

## A brief review of skull base chordomas

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### Abstract

Skull base chordomas are slow growing neoplasms usually located along the midline. They display a locally invasive nature with possibilities of extracranial metastasis. Presentation is usually late and depends upon the location and extent of the tumour. Management aims at gross total resection via open microsurgical or endoscopic approach followed by adjuvant radiotherapy. Prognosis may be good for the classical and chondroid subtypes but remains poor for de-differentiated type.

**Keywords:** Chordoma, skull base, surgical management, radiotherapy.

**DOI:** 10.47391/JPMA.23-103

### Introduction

Chordomas located in the skull base are an unusual group of bone neoplasms that arise from the primitive notochordal tissue and despite being histologically benign, possess a high propensity for local recurrence. The preferred treatment option is gross total surgical resection via open (microsurgery) or endoscopy, followed by adjuvant radiation therapy. The decision regarding the choice of surgical approach still lacks consensus as both open and endoscopic surgical approaches have shown certain advantages and limitations in achieving optimal and long-term disease control.

### Review of literature:

Chordomas are rare, representing 1-4% of all bone tumours, with an overall incidence of 0.8 per million.<sup>1-3</sup> They arise from the embryonic remnants of the primitive notochord and may be found anywhere along the neuroaxis, but typically the skull base and spine.<sup>1-3</sup> Skull base chordomas account for 0.1-0.2% of all intracranial tumours and 35% of all chordomas.<sup>1,4,5</sup> They are usually located around the sphenoid-occipital synchondrosis involving the clivus, petroclival region, sella, parasellar region, or the craniovertebral junction.<sup>3,4</sup>

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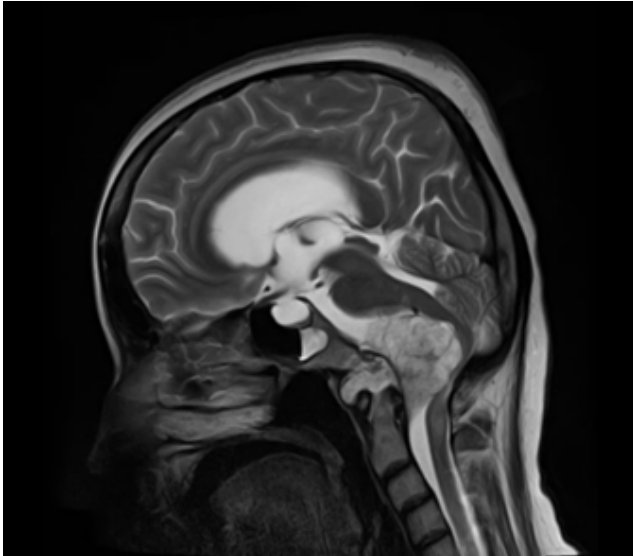
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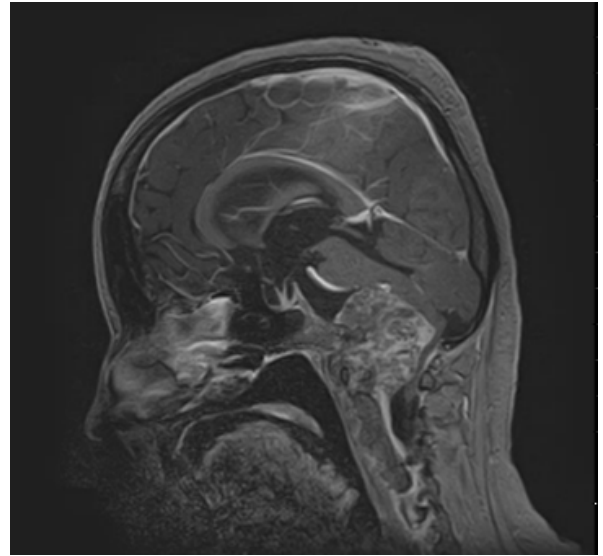
Chordomas are divided into three histopathological subtypes: Classical or conventional chordomas, chondroid chordomas, and de-differentiated chordomas, which determine the prognosis of these tumours.<sup>1,6</sup> Conventional chordomas are composed of clear vacuolated cells known as "physaliphorous cells" suspended in a mucous-myxoid matrix but lack any mesenchymal or chondroid differentiation.<sup>1</sup> Chondroid chordomas, on the other hand, have hyaline cartilage-like stroma containing physaliphorous cells.<sup>1,6</sup> The de-differentiated type possesses a sarcomatoid differentiation and malignant mesenchymal component.<sup>1,6</sup> Prognosis is generally favourable for the first two types, with a three-year overall survival of 90%, but poor for the de-differentiated type, with a three-year overall survival of 60%.<sup>1</sup>

Chordomas possess an osteodestructive nature and display invasive local growth with high rates of locoregional recurrence and possibilities for extracranial metastasis.<sup>1,2</sup> Skull base chordomas typically arise in the midline and may invade the cavernous sinus, petroclival region, cerebellopontine angle, infratemporal fossa, parapharyngeal space, prepontine cistern, foramen magnum, and the temporal bone.<sup>1,6</sup> The mean age at diagnosis is between 5th to 6th decades of life with an equal gender distribution.<sup>1,3</sup> Presentation is usually late, owing to slow growing nature of the tumour.<sup>1,5,6</sup> Headache, predominantly occipital or retro-orbital is the most common presenting symptom followed by ocular symptoms, cranial nerve deficits, and symptoms pertaining to cerebellar dysfunction, brainstem involvement, or pituitary dysfunction.<sup>1,5,6</sup>

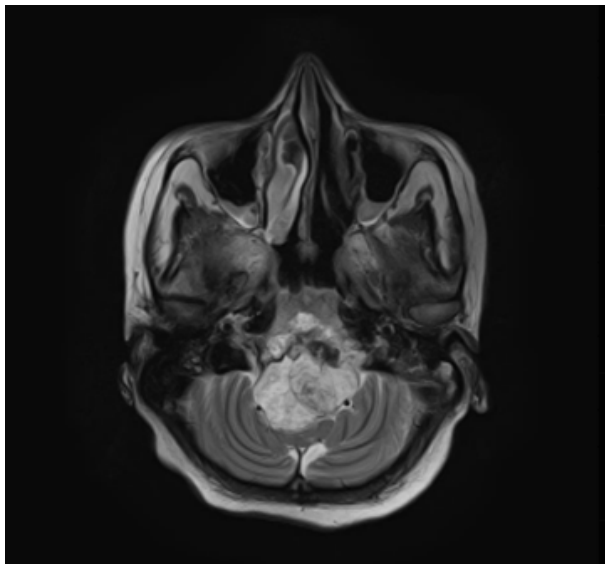
Computed Tomography scans (CT scans) and Magnetic Resonance Imaging (MRI) are used for the diagnosis, and preoperative surgical planning.<sup>1,5,6</sup> Chordomas usually appear hypo to isodense on CT scans and demonstrate lytic bone destruction, compression of surrounding brain parenchyma, and occasional dystrophic calcifications.<sup>1,5</sup> Significant enhancement is seen on contrast CT scans.<sup>1,5</sup> MRI is considered the best investigation to delineate the extent of the tumour. On T1 weighted MRI sequences chordomas appear hypo to isointense and may demonstrate small hyperintense foci representing intratumoural haemorrhages.<sup>1,5</sup> They are typically hyperintense on T2-weighted sequences and show



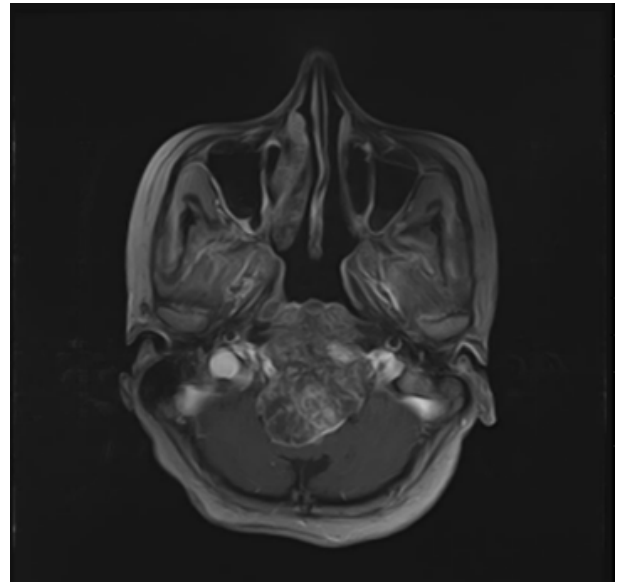
**Figure-1a:** Sagittal section T2 weighted MRI showing a hyperintense skull base chordoma.



**Figure-2a:** Sagittal section of T1 post-contrast MRI sequence.



**Figure-1b:** Axial section T2 weighted MRI showing a hyperintense skull base chordoma.



**Figure-2b:** Axial section of T1 post-contrast MRI sequence.

heterogenous enhancement (honeycomb appearance) on T1 post-contrast sequences. (Figure 1 and 2.),<sup>1,5,6</sup> Vascular studies are important to determine vascular anatomy and to identify the encasement of critical vascular structure.<sup>7</sup>

The management of skull base chordomas poses a significant challenge, owing to the location, multicompartmental growth, and the invasive nature of these tumours, which render complete resection virtually impossible in most cases without risking neurological deficits.<sup>1,3,4</sup> The preferred treatment option, therefore, is maximal safe resection (MSR) followed by adjuvant

radiation.<sup>1,3,4,6</sup> Intraoperative neuromonitoring techniques, such as cranial nerve electromyography, somatosensory evoked potentials (SSEPs), and brainstem auditory evoked response (BAER), may be used to delineate the limits of dissection and extent of tumour resection.<sup>7</sup> Surgical options include open microsurgical skull base approaches (anterior or lateral) and endoscopic (midline) approaches.<sup>4</sup> Lesions of the upper clivus may be approached anterolaterally via a frontotemporal or pterional craniotomy, with or without orbitozygomatic osteotomy, and accessed via subtemporal, infratemporal, transylvian, anterior sub-frontal, or pterional routes.<sup>1,2,4</sup>

These approaches are essentially intradural and involve extensive drilling of the skull base structures.<sup>4</sup> Mid-clival lesions, located contralaterally, may be approached posteriorly or laterally, via retro-sigmoid, posterior petrosal, combined petrosal, and posterior subtemporal pre-sigmoid-trans petrous approaches.<sup>2,4</sup> For lesions of the lower clivus, posterolateral access via preauricular subtemporal, far lateral, and extreme lateral approaches may be used.<sup>2,4</sup>

Endoscopic approaches are less invasive in comparison to open microsurgery, offer superior visualization of midline structures from sella to craniocervical junction (CCJ), and utilize the anatomic corridors with lesser brain retraction and lesser damage to neurovascular structures of the skull base.<sup>2,4</sup> The extended trans-sphenoidal approach which includes anterior clivectomy, is used for tumours located above the hard palate with lateral extension limited to the internal carotid arteries (ICAs).<sup>7</sup> The transmaxillary approach is used for centrally located tumours involving the nasopharynx and CCJ.<sup>7</sup> The learning curve for endoscopy, however, is steep and they offer limited exposure in tumours with significant lateral extension.<sup>4</sup> Combined microscopic and endoscopic approaches may be useful and can allow better access to skull base in carefully selected cases.<sup>7</sup>

Several studies have compared the outcomes, of open vs. endoscopic approaches, in terms of the extent of tumour resection, rate of recurrence, postoperative complications, and long-term sequelae. The extent of resection (EOR) (total vs. partial), has been found to be significantly associated with the risk of recurrence.<sup>2</sup> Gross total resection (GTR) of tumours, is associated with lower recurrence rates and better overall survival.<sup>2,3</sup> In their meta-analysis of 406 patients, Patra et al., did not find any significant difference between the GTR for endoscopic (38%) vs. open (34%) approaches.<sup>4</sup> Whereas, Baig et al., determined the mean GTR to be better for endoscopic (51.9%) vs. open approaches (41.7%), which was in turn associated with fewer overall complications and lesser rate recurrence (16.1 vs. 36.3%).<sup>3</sup> Cannizarro et al., found the overall recurrence rate for skull base chordomas to be 25.6%. The results of the comparison between open and endoscopic techniques, however, were similar to Patra et al., in being statistically insignificant, except when subgrouped for ages > 40 years (vs < 40 years).<sup>2</sup>

Surgical resection without radiotherapy is associated with a high local recurrence rate.<sup>1,6</sup> High doses of photon radiation (mean radiation dose: 67 Gy), preceded by surgical resection, have remained the mainstay of treatment for years, but the development of newer strategies, such as radiosurgery and proton base radiation

therapy (PBT) have shown better outcomes and are largely substituting radiotherapy.<sup>1-3,6</sup> PBT has shown a mean 5-year local control better than both radiosurgery and photon radiotherapy, however, the mean 5-year overall survival is equal for both PBT and radiosurgery.<sup>3</sup> Moreover, high-dose photon radiation is associated with a risk of damage to surrounding neurovascular structures whereas, PBT, being precise and focused, offers an additional safety advantage, though its cost-effectiveness is still debated.<sup>3</sup>

The prognosis of chordomas depends upon the histological subtype, the extent of resection, and adjuvant radiation therapy.<sup>1-3</sup> The mean overall survival for chordomas after surgery and adjuvant radiation is 6.29 years, while the survival for untreated chordomas is 6-24 months.<sup>1</sup>

## Conclusion

Skull base chordomas require management via adequate surgical resection of the tumour followed by adjuvant radiation therapy. Despite the recent literature favouring minimally invasive endoscopic techniques, certain limitations stress the need for an individualised treatment plan for each patient, based on the extent of the tumour, its proximity to critical skull base neurovascular structures, and the preference of operating surgeons.

**Disclaimer:** None.

**Conflict of Interest:** None.

**Source of Funding:** None.

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