Endoscopic Endonasal Excision of Odontoid Process

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Abstract: Approaching the crano-vertebral junction is a challenging procedure because of its association with the spinal nerves, cranial nerves and the vertebral arteries. The complex anatomy of the cervical joints formed by the occipital bone, atlas and the axis makes the task more complex one. With the advent of the endoscopic approach to address the peg of axis, spinal cord compression at the cervical level can be surgically managed with minimal morbidity. Among the endoscopic approaches, the endonasal approach to the odontoid process provides a straight pathway and is comparatively less morbid than the transoral approach.

I. Introduction-
Endoscopic approach to the CVJ is becoming preferred over open approaches, as it is more precise in attending the site of lesion, without altering much of the normal anatomy during its access. A strict adherence to the midline during the initial mucosal incisions using landmarks such as teeth, hard palate, pillars and tubercle of C1, can prevent much of the complications that occur due to the injury to the vessels and nerves, as they lie either laterally or deep to the odontoid within the dura.

Most of the postoperative complications that occur are due to the injury to the soft tissues encountered during the exposure of the odontoid process. Though the exposure obtained through the transoral route is wider, the soft tissue injury is higher as compared to the endonasal approach. This article reviews the added advantage of the transnasal approach over transoral approach through a case series of five patients from our institute.

II. Role Of Oropharyngeal And Nasopharyngeal Biota In Causing Infection At The Defect Site-
Though there are many studies related to the normal commensals of the oropharynx and the nasopharynx, the difference in their innate propensity to cause meningitis is least studied. The pathogenic microbes of the pharynx are prevented from invasion by the defence mechanism provided by an intact mucosal barrier as well as by the symbiotic relationship between the normal commensals and the host mucosa. In many studies, the risk of infection is found to be more common with an oropharyngeal defect than with a nasopharyngeal defect, and is related to the contamination of the wound with oral secretions containing diverse microbial flora and also from pathogenic microbes present in oral feeds, but there has been no extensive study regarding the difference in infection rate.

In endoscopic surgeries, there is a definite period of time postoperatively for the defect to close, during which the mucosal secretions constantly bathe the surface and interact with the healing process. In midline vertical incisions of the posterior pharyngeal wall in transoral route, an unsutured wound or in cut through of sutures, the healing occurs by secondary intention. During the healing process of such a wound, stagnation of secretions occur as a result of deep and wide wounds and also due to reduced local mucociliary clearance caused by the cautery induced collateral damage to the mucosa. This stagnation predisposes colonization of the wound by pathogenic microbes.

A delay in oral feeding in case of velopharyngeal insufficiency, alters the physiological properties of saliva leading to an altered oral and oropharyngeal microenvironment. The interactions occurring between various bacterial species of the oral cavity promotes a diverse microbial environment which can be contained symbiotically by oral or the oropharyngeal mucosa but not the neuronal structures that are being exposed during the surgery.

These factors increase the rate of infection in transoral approach and is primarily mediated by the velopharyngeal insufficiency. It is important here to note that, there is also nasopharyngeal contamination of oral secretions occurring even in normal individuals as evidenced from direct spread of infection owing to the contiguity. Hence, the reduced incidence of infection and meningitis in transnasal route is related to much less incidence of nasal reflex, and the “U” shaped mucosal flap elevated during the transnasal approach which covers the s
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urological site even without sutures. This technique avoids deep wounds and stasis of secretions and early intake of oral feeds maintaining a healthier microenvironment.

In a study on 13 patients undergoing transnasal approach, Y.S. Yen et al. encountered six cases with meningitis with a turbid CSF. The culture from CSF tap was reported to be Streptococcus pneumonia. This again warrants further study on this aspect as much of the cultures from meningitis is related to staphylococcus aureus and streptococcus pneumoniae and the reports of an anaerobic or mixed infection are rare.

III. Distribution Of Pharyngeal Plexus

The density of pharyngeal plexus has been studied by cadaveric dissection of 7 specimens by Kathryn et al. This study revealed a varying distribution of density of the pharyngeal plexus. The study revealed a significantly lower density of nerves above the palatine plane (p <0.05). The average count below the hard palate was found to be 178.8 nerves/cm³ while that above was 75.4 nerves/cm³. Further, the study revealed a relatively lower density within 1 cm of midline as compared to the lateral aspect of the posterior pharyngeal wall.

This adds to the fact that a strict adherence to midline can maintain the velopharyngeal co-ordination during the swallowing process and more so in transnasal approach where mucosal incisions are superiorly placed avoiding the relatively dense plexus in the region of the oropharynx.

IV. A Case Series In Transnasal Odontoid Excision

<table>
<thead>
<tr>
<th>S.No</th>
<th>Age/sex</th>
<th>Etiology</th>
<th>Symptoms</th>
<th>Duration (months)</th>
<th>Radiological finding</th>
<th>Outcome of trans nasal approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23/m</td>
<td>Spontaneous</td>
<td>paraplegia</td>
<td>3</td>
<td>CVJ compression by odontoid</td>
<td>Started oral feeds by 2nd POD</td>
</tr>
<tr>
<td>2</td>
<td>43/m</td>
<td>spontaneous</td>
<td>Paraplegia</td>
<td>9</td>
<td>CVJ compression by odontoid</td>
<td>Died on 5th POD due to cardiogenic shock</td>
</tr>
<tr>
<td>3</td>
<td>10/f</td>
<td>Accidental fall</td>
<td>paraplegia</td>
<td>10 days</td>
<td>Atlantoaxial Subluxation</td>
<td>Started oral feeds by 2nd POD</td>
</tr>
<tr>
<td>4</td>
<td>22/m</td>
<td>spontaneous</td>
<td>paraplegia</td>
<td>6</td>
<td>CVJ compression by odontoid</td>
<td>By 2nd POD</td>
</tr>
<tr>
<td>5</td>
<td>50/m</td>
<td>spontaneous</td>
<td>paraplegia</td>
<td>8</td>
<td>CVJ compression by odontoid</td>
<td>By 3rd POD</td>
</tr>
</tbody>
</table>

*All these patients underwent posterior fixation on 2nd POD. No CSF leak was encountered in any of our cases.

V. Case Presentation

Endonasal endoscopic excision of odontoid process was done for 5 cases over a period of 1½ years. In this 4 were male, 1 was female. These patients presented with inability to use the limbs over a varying degree of duration of about 1 to 5 months, with gradual loss of limb movements except for 1 female child who presented acutely due to accidental fall. After CT & MR imaging (fig. 1 shows compressive effect of the odontoid on the spinal cord) endonasal endoscopic excision was done by lateralizing inferior tubturinate on both sides using a three handed technique with EMG monitoring of 12 cranial nerve. Posterior wall of nasopharynx raised as a flap using radiofrequency cautery until C1 ring is visualized. This provides an exposure from the floor of sphenoid sinus to the 2nd cervical vertebra. C1 ring is removed with skull base drill using coarse diamond burr. The atlantooccipital membrane over the odontoid was carefully removed to fully expose the odontoid process, which was removed using the same drill and burr from tip to base in a gradual thinning manner. This exposes the dura with its pulsation indicating completion of resection. The defect was packed with collagen sheet and fibrin glue after achieving complete haemostasis.

Patient’s neck was secured in cervical collar. Post-operative CT was done on 1st POD (fig. 2 shows complete removal of the odontoid for the same patient) to check for the complete resection followed later by posterior stabilization of the cervical vertebra on the 2nd POD. Patients were started on oral feeds on the same day of trans nasal surgical procedure. They were given third generation cephalosporins for a period of 10 days. One patient died on the 10th POD due to cardiac failure. Other patients recovered from their weakness gradually over a period of 3 -12 weeks & were able to do their work individually. All these cases were done without image guidance, since it is not available in our institution.

VI. Discussion

Endonasal endoscopic approach to odontoid process offers a straightforward route, without interfering the swallowing mechanism and with a reduced infective rate, unlike in trans oropharyngeal route. The angle of this approach makes it a much simple route towards the odontoid process. The team approach involving neon & ent surgeons offers complimentary advantage in this procedure. Patients were subjected to this approach aft

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er exclusion of sinonasal pathology. With image guidance this procedure will be made more versatile. Moreover, in transnasal approach, there is possibility of preservation of the C1 arch and posterior fixation can be avoided. This is possible due to the craniocaudal approach used in transnasal odontoidectomy. In transnasal approach to the odontoid process:

- Excessive traction over the soft palate is not needed.
- Post procedure velopharyngeal insufficiency requiring swallowing therapy is avoided.
- Damage to the endotracheal tube due to friction caused by the bur and the shaft of the bur, that occurs during the transoral approach, is avoided. Hence, it makes the work of the assisting surgeon easier and attend the site of odontoidectomy better.
- Position of the dense must be confirmed through the CT scan or the digital X-ray cervical spine, to assess its accessibility before the endonasal approach.

VII. Conclusion-

Endonasal endoscopic excision of odontoid process provides direct corridor to the craniovertebral junction, enabling complete removal of the dens without any cross infection from the oropharyngeal region. It does n’t interfere with deglutition process. Hence, this approach is much better than the transoral route.

Main Message-
1. Endoscopic endonasal corridor provides direct approach to odontoid process excision.
2. By avoiding soft palate retraction this approach does not interfere with deglutition.
3. Need not share the airway with the anaesthesiologist. Hence, damage to the endotracheal tube is avoided.
4. Unlike in transoral route, hyperextension of neck can be avoided. Therefore, there is no risk of aggravating neurological problems.

Current Research Questions-
1. Approach provides direct corridor to the craniovertebral junction but difficulty pertaining to haemostasis happens due to the length factor from anterior nasal spine to prevertebral tissues.
2. Anatomical orientation at times disturbing during which navigation helps us in proper orientation but this facility not available in our institution.
3. Advantage exists in the form of early starting of oral feed which is not the same in transoral route.

Key References-

Self Assessment Questions-
1. Transoral route is the most commonly used approach for odontoidectomy. Ans. true
2. Which of the following statement is false regarding transoral approach for odontoidectomy?
   a. Incidence of meningitis in cases of CSF leak is higher
   b. Manipulation of soft palate and necessity for palatal split is less.
   c. Provides wider space for instrumentation and bleeding control.
   d. Difficult angulation of instruments. Ans. b
3. True regarding post operative nasal regurgitation of food and dysphagia after odontoidectomy, a. is less in transoral approach
   b. Caused by hypoglossal nerve involvement c. is due to velopharyngeal insufficiency. Ans. c
4. False regarding cephalometric analysis of the cervical spine before surgery,
   a. level of the tip of odontoid process is assessed in relation to the hard palate.
   b. is not necessary in transnasal route.
   c. used to determine the migration of odontoid process
   d. Distance between posterior end of hard palate and the odontoid process determines the lower limit of dissection via the trans nasal route.
   ans. b

5. Trans nasal approach facilitates an angle of instrumentation that is comfortable for the surgeon in cases where neck extension is to be strictly avoided - true/false
   Ans. True

Footnotes:
CONTRIBUTORS - As the author & co-author of this work, we did this surgical approach as a team complementing each other’s work which gave us the confidence to do this work.

COMPETING INTERESTS - There are no competing interests reflected in this article.

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Fig 1: pre-operative MRI showing compression at the craniovertebral junction by the odontoid

Fig 2: post-operative X-ray of the same patient showing complete excision of odontoid by transnasal approach