*

Pathological evaluation revealed a predominantly intraneural neoplastic proliferation with marked enlargement of the nerve fiber bundles. The prominent lymphoplasmacytic infiltration, particularly in the epineurium, initially suggested an inflammatory process (Fig. 3A). The tumor was composed of large spindle-shaped and epithelioid cells with nuclear pleomorphism and pale eosinophilic cytoplasms (Fig. 3B, C). Mitoses were present and the Ki-67 labeling index was high. An extensive differential diagnosis was considered. Immunohistochemical stainings revealed that the tumor cells were strongly positive for vimentin, S-100 protein (Fig. 3F) and SOX 10, but were negative for Melan-A and HMB-45 (Fig. 3D, E). INI-1 was retained. Although the possibility of a malignant peripheral nerve sheath tumor could not entirely be ruled out, the diagnosis of malignant melanoma was favored.

## 3. Discussion

### *3.1. Review of relevant trigeminal nerve anatomy*

The trigeminal nerve exits the anterior pons at the level of the middle cerebellar peduncle as portia major (sensory fibers) and portia minor (motor fibers). After traversing the prepontine cistern, the trigeminal nerve enters Meckel's cave posterolateral to the cavernous sinus where portia major forms the Gasserian ganglion. The Gasserian ganglion gives rise to the three divisions of the trigeminal nerve. The ophthalmic division enters the lateral wall of the cavernous sinus and courses anteriorly through the superior orbital fissure, providing sensory innervation to the nose, eye and forehead. The maxillary division leaves the Gasserian ganglion and traverses below the dura of the middle cranial fossa. The maxillary nerve passes below the junction of the medial and lateral walls of the cavernous sinus at the inferior aspect of the ophthalmic division [11]. It does not enter the cavernous sinus

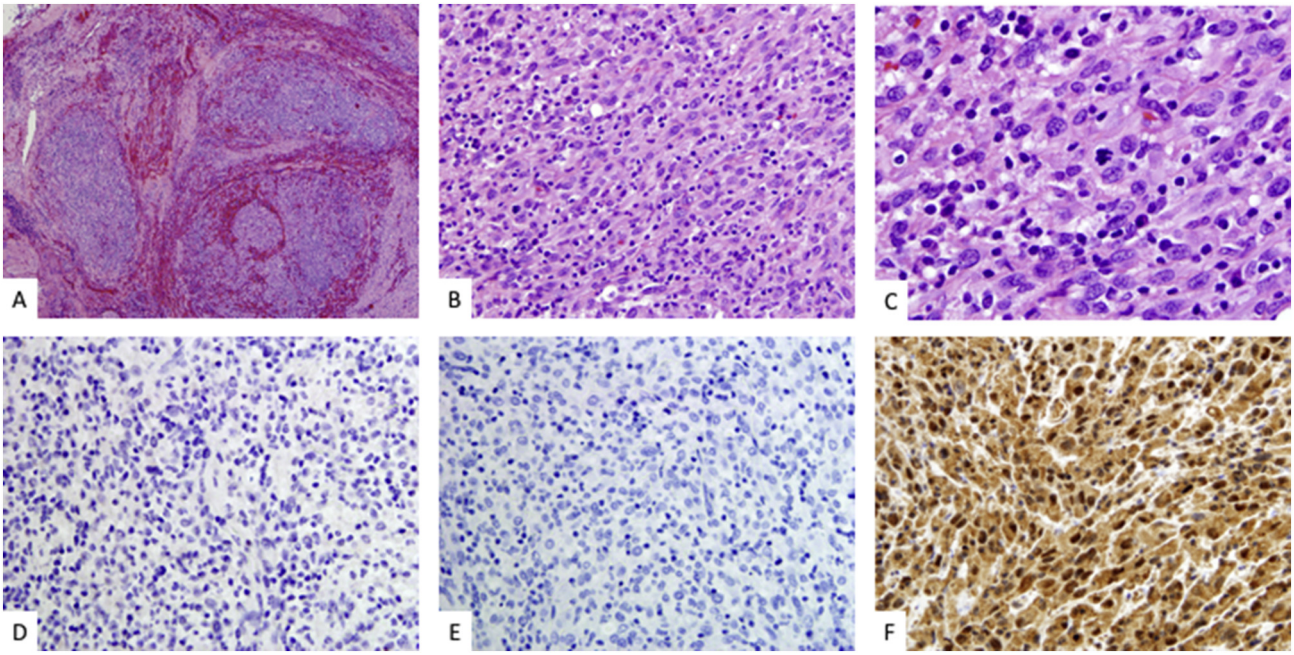


**Fig. 3.** Neurotropic malignant melanoma. A. Well-circumscribed neoplastic proliferation predominantly within the confines of the epineurium. Note the dense epineurial fibrosis and the associated small mononuclear inflammatory cell infiltrate (H&E, x20); B and C. Diffuse tumor cell infiltrate with spindle and epithelioid morphology, nuclear pleomorphism and mitoses (H&E, x100 and x400); D. HMB-45, x100; E. Melan-A, x100; F. S100 protein, x100.

[11]. As the maxillary division courses anteriorly it gives rise to the meningeal nerve, which provides sensory innervation to the dura of the middle cranial fossa, then it exits the skull base through foramen rotundum into the pterygopalatine fossa, where it divides into several branches [11]. These include the ganglionic branches to the pterygopalatine ganglion, the zygomatic nerve, the posterior superior alveolar nerves, and the infraorbital nerve [11]. The infraorbital nerve traverses the inferior orbital fissure before entering the infraorbital groove and canal, where it gives rise to the anterior and middle superior alveolar nerves [11]. After traversing the infraorbital canal, the infraorbital nerve exits the infraorbital foramen and provides sensory innervation to the inferior eyelid, the lateral aspect of the nose, the anterior aspect of the cheek, and the skin and oral mucosa of the superior aspect of the mouth [11]. Finally, the mandibular division of the trigeminal nerve leaves the Gasserian ganglion and is joined by the motor fibers of portia minor prior to exiting through foramen rotundum into the infratemporal fossa. The mandibular division provides motor innervation to the muscles of mastication, the mylohyoid, the anterior belly of the digastric, tensor veli palatini and tensor tympani [11]. In addition, the mandibular division provides sensory innervation to the inferior aspect of the face, the lower teeth and oral mucosa, part of the ear and the temple [11].

### 3.2. Anatomical relationships of the pterygopalatine fossa

A complete understanding of the challenging anatomical relationships found within the pterygopalatine fossa is needed to safely perform a transpterygoid approach for a lesion in Meckel's cave. The borders of the pterygopalatine fossa include the following: pterygoid process and the sphenoid posteriorly, the perpendicular plate of the palatine bone anteromedially, the maxilla anterolaterally, the pterygomaxillary fissure laterally, the inferior orbital fissure superiorly and the palatine process inferiorly. The maxillary nerve enters from the middle cranial fossa through foramen rotundum on the posterior wall. The vidian canal (pterygoid canal) is medial to foramen rotundum on the posterior wall of the fossa. The vidian canal communicates with foramen lacerum and transmits the vidian nerve, artery and vein [11]. The vidian nerve is formed from the joining of the greater superficial petrosal nerve (taste fibers from the palate as well as preganglionic parasympathetic fibers from the superior salivary nucleus) and the deep petrosal nerve (postganglionic sympathetic fibers from the superior cervical ganglion) [11]. The vidian nerve terminates in the pterygopalatine ganglion, which then sends postganglionic parasympathetic fibers along the zygomatic branch of the maxillary nerve to the lacrimal gland [11]. The vascular structures of the fossa, including the internal maxillary artery, sphenopalatine artery, the descending palatine artery and the posterosuperior alveolar artery, are found in the anterior compartment of the fossa while the nerves and pterygopalatine ganglion are found within the posterior compartment.

The pterygopalatine fossa communicates with several skull base and maxillofacial structures. The pterygomaxillary fissure along the lateral aspect of the fossa communicates with the infratemporal fossa. The fossa communicates superiorly with the orbit through the inferior orbital fissure and transmits the inferior orbital nerve and the zygomatic branch of the maxillary nerve. The palatovaginal canal provides communication between the fossa and the nasopharynx medially while transmitting the pharyngeal branch of the maxillary nerve [11]. The greater and lesser palatine nerves from the pterygopalatine ganglion leave the fossa through the greater and lesser palatine foramen to enter the oral cavity [11]. The nasal branches of the maxillary nerve leave the fossa through the sphenopalatine foramen.

### 3.3. Anatomical considerations for the endoscopic transpterygoid approach to Meckel's cave

The endoscopic approach to the ptertygopalatine fossa and Meckel's cave has previously been described [9,10,12,13]. This approach is less invasive than other surgical techniques for resecting maxillary nerve lesions while providing excellent visualization within the pterygopalatine fossa. Relative contraindications to this approach include extension of the lesion of interest into the posterior fossa, peripheral involvement of the ophthalmic division of the trigeminal nerve, preexisting ophthalmic division neuropathy (increased risk of corneal keratopathy with diminished corneal sensation and subsequent injury to the vidian nerve) and tumors larger than 2.5 cm [10].

We prefer the binarial approach to optimize working angles while maximizing exposure. As performed in our patient, the pterygopalatine fossa can be identified by removal of the posteromedial wall of the maxillary sinus. The crista ethmoidalis is used to identify the sphenopalatine artery, which passes through the sphenopalatine foramen [14]. Opening this foramen allows access to the pterygopalatine fossa. The artery may need to be sacrificed to maintain hemostasis during the dissection. For this reason, we prepare our nasoseptal flap on the contralateral side. The orbital process of the palatine bone is removed for complete visualization of the fossa [13]. Once in the fossa, the vidian nerve can be identified at the junction of the medial pterygoid plate and the sphenoid sinus [13]. This is a landmark for the internal carotid artery [13]. Removal of the medial pterygoid plate is performed to gain access to the lateral aspect of the sphenoid sinus if further medial exposure is needed, as in the above case [13].

### 3.4. Pathology of neurotropic melanoma

Making the diagnosis of neurotropic melanoma, also known as desmoplastic neurotropic melanoma, can be difficult. Classic melanoma markers Melan-A and HMB-45 are often negative [15]. In this case, the degree of S-100 and SOX 10 positivity was felt to be more consistent with melanoma than a malignant peripheral nerve sheath tumor. Finally, the presence of both large epithelioid cells and spindle cells is more suggestive of melanoma than malignant peripheral nerve sheath tumor [15].

## 4. Conclusion

Neurotropic melanoma can present a diagnostic challenge for surgeons as well as pathologists. This rare clinical entity is generally found within the head and neck and can involve the trigeminal nerve. Endoscopic approaches to the trigeminal nerve allow for safe and effective resection of these lesions. However, a strong understanding of the microsurgical anatomy is necessary prior to such an undertaking.

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