The Role of the Endoscopic Endonasal Route in the Management of Craniopharyngiomas

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Key words
- Craniopharyngioma
- Endoscopy
- Expanded endonasal approach
- Transsphenoidal surgery

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
EEA: Endoscopic endonasal approach

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BACKGROUND: **Craniopharyngiomas represent one of the major challenges of neurosurgery. Surgical management of craniopharyngiomas classically required various transcranial approaches with the transsphenoidal route reserved for very selected cases. With the widespread use of endoscopes in endonasal surgery in the past decade, the extended endoscopic endonasal transtuberculum and transplanum approaches have been proposed as an alternative surgical route for removal of different types of suprasellar tumors, including solid craniopharyngiomas in patients with normal pituitary function and small sella.**

METHODS: **A detailed report is presented of the technique used by the authors for the endoscopic endonasal approach for the resection of craniopharyngiomas. For each type of craniopharyngioma, hints and anatomic "main landmarks" are provided throughout each step of the procedure.**

CONCLUSIONS: **The endoscopic endonasal approach offers advantages in the management of craniopharyngiomas that historically have been approached via the transsphenoidal route (i.e., purely intrasellar or intra-suprasellar infradiaphragmatic, preferably cystic lesions in patients with panhypopituitarism). Use of the "extended" endoscopic endonasal approach overcomes the limits of the transsphenoidal route to the sella enabling the management of different purely suprasellar and retrosellar cystic/solid craniopharyngiomas, regardless of the sellar size or pituitary function.**

INTRODUCTION

The surgical management of craniopharyngiomas is challenging. Complete removal of a craniopharyngioma has been advocated as the most effective treatment (27, 37, 59, 64, 68, 69, 72, 74). Nevertheless, despite the benign nature of craniopharyngiomas, complete surgical removal cannot always be achieved because of the frequent proximity and adhesions of the tumor to vital neurovascular structures. Additionally, craniopharyngiomas can recur even after radical resection. The surgical removal of recurrent craniopharyngioma is even more troublesome because of scar formation and new adhesions (2, 27, 37, 59, 64, 68, 69, 71, 72).

Surgical resection of craniopharyngiomas historically has been performed via different microsurgical transcranial approaches (i.e., subfrontal, frontolateral, pterional) with the transsphenoidal approach, performed with either a microscope or an endoscope, classically restricted to intrasellar or intrasuprasellar subdiaphragmatic tumors (38, 54). The introduction and diffusion of the extended transsphenoidal approach foreseen by Hardy (36) and described by Weiss (70) created a new paradigm in transsphenoidal surgery opening a new corridor to the suprasellar space. The evolution of surgical techniques and technology in recent decades has decreased morbidity and increased effectiveness of transcranial and transsphenoidal approaches (20, 23, 28, 33, 39, 40, 63).

The widespread use of the endoscope in sinus surgery (49, 58, 67) was brought to transsphenoidal surgery for the treatment of pituitary tumors (3, 9). The wider panoramic view offered by the endoscope increased the versatility of the transsphenoidal approach and permitted it to be expanded to different parts of the skull base, allowing the removal of different "pure" supradiaphragmatic lesions (5, 8, 10, 11, 17, 18, 20, 25, 30, 31, 41, 43-45, 48, 51, 53). Because craniopharyngiomas often are infrachiasmatic midline tumors, the endonasal route provides the advantage of accessing the tumor immediately after suprasellar dural opening, without brain or optic nerve retraction and with direct visualization through a straight surgical route (46).

Because the approach has a caudal-cranial orientation and the tumors are basically infrachiasmatic, the original classification of craniopharyngiomas in relation to the chiasm (prefixed or postfixed) could result out of date Kassam et al. (45) drew attention to the relationships between infundibulum and craniopharyngiomas and proposed a new classification identifying 4 categories: type I, preinfundibular; type II, transinfundibular; type III, retroinfundibular; and type IV, isolated third ventricular (not well accessed via endonasal routes).

In this article, we present the surgical nuances based on our experience with the endoscopic endonasal approach (EEA) in the treatment of craniopharyngiomas. We highlight the feasibility of this technique and evaluate its advantages and limits compared with the transcranial and transsphenoidal microscopic approaches.

SURGICAL TECHNIQUE

The EEA is a 2-surgeon, 3- or 4-hand technique performed using a rigid endoscope (0 degrees), 18 cm in length and 4 mm in diameter (KARL STORZ GmbH & Co., Tuttlingen, Germany), as the sole instrument for visualizing the surgical field. At the beginning of the procedure, the primary surgeon is placed at the right of the patient's bed regardless of whether he or she is right-handed or left-handed, with the assistant surgeon on the left side of the patient and the scrub nurse at the level of the patient's legs. Each surgeon looks into a dedicated monitor, adjusted in front of him or her at a personalized height and distance.

Operative Nuances for Standard Craniopharyngioma Surgery

Not every craniopharyngioma that is amenable for removal via the transsphenoidal route requires a so-called extended approach; some lesions can be removed by via a "standard" approach to the sellar region, as for pituitary adenomas (6, 32, 34). The indications for the endoscopic standard approach for removal of a craniopharyngioma are the same as the indications well defined several decades ago for the microsurgical transsphenoidal technique (34). This procedure is reserved for patients with enlargement of the pituitary fossa and preferably cystic extra-arachnoidal infradiaphragmatic tumors (1, 16, 54, 55, 61, 66), intrasellar or with suprasellar (52) and retrosellar (38) extensions, if symmetric and well defined. It is more appropriate in patients with hypopituitarism (55).

The endoscope can provide additional benefit when dealing with such lesions via a standard transsphenoidal route because retrosellar and suprasellar areas are more easily visualized, especially with angled scopes and in cases of prefixed chiasm. The endoscope allows the surgeon to verify the completeness of tumor removal, explore the inner aspect of the cyst wall, confirm removal of cyst contents, and assess the possible presence of cerebrospinal fluid (CSF) leak (**Figures 1–3**) (13).

Operative Nuances for Extended Craniopharyngioma Surgery

The bone over the sella is removed, and the planum sphenoidale is opened anteriorly to the anterior margin of the tumor, which is determined with image guidance. Complete removal of the tuberculum sellae (i.e., the suprasellar notch (21) as seen from the endonasal perspective) including bilateral medial

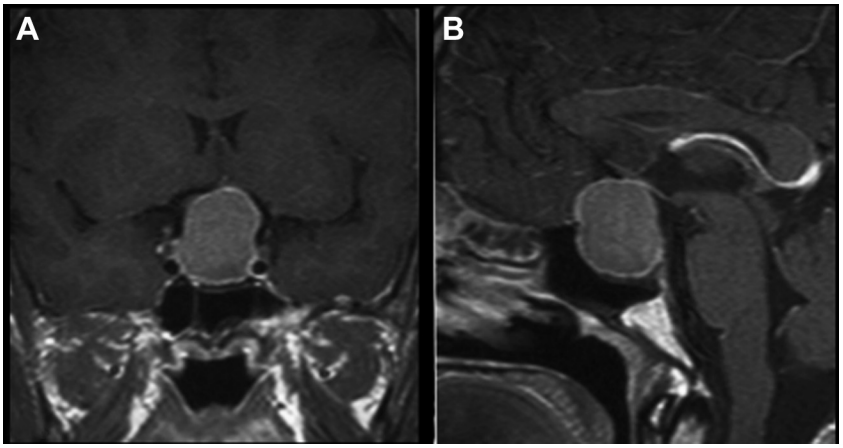

Figure 1. (**A** and **B**) Preoperative magnetic resonance imaging showing an intra-suprasellar, partially cystic craniopharyngioma. The mass extends bilaterally up to the medial wall of both cavernous sinuses and upward, compressing the optic chiasm.

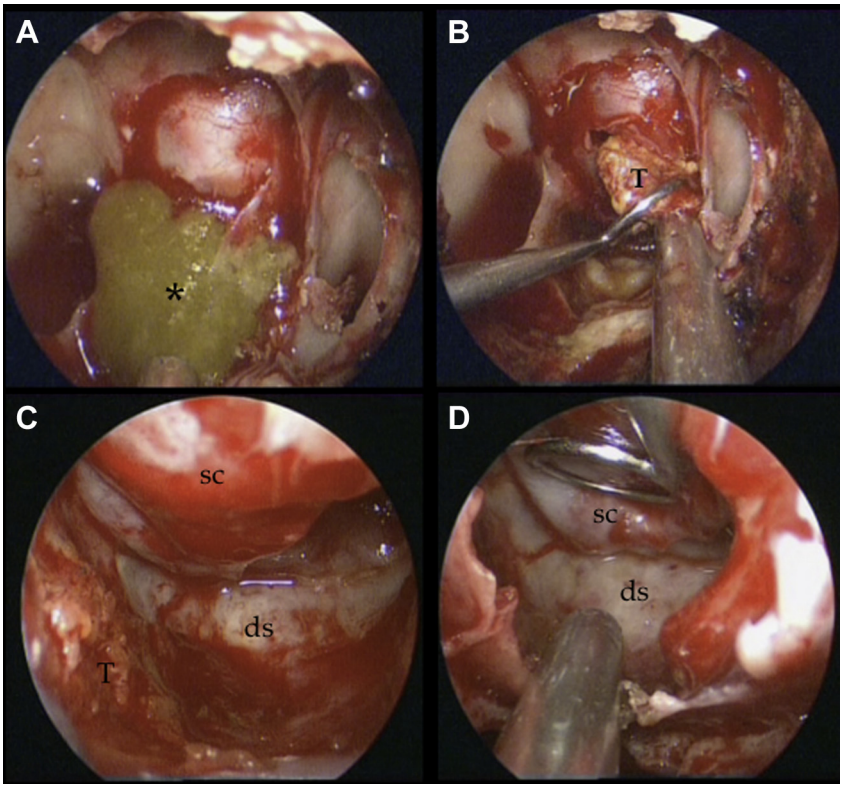

Figure 2. Intraoperative photos. (**A**) On opening of the dura mater, the fluid component ("motor oil") flows out and is drained. (**B** and **C**) Debulking of the solid part proceeds via curettage up to the cavernous sinus medial walls, from which tumor is peeled off. (**D**) After tumor removal, the sellar cavity is occupied by the suprasellar cistern, which, freed from tumor compression, has fallen. The *asterisk* indicates "motor oil" fluid component. T, tumor; sc, suprasellar cistern; ds, dorsum sellae.