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Endoscopic Endonasal Excision of Odontoid Process

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Abstract: *Approaching the cranio-vertebral junction is a challenging procedure because of its association with the spinal nerves, cranial nerves and the verebralarteries . The complex anatomy of the cervical joints forme d by the occipital bone, atlas and the axis makes the task more complex one[1] . With the advent of the endosc opic approach to address the peg of axis, spinal cord compression at the cervical level can be surgically man aged with minimal morbidity. Among the endoscopic approaches, the endonasal approach to the odontoid proce ss provides a straight pathway and is comparatively less morbid than the transoral approach.*
Key Words*: endonasal corridor, endoscopic, odontoid process, excision.*

I. Introduction-

Endoscopic approach to the CVJ is becoming prefered 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 t o the midline during the initial mucosal incisions using landmarks such as teeth, hard palate, pillars and tub ercle of C1, can prevent much of the complications that occur due to the injury to the vessels and nerves, a s 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 encount ered 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 adde d advantage of the transnasal approach over transoral approach through a case series of five patients from our in stitute.

II. Role Of Oropahryngeal 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 nasophar ynx , 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 mucosa- the mucosa l barrier as well as by the symbiotic relationship between the normal commensals and the host mucosa[6] . In man y studies, the risk of infection is found to be more common with an oropharyngeal defect than with a nasopha ryngeal defect[2] , and is related to the contamination of the wound with oral secretions containing diverse microb iota and also from pathogenic microbespresent in oral feeds,but there has been no extensive study regarding th e difference in infection rate.

In endoscopic surgeries, there is a definite period of time postoperatively for the defect to close , durin g which the mucosal secretions constantly bathe the surface and interact with the healing process . In midli ne 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 ca used by the cautery induced collateral damage to the mucosa. This stagnation predisposes colonization of the w ound 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 vari ous bacterial species of the oral cavity promotes a diverse microbial environment which can be contained symb iotically by oral or the oropharyngeal mucosa but not the neuronal structures that are been exposed during the su rgery.

These factors increase the rate of infection in transoral approach and is primarily mediated by the velop haryngeal insufficiency. It is important here to note that , there is also nasopharyngeal contamination of oral secr etions occurring even in normal individuals as evidenced from direct spread of infection owing to the contigui ty. Hence, the reduced incidence of infection and meningitis in transnasal route is related to much less inciden ce of nasal reflex, and the 'U' shaped mucosal flap elevated during the transnasal approach which covers the s

urgical 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 case with me ningitis with a turbid CSF. The culture from CSF tap was reported to be Streptococcus pneumonia[5] . This again warrants further study on this aspect as much of the cultures from meningitis is related to staphylococcus aureu s 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 e t al .This study revealed a varying distribution of density of the pharyngeal plexus. The study revealed a signific antly lower density of nerves above the palatine plane ($p < 0.05$)[6]. The average count below the hard palate was f ound to be 178.8 nerves/cm^3 while that above was 75.4 nerves/cm^3 . Further, the study revealed a relatively lowe r density within 1 cm of midline as compares 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 place d avoiding the relatively dense plexus in the region of the oropharynx.

IV. A Case Series In Transnasal Odontoid Excision-

S.No	Age/sex	Etiology	symptoms	Duration (months)	Radiological fin ding	Outcome of trans nasal approach	
						swallowing	Motor functions
1	23/m	Spontaneous	paraplegia	3	CVJ compression b y odontoid	Started oral fe eds by 2nd PO D	Waking without su pport by 5wks
2	43/m	spontaneous	Paraplegia	9	CVJ compression b y odontoid	Died on 5thPOD due to cardiogenic sho ck.	
3	10/f	Accidental fa ll	paraplegia	10 days	Atlantoaxial Sublux ation	Startedoralfee ds by 2ndPOD	Waking without s upport by 5 wks
4	22/m	spontaneous	paraplegia	6	CVJ compression b y odontoid	By 2nd POD	By 4wks
5	50/m	spontaneous	paraplegia	8	CVJ compression b y odontoid	By 3rd POD	by 6 wks.

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

V. Case Presentation

Endo nasal endoscopic excision of odontoid process[2]was done for 5 cases over a period of 1 ½ 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 prese nted 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 turbinate on both sides using three handed technique with EMG monitoring of 12th cranial nerve. Posterior wall of nasopharynx raised as a fl ap using radiofrequency cautery until C1 ring is visualized. This provides an exposure from the floor of sphenoi d sinus to the 2nd cervical vertebra. C1 ring is removed with skull base drill using coarse diamond burr. The atlan to occipital 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 ofresection. The defect was packed with collagen sheet and fibrin glue[3] after achieving completehaemostasis.

Patient's neck was secured in cervical collar. Post- operative CT was done on 1st POD (fig.2. sho ws 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 2ndPOD. Patients were started on oralfeeds on the same da y of trans nasal surgical procedure. They were given third generation cephalosporins for a period of 10 days. On e patient died on the 10th POD due to cardiac failure. Other patients recovered from their weakness gradually ov er 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 straight forward route, without interfer ing the swallowing mechanism and with a reduced infective rate ,unlike in trans oropharyngeal route. The angl e of this approach makes it a much simple route towards the odontoid process. The team approach involving neu ro &ent surgeons offers complimentary advantage in this procedure. Patients were subjected to this approach aft

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 b e avoided[7].This is possible due to the craniocaudal approach used in transnasalodontoidectomy.
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[1] to the craniovertebraljunct ion, enabling complete removal of the dens without any cross infection[4] 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 doesnot 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 diffcultypertaining to haemostasis hap pens 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 fa cility not available in our institution.
3. Advantage exists in the form of early starting of oral feed which is not the same in transoralroute.

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Self Assessment Questions-

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. Manupulation 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 tra nsoral 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 dissectio n via the trans nasal route.
ans.b
5.Trans nasal approach facilitates an angle of instrumentation that is comfortable for the surgeon in cases whe re 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 compli menting each others 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 transnasalapproach