Navigation assisted Endoscopic surgery for Clival Chordoma

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Rationale

Trans-sphenoid approaches to the ventral midline skull base were first attempted in ancient Egypt.

It was revived last century & restricted to pituitary.

Recent surge of the endoscopic endonasal skull base approaches have expanded beyond the sella.

Controversy of the merits of endoscopy versus radical resection in large or infiltrative tumors ??

De Tommasi C; Vance ML; Okonkwo DO; Diallo A; Laws ER. Surgical management of adrenocorticotropic hormone-secreting macroadenomas: outcome and challenges in patients with Cushing’s disease or Nelson’s syndrome. J Neurosurg 2005 Nov;103(5):825-30.
Advantage of endoscopy

The endoscopic endonasal corridor have extended beyond the midline to include the lateral and clival skull base.

The dynamic property of the endoscopic surgery overcomes the limiting 2D perception. Recent 3D endoscopes.

Improved illumination & angled lenses enhance manipulation in hidden areas involved in chordomas e.g. Meckel’s cave, para-clival ICA, pterygo-palatine or infratemporal fossa.
Frameless stereotaxis

- Intraoperative Frameless stereotaxy provides continuous 3D localization of interactive real-time image guidance with constant monitoring of the surgical instruments.

- It helps to keep a correct surgical trajectory.

- It is a standard technique in different skull base interventions.

- It provides a valuable guidance for the surgeon to increase surgical safety with consequent smooth surgical recovery.
- ElectroMagnetic tracking tracks the position & orientation of instruments in any of three planes
- No line-of-sight restriction
- No modification of surgical technique
- Easily integrates with other equipment & instruments
Objective

Evaluation of electromagnetic frameless stereotactic navigation guidance combined with endoscopy in the management of skull base clivus chordomas

Advantages & limitations will be explored
Simple Clivus Chordoma
Best results

- Maximal resection followed by proton beam irradiation.
- Overall survival is dependent upon local control of disease.
- Prognostic factor for local control of disease is amount of residual tumor after original surgery < 25 cc residual tumor
- Clear margins are achieved in < 50% of Clivus chordomas
- Doses of 70 CGE necessary for control of residual disease.
Radical Surgical Cure?
Brain stem infiltration?
Cavernous sinus affection
Results of aggressive microsurgical resections of Clivus chordoma
Retrospective. 74 patients, aggressive microsurgical resection of cranial base chordomas, 121 procedures.

Primary operation 63%, re-operation 37%. Mean F/U 8 years

Outcome: Gross total resection 72%, subtotal resection 28%, morbidity 32%, alive with disease 50%, died of disease 15%, died of complications 3%.

10-year recurrence free 31% (primary surgery 42% vs reoperation 26%, sign*)

Conclusion: Aggressive microsurgical resection can be followed by long-term tumor free survival, with good functional outcome
Retrospective study in 49 patients.

Transethmoidal approach 36%, pterional 23%, retrosigmoid 23%.

Outcome: GTR 49%, subtotal resection 51%. Initial surgery GTR 78%. 5-year survival 65%, 10-year survival 39%

Morbidity: New neurological deficit 12%

Conclusion: Chordoma cannot be regarded as surgically curable tumors, given the 5- and 10-year
Why don’t we try other options & complimentary team therapy
No surgical limitations exist for endoscopic **transoral** compared to pure endonasal or transcervical approaches.

Zero & 30° angled lenses increase exposure of posterior pharyngeal wall and clivus surgical exposure.

Trans-oral endoscopy with pure **transnasal** endoscopic procedure provides wider linear and angled surgical route.
Endoscopy is a useful complement to the standard microsurgical approach to the anterior CCx junction by transnasal, transoral or transcervical routes.

It provides a better decompression without transfacial ap.

Neuronavigation allows better orientation of surgical field.

Intraoperative fluoroscopy recognizes residual compression.
Size does not limit endoscopy
Neurovascular Infiltration does
Postop, small Clivus chordoma
Postop, small clivus chordoma, another patient
Huge, but extradural
Huge, but extradural
Lateral involvement to jugular foramen
Huge intradural Chordoma
Radical Surgical Cure
Extensive Skull base involvement
Posterior extension to brain stem
Rare Suprasellar extension
Patients and methods

Pure endonasal &/or transoral resection of clivus chordomas was performed during 160 pure endoscopic skull base surgeries.

Combining navigation to endoscopic technique was used in 15 pts.

Redo 2-3 times if de novo symptoms arise.
Endoscopic approach

- Pure Binasal &/or transoral
- No holder, free hand
- 4 hands, may be 6 hands
- Neurosurgeon
- Endonasal surgeon
- Navigator
- Proper repair: fat, Haddad flap, septum, durarpatch
- Radiosurgery
Multimodality Treatment team
Changing Rationale

In our area of the world, most patients present with huge lesions, beyond conventional radical resection.

Neurovascular structure, CSF leak & reconstruction limit both microscopic & endoscopic block resection.

Navigation guidance has increased accuracy of localization & safe resection in skull base tumors (1).

CNs Monitoring is of great help.

Changing Rationale

Endoscopic navigation of safe wide decompression & pathological confirmation allows complimentary use of current effective treatment modalities such as radio-surgery or proton beam radiotherapy.

Re-do is hard to offer to complicated or dead patients.
Safe skull base endoscopy
Problem is Repair & not Resection

Use of equine collagen foil as dura mater substitute in endoscopic endonasal transsphenoidal surgery

Surg Neurol 2006 Feb;65(2):144-8 (ISSN: 0090-3019)

Cappabianca P; Esposito F; Cavallo LM; Messina A; Solari D; di Somma LG; de Divitiis E
Department of Neurological Sciences, Division of Neurosurgery-Universita degli Studi di Napoli Federico II, 80131 Naples, Italy.
Vascularized or artificial material

Need for intrasellar packing in sellar reconstruction of transsphenoidal surgery: Less is more?

J Clin Neurosci 2006 May;13(4):423-7

Chen HC; Lee ST
Department of Neurosurgery, Chang Gung University and Chang Gung Memorial Hospital, 222, Mai-Chin Road, Keelung 204, Taiwan, Republic of China.
Intrasellar, infrasellar, Supra-sellar & Lateral Chordoma

Cavernous sinus, carotid encased, hypothalamus, peduncle, medial temporal lobe, Chiasm

Radical Surgical Cure

???????????
Radical Surgical Cure?  
Brain stem infiltration?  
Cavernous sinus affection
Chordoma: Endoscopic Navigation
Surgical Pearls

- Pedicled nasal septal vascularized flaps presents an excellent solution for CSF leak after surgery.

- Few chordomas invade the dura.

- Fat or other non-vascularized material may interfere with healing or postoperative MRI interpretation.

- Respecting the concept of avoiding CN’s crossing, we can perform safe endoscopic chordoma surgery.
Preop CT

[CT scan images]
Preop MRI, chordoma, cavernous sinus & carotid encasement
Preoperative MRI, Extensive chordoma
2 endoscopic redo + Pterional + Radiosurgery
Postop, extensive chordoma

Resection & repair
Bilateral Carotid encasement

Preop
Conclusion

Removal of large or small chordoma was possible with a high degree of respectability, a low incidence of complication and good functional recovery.

Partial recovery was noted in > 50% survivors.

More resection was associated with the use of navigation controlled endoscopy.
Navigation Assisted Resections

Midline skull base Chordomas, were treated successfully endoscopically with navigation control. Radiosurgery completes the job.
Conclusions

Navigation guided endoscopic surgery of skull base chordoms is an added safe armamentarium in neurosurgical minimally invasive quest to this lesion.

Interactive real-time image guidance with constant monitoring of the surgical instruments in relation to the normal & pathologic structures provides a valuable surgical tool to avoid injurious events.

Radiosurgery completes the risky job of radicalism.
Preop & post op Perimetry, no improvement Lt eye
Pre & post op Perimetry, improvement Rt eye

[Eye chart images]
Marked improvement both eyes