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Time to Modify Rather than Discard the Transoral Approach to Selected Cases of Clival Chordomas at the Craniocervical Junction

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Abstract

Maintaining the transoral approach in the armamentarium of surgical approaches to clival chordomas mainly as a complimentary procedure to endonasal endoscopic approach in selected cases is advantageous. Lateral extension of the disease is a limitation to both approaches and is addressed by transcranial approaches. Especially for extensive lesions the simultaneous combination of approaches is based upon the predicted blind spots for each approach and certain technical nuances need to be considered.

Keywords
- clival chordomas
- endonasal endoscopic approach
- transoral approach

Are Transoral Approaches for Craniocervical Junction Tumors Obsolete?

Surgical approaches to clival chordomas in the modern era are predominantly midline endoscopic approaches namely endonasal endoscopic approaches (EEA) and transcranial lateral approaches. Especially with development of endoscopic procedures, few classical approaches have been replaced and are no longer widely used. The disappearance of extensive surgical approaches from the armamentarium of treating these chordomas is also due to several other reasons besides being technically demanding as they may be associated with morbidity and also after better understanding of the biological nature and potential targeted therapy to these tumors.[1] Transoral approaches are advocated for upper cervical vertebral body axial tumors. Advanced chordomas of the lower clivus frequently extend caudally at the craniocervical junction (CCJ) presenting a limitation to the EEA.[2–5]

Although several large surgical series indicated the advantage of the transoral approach to these lesions in these situations,[6,7] here we discuss the exact additional benefit of this approach as complimentary to the EEA and in particular the nuances in achieving maximal benefit and limiting unnecessary morbidity.

Additional Advantages of Transoral Approaches in the Endoscopy Era

For chordomas located in the lower third of the clivus, several series indicated the lower chance of achieving gross total resection (GTR) with the endoscopic approaches and hence inferior long-term tumor control rates.[2,4,5] The lateral limitations of the midline approaches at the lower clivus are the hypoglossal canals and Eustachian tubes.[4] It is unclear in those studies whether it was the impact of lateral extension or clearance of the caudal extension of the tumor that was responsible for the inferior GTR rates.[2]

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Several parameters have been described predicting the limitations of EEA to the inferior extent of the lesion. Kassam and his group described the nasopalatine line projecting to the CCJ as a straight line joining the inferior tip of the nasal bone to the posterior limit of the hard palate on the midline sagittal images.[8] Nevertheless, this predicts the line of view provided by the endoscope, below which a blind spot exists. However, this is an extreme reach for the instruments' manipulation under vision from this approach and hence this inferior limit is even more restricted.

Although it is conceivable to perform a transoral approach for a caudad residual following EEA at a later stage, with careful planning the need for an additional approach can be anticipated and performing both approaches if needed in the same sitting is obviously desirable.

For technical clarification, there are two variations (►**Fig. 1**). These include a classic transoral approach for predominantly localized lesions at the CCJ with additional endoscopic assistance and introduction of the endoscope either via the endonasal or directly through a transoral route. The other is an extended endonasal endoscopic transsphenoidal resection with an additional microscopic (and endoscopic-assisted) transoral approach for more extensive lesions or those with more cranial extension.

The main question is the ability of an entirely endoscopic transoral approach to deal with caudal extent of the lesion. Although the endoscope may provide wide viewing angles, the microscopic transoral approach with the application of the appropriate retractors allows the seamless manipulations by the instruments and resection of the caudal craniospinal extension. Perhaps using curettes to resect chordomas of soft consistency is feasible by transoral endoscopy alone, but still for some caudal extensions, retraction of the tongue, allowing space between the endoscope and instruments, and performance of more demanding steps require a transoral approach as described below. The additional advantages of a transoral approach with microscope assistance are the wider operative view obtained and the ease of closure of the pharyngeal wound using sutures. The transoral microscope assisted approach also allows single surgeon using the high speed burr to resect the cervical vertebral body and potential for stabilization with custom implants through the open approach and also ultrasonic aspiration of tumor with relative ease. Nevertheless, endoscopy assistance is advantageous in many of these cases.

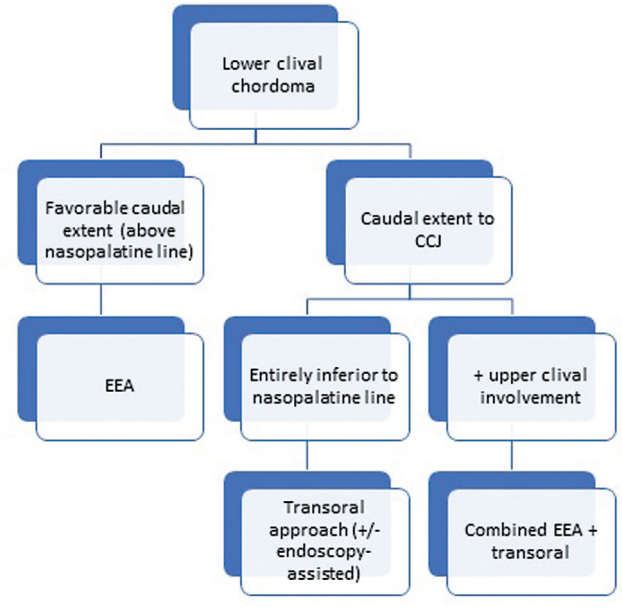

Fig. 1 Algorithm considering the role of transoral approaches for surgical management of lower clival chordomas. CCJ, craniocervical junction; EEA, endonasal endoscopic approach.

Limitations of the Transoral Approaches

Limits of Exposure

However, depending on the incision or flap at the posterior pharyngeal wall usually a relatively wide lateral and craniocaudal exposure is feasible. Nevertheless, the lateral limit of the resection margin is limited at the lower clivus by the hypoglossal canals and possibly the Eustachian tubes, while at the upper cervical spine by the uncovertebral joints and vertebral arteries.

Individual patients' anatomical variations determine the craniocaudal exposure. However, the type of retractors such as a modified transoral retractor that included longer self-retaining pharyngeal retractors and modified soft palate retractors may increase the cranial exposure without incising into the soft palate and special instruments may increase the reach for resections. Again, depending upon anatomical variations, intraoperative fluoroscopy or other image-guidance may possibly reveal that the exposure extends to the C3/4 junction at the anterior cervical spine.

Blind spots using the operating microscopic view beyond the limits of the exposure may be partially overcome by the assistance of angled endoscopes.[7]

Intradural Extension

Although this is not a limitation as such, achieving control of cerebrospinal fluid (CSF) leakage and its potential morbidity requires meticulous attention to details to prevent this. Certainly, long microinstruments when operating amongst the intradural neurovascular structures are selected.

Transoral Approaches as Complimentary Addition to Endoscopic Resections

The extent of lower clival chordomas near the CCJ in the lateral and the craniocaudal directions as well as through the dura determines the selection of the approach and the use of different complimentary approaches as shown in ►**Fig. 2**.

Nuances of Transoral Approaches

Studying the preoperative imaging is important not only for planning the transoral approach but also for selection of additional trajectories as demonstrated in ►**Fig. 2**. Oral and dental examinations are to ensure adequate hygiene and lack of infections and avoid loose teeth dislodgements during placement of the retractor. Pharyngeal preoperative preparation and use of antiseptic mouthwash start 2 days

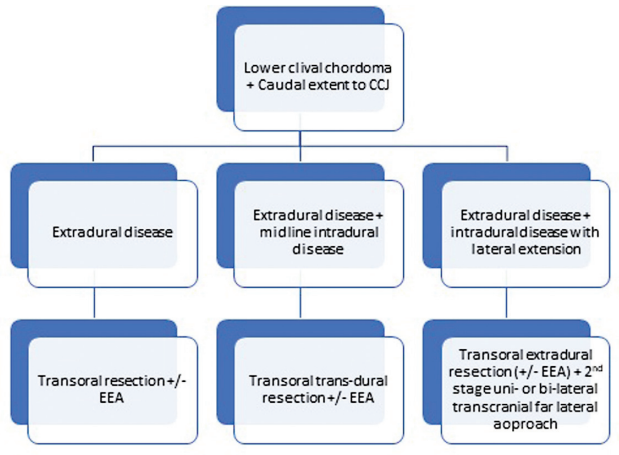

Fig. 2 Considerations for transoral resection of clival chordomas tailored to extent of disease. CCJ, craniocervical junction; EEA, endonasal endoscopic approach.

prior to surgery. The intraoperative oral preparation includes aqueous iodine solution and not alcoholic preparations as cautery is used. Positioning the patient for surgery is supine with head neutral as most of these cases there are no issues with spinal instability, but the anesthetic setup takes into consideration the location of the endotracheal tube such as a south Ring Adair-Elwyn tube (RAE) or alternatively a nasal RAE. Although it may be advantageous to place the nasogastric tube at the start rather at the end with presence of a pharyngeal incision, its placement at the end of the procedure avoids it being in the way during dissection. It also avoids the constant irritation of having to move the nasogastric tube out of the line of sight unless the tube is able to be retracted laterally with the posterior pharyngeal wall mucosa and constrictors muscles when placing the self-retaining pharyngeal wall retractor.

The setup includes the use of image-guidance that can rely on electro-magnetic (EM) as the head is not fixed and some prefer the additional image intensifier to ensure ideal positioning of the retractor. Provision of space is needed for additional monitors besides the image-guidance when endoscopy is used. The intraoperative fluoroscopy can be used if navigation not available or as an adjunct to the navigation and can be positioned under the operating table using primarily lateral fluoroscopy imaging during surgery and does not affect the surgeons position if operating from the cranial end or then switching to a lateral position as surgery dictates. The endoscopic video stack and navigation screens can be positioned to the side of the surgeon at the head of the table on the side opposite to the microscope and likewise with the navigations screens. Operating room assistant scrub staff and instruments can be positioned also opposite to the side of the microscope and along the side of the table and so out of the way of the endoscopic and navigation stack systems (►**Fig. 3**).

Different mucosal incisions and fashioning of flaps on the posterior pharyngeal wall have to be tailored (see modification in the next section) to the configuration of the lesion. Careful placement of the retractor cannot be over emphasized especially in edentulous patients and in the presence of loose teeth (►**Fig. 4**). Retracting the uvula may result in lacerations and frequent adjustment of the retraction during long procedures should be followed to avoid postoperative soft tissue swelling. This part of the retraction depends upon the use of a concomitant EEA (see in the next section).

The endoscope will come in from the side opposite to the microscope and on the side of the operating room scrub staff. This also applies to the high-speed drill used. Drilling with the use of different "guarded" drills provides the exposure as needed and ensures removal of infiltrated bone. The resection is piecemeal and most chordomas are favorably soft or gelatinous in consistency, but this is not always the case especially with recurrent cases or postradiation. For these, careful microsurgical dissection of the neurovascular

Fig. 3 The setup for combined endoscopic endonasal and transoral approach for a craniocervical chordoma.

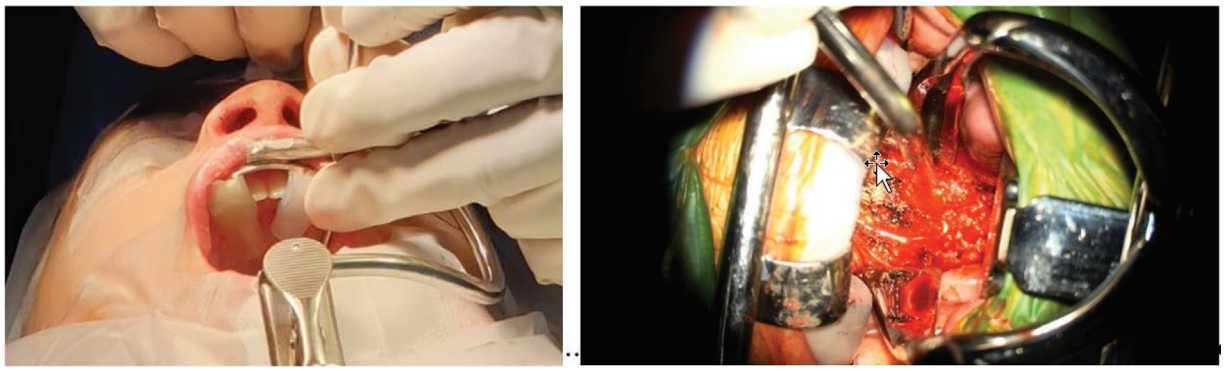

Fig. 4 Application of the retractor for a transoral approach.

structures when these lesions are extending intradurally. Perhaps potentially controversial, for extradural chordomas most would advocate to keep the integration of the dura rather than resecting the dura aiming at improved tumor control but facing the potential morbidity of CSF leakage. Care if possible should be exerted during tumor delivery as seeding and implantation of chordoma cells in the pharynx, oral, or nasal cavity are real.

Closure by absorbable sutures approximates the muscles and careful suturing of the mucosal edges. After care includes nasogastric feeding for a few days followed by soft diet until the incision heals.

Modification of the Transoral Approach Combined with Endoscopy to Enhance Resection and to Limit Potential Morbidities of Transoral Approaches

The initial incision for a "classical" transoral approach is usually in the shape of a semicircular flap in the posterior wall of the nasopharynx. This has to be tailored to individual cases but in cases wherein a superior extension is required, then a linear incision would be amenable for further extension. For those large lesions extending cephalad to the upper clivus, the additional EEA is through a transsphenoidal route and hence the long mucosal incision is fashioned to encompass both approaches. In general, in most cases a linear incision is easier to extend craniocaudal, retract laterally with the pharyngeal self-retaining retractors, and to close with sutures is advantageous.

One of the morbidities of the transoral approach is additional palatal incision and mobilization to improve the trajectory at the cranial end of the exposure. This step should be discarded as further cranial extension is dealt with by the EEA.

In cases of combined transoral and EEA approaches for chordomas with intradural extension, planning for adequate repair against postoperative CSF leak is imperative. It may be feasible to harvest a generous nasoseptal flap to reach caudad and to cover the defect but at least in some cases the inferior end of the incision may be vulnerable and in addition requires a meticulous mucosal repair that may include dural substitutes and sealants.

Future Developments

Tubular Surgery

This has the advantage of directly exposing and approaching the lesion. This is especially for small-sized chordomas. With large tumors, tubular surgery may have some limitations with the surgical field of view and the constant need to change the tube position to access the lateral and cranial caudal edges of the exposure and possibly increased pressure on the tongue resulting in increased tongue swelling in the postoperative phase. Also, special instruments may be required.

Robotic-Assisted Surgery

The use of transoral robotic surgery is emerging technology and technical case reports are starting to appear in the literature.[9]

Conclusions

Maintaining the transoral approach in the armamentarium of surgical approaches to clival chordomas mainly as a complimentary procedure to EEA in selected cases is advantageous. Lateral extension of the disease is a limitation to both approaches and is addressed by transcranial approaches. Especially for extensive lesions the simultaneous combination of approaches is based upon the predicted blind spots for each approach and certain technical nuances need to be considered.

Conflict of Interest
None declared.

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