The Endoscopic Endonasal Approach for Removal of Petroclival Chondrosarcomas

Leo F.S. Ditzel Filho, MD[a], Daniel M. Prevedello, MD[a,b,*], Ricardo L. Dolci, MD[b], Ali O. Jamshidi, MD[a], Edward E. Kerr, MD[a], Raewyn Campbell, MD[b], Bradley A. Otto, MD[a,b], Ricardo L. Carrau, MD[a,b]

KEYWORDS

• Endonasal • Endoscopic • Chondrosarcoma • Petroclival • Skull base

KEY POINTS

- Skull base chondrosarcomas are locally aggressive and arise from the petroclival synchondrosis to involve multiple surrounding regions.
- Despite local aggressiveness, they often "respect" the dura, displacing rather than transgressing it like other skull base malignancies.
- Although the dura is often intact at the end of tumor resection, elevating a vascularized nasoseptal flap is still a key portion of the procedure to protect the exposed internal carotid artery (ICA).
- A standard wide transsphenoidal approach is coupled with other modules of the expanded endoscopic endonasal approaches, according to tumor characteristics.
- From its main component in the petroclival synchondrosis, the tumor may be "followed" into the cavernous sinus, Meckel's cave, the middle and posterior cranial fossae, and the craniovertebral junction.
- Removal of the posterior wall of the maxillary sinus grants access to the pterygopalatine fossa; locating the vidian nerve within it and tracing its path posteriorly will lead to the foramen lacerum and the transition between the petrous and paraclival portions of the ICA.

INTRODUCTION

Chondrosarcomas of the skull base are rare, locally invasive tumors that typically arise in the petroclival region, from degenerated chondroid cells located within the synchondrosis.[1–3] Given their usually slow growth rate, they are capable of reaching sizable dimensions, promoting bone erosion and significant displacement of neurovascular structures before causing symptomatology that will eventually lead to diagnosis; cranial neuropathies and headaches are common complaints. From the petroclival region, they may invade the upper clivus and cavernous sinus superiorly, Meckel's cave and the medial middle cranial fossa laterally, the posterior cranial fossa medially and posteriorly,[2] and the craniovertebral junction inferiorly. Moreover, chondrosarcomas have been shown to spill into the infratemporal fossa and the high cervical region, infiltrating the jugular foramen and even

[a] Department of Neurosurgery, Wexner Medical Center, The Ohio State University, 410 West 10th Avenue, Columbus, OH 43210, USA; [b] Department of Otolaryngology–Head & Neck Surgery, Wexner Medical Center, The Ohio State University, 410 West 10th Avenue, N-1049 Doan Hall, Columbus, OH 43210, USA
* Corresponding author. Department of Neurological Surgery, Wexner Medical Center, The Ohio State University, 410 West 10th Avenue, N-1049 Doan Hall, Columbus, OH 43210.
E-mail address: Daniel.Prevedello@osumc.edu

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the jugular vein. Despite this local aggressiveness, these lesions often spare the dura, compressing and displacing rather than transgressing it. This behavior, coupled with their ability to affect multiple cranial compartments simultaneously, renders the ventral transnasal corridor particularly appealing for their surgical management. Due to their ventral trajectory, potential advantages of endoscopic endonasal approaches (EEAs) include the possibility of accessing multiple skull base compartments, even bilaterally, in a single procedure while avoiding retraction or manipulation of neurovascular structures; this is exceptionally displayed during endonasal resection of chondrosarcomas.[2,4–6]

Hence, herein the authors describe their indications, contraindications, surgical technique and anatomy, complication management, and perioperative care for the endoscopic endonasal resection of skull base chondrosarcomas. Nevertheless, one must be aware that this is a heterogeneous group that may present in a wide variety of scenarios; thus, we will focus on describing the rationale behind surgically addressing those lesions located mainly in the petroclival region with involvement of neighboring compartments.

INDICATIONS/CONTRAINDICATIONS

For indications and contraindications please refer to **Table 1**.

SURGICAL ANATOMY

The surgical anatomy of the petroclival region and its surroundings,[7–10] as well as of the related endonasal approaches,[11–17] has been described. The key landmarks and structures from a ventral perspective are illustrated in **Fig. 1**.

SURGICAL TECHNIQUE

Preoperative Planning

All patients undergoing endonasal resection of a petroclival chondrosarcoma are submitted to the following:

- Anesthesia evaluation with nasal swab and culture; all patients are treated on the morning of surgery with a single nasal application of a povidone-iodine solution at 5% (3M, St. Paul, MN); if positive for methicillin-resistant *Staphylococcus aureus* (MRSA), the patients also receive vancomycin during induction.
- Magnetic resonance imaging (MRI) of the brain and computed axial tomography (CT) scan, both thinly sliced (<3 mm) and fused for intraoperative navigation. Special attention is given to the relation of the tumor to the different segments of the internal carotid artery (ICA); this characteristic will ultimately dictate which EEA modules must be performed during tumor resection.
- Otolaryngology evaluation, to detect sinonasal abnormalities, especially signs of infection.
- Evaluation by the speech therapy/swallowing disorders team in case of jugular foramen involvement.
- Audiometry in case of involvement of the cerebellopontine angle, internal acoustic canal and/or cranial nerve VII/VIII complex.

Preparation and Patient Positioning

Preparation

- General anesthesia with orotracheal intubation.
- Prophylactic antibiotics: cefepime if MRSA negative, cefepime and vancomycin if positive.
- Urinary catheter placement.
- Copious nasal irrigation with oxymetazoline hydrochloride solution and facial/nasal decontamination with iodine solution; the abdomen and the right thigh are also prepped in case fat or muscle grafts are necessary, respectively.
- Insertion of intraoperative monitoring needles according to tumor characteristics (cavernous sinus/cerebellopontine angle/jugular foramen involvement).
- The navigation tower and at least 2 monitors are positioned according to the otolaryngologist's hand dominance (**Fig. 2**).

Table 1
Indications and contraindications

	Contraindications	
Indications	**Relative**	**Absolute**
• Petroclival chondrosarcoma with or without extension into adjacent compartments	• Presence of sinonasal infection[a]	• Clinical instability that prevents general anesthesia • Lack of appropriate personnel and/or equipment

[a] Treat for 3 weeks (if bacterial) or 6 weeks (if fungal) before proceeding with endonasal surgery.