



## Transoral Transpharyngeal approach to Craniovertebral Junction: Indications, Management and outcomes in a Survey of 7 Cases

Susanth Subramanian and Vivek Joseph

Department of Neurological sciences, Christian Medical College, Vellore

### ABSTRACT

**Introduction:** The transoral-transpharyngeal surgical approach is a direct operative approach for pathology ventral to the craniovertebral junction and upper spinal cord. In selected patients, this approach is effective in the treatment of extradural compressive lesions from the cervico-medullary junction to the C3 vertebra. We present 7 patients who underwent transoral transpharyngeal surgeries by a single surgeon (BVJ) for ventral CVJ compression due to different pathologies.

**Material and Methods:** Retrospective data analysis of 7 patients who underwent transoral transpharyngeal surgeries for various pathologies affecting the craniovertebral junction was performed from January 2015 to January 2017. The hospital records, outpatient physician records, and radiographic studies of all 7 patients were reviewed. **Results:** The mean age of the study group was 36 (range 10-64) years. There were 4 (57.1%) males and 3 (42.9%) females. 6 (85.7%) out of seven patients presented with features of cervical cord compression. In one patient (14.3%) only neck pain with restriction of neck movement was present. Of the 7 patients, 3 (42.8%) had irreducible atlantoaxial dislocation with basilar invagination, 2 (28.6%) had irreducible atlantoaxial dislocation and 2 (28.6%) had CVJ tuberculosis. The most common presenting symptom of the group was spastic quadriparesis and paresthesias involving all four limbs. The mean preoperative Nurick grade was 1.9 and the mean imJOA score was 13.5/19 for the group. All patients were operated through transoral-transpharyngeal approach and all of them underwent occipito-cervical fusion subsequently. 5 (71.4%) out of 7 patients had symptomatic improvement postoperatively. One patient (14.3%) required tracheostomy postoperatively for prolonged ventilation and he was discharged on BIPAP.

However he expired after three months of surgery due to ventilator associated pneumonia. One patient (14.3%) had transient hoarseness of voice and difficulty in swallowing postoperatively for which improved over next two weeks. The mean follow-up of our series (n=5) was 18.4 months. One patient was lost to follow-up. The mean Nurick grade improved to 0 and mean imJOA improved to 19/19 at follow-up. All patients were symptom-free at follow-up and there was radiological reduction with bony fusion in all of them. **Conclusion:** Transoral odontoidectomy is a safe and efficacious approach for the treatment of selected patients with compressive pathology of the ventral brain stem and upper cervical cord. Patients must be selected judiciously and a detailed radiological examination is advised to define the extent of compression, reducibility, and instability present in an individual patient.

**Keywords:** Transoral, Transpharyngeal, CVJ

### INTRODUCTION

Craniovertebral junction (CVJ) comprises lower clivus, foramen magnum, C1 and C2 vertebra anteriorly and the surgical approaches to pathology involving this region may be either anterior, posterior or posterolateral. Of these, the posterolateral approaches requires variable degree of brainstem and upper cervical cord manipulation which is known to produce neurological deficits.<sup>[1]</sup> Several pathological processes can cause ventral compression of lower medulla and rostral spinal cord and transoral approaches represents an efficient direct method of decompression if the offending pathology is at the level of lower clivus, cervico-medullary junction or ventral to first three cervical vertebra.<sup>[2]</sup> The most common application of the procedure is in the resection of odontoid process for congenital basilar invagination, in cases of rheumatoid

arthritis, congenital atlantoaxial dislocation or chronic traumatic dislocation of dens.<sup>[2]</sup> The other indication of the approach is in the management of craniovertebral junction tuberculosis.<sup>[3]</sup>

## MATERIALS AND METHODS

Over a period of two years, from January 2015 to January 2017, retrospective data analysis of 7 patients who underwent transoral odontoidectomy by a single surgeon (BVJ) for various pathologies affecting the craniovertebral junction was performed. The hospital records, outpatient physician records, and radiographic studies of all 7 patients were reviewed. Each case was characterized by age, sex, type of pathology, neurological findings, treatment administered, complications and outcome.

### Preoperative Care

All patients after admission in the ward was assessed for respiratory function with arterial blood gas analysis and single breath count. Cervical spine x-rays (open mouth AP view, lateral neutral and extension) were obtained. CT spine with 3D reconstruction and MRI was obtained to delineate the anatomical variation at CVJ, and nature and likely pathology of the compression. They were started with betadine mouth gargles eighth hourly for oral preparation before surgery. Cervical traction was applied preoperatively in 5 out of 7 patients in our series. In two patients with CVJ tuberculosis, traction was not applied as there was no instability of the CV Junction.

### Surgical Technique

After intubation with a flexible oral endotracheal tube, patient is positioned in supine position with neck extended and head is fixed with Mayfield head clamp. The oral cavity was prepared with 10% povidone iodine solution. After preparation of oral cavity, Eumosome (Clobetasone topical cream 0.05%) was applied over the lips, tongue and tonsillar pillar and fauces. The surgeon works from seated above the patient's head. Dingman mouth retractor was used for automatic exposure incorporating the tongue blade. This provided self-retaining exposure of the oral cavity and the oropharynx. The soft palate was pulled superiorly into the naso-pharynx with a rolled up gauze piece sutured to the soft palate and to 2 red rubber catheters introduced through each nostril. The level of the anterior arch of atlas is identified with the help of fluoroscopy. A linear midline incision is made after infiltrating with 2% lignocaine and the mucosa is divided in the midline and the soft tissue reflected off the anterior arch of the atlas, C2 body and laterally till the C1-C2 facet joint. C1 anterior arch is drilled and removed with bone punches. The odontoid and the upper part of the C2 body are thinned out with a drill. This is then lifted off the posterior longitudinal ligament and removed with a rasper and disc forceps. The C2 median corpectomy is carried inferiorly till just above the C2/3 disc space as identified on fluoroscopy. Hemostasis is achieved. The longus colli and longus capitis muscles were

approximated and, subsequently, the posterior pharyngeal musculature and the posterior pharyngeal mucosa. Naso-gastric tube was inserted and position is confirmed.

Posterior occipito-cervical fusion combined with posterior fossa decompression is usually mandated in all these cases and performed during the same sitting or as a separate procedure. The patients are nursed with cervical traction in neutral position if the procedure is planned in a separate sitting.

### Postoperative care

Patients are extubated on the same day and cervical traction is maintained for those patients in which the posterior fusion surgery is not done in the same sitting. If posterior occipito-cervical fusion is done in the same sitting patients are started on NG feeds after 24 hours and clear fluid are started on third postoperative day. They are ambulated as early as possible. Otherwise oral feeding is started around the 2<sup>nd</sup> or 3<sup>rd</sup> postoperative day following the posterior fusion. Intravenous antibiotic, Inj. Ceftriaxone 2gm once daily is administered as prophylaxis for the first three postoperative days. Following instrumented posterior fusion, Intravenous Inj. Cloxacillin 1gm sixth hourly and Inj. Gentamycin 3-5mg/kg is given as a single dose for three days. Daily inspection of the oral cavity is performed to look for wound dehiscence or infection. Hydrogen peroxide mouth gargles are administered every sixth hourly for first five days. Early ambulation is advised once posterior fusion is done, using a Philadelphia collar.

## RESULTS

Out of the 7 patients included in the study, 4 (57.1%) were males and 3 (42.9%) were females. The mean age of the study group was 36 (range 10-64) years. 6 (85.7%) out of the 7 patients presented with features of cervical cord compression. In one patient (14.3%) only neck pain with restriction of neck movement was present. The functional status was assessed using the Nurick grading and Indian modified Japanese orthopedic association scoring system (im JOA). The mean preoperative Nurick grade was 1.9 and the mean imJOA score was 13.5/19 for the group. Of the 7 patients 3 (42.8%) had atlantoaxial dislocation with basilar invagination, 2 (28.6%) had atlantoaxial dislocation and 2 (28.6%) had CVJ tuberculosis. The results are summarized in Table 1.

**Table 1. Pathology of CVJ compression**

Serial No	Causes of CVJ compression	Number of cases
1	Irreducible AAD	2
2	Irreducible AAD with BI	3
3	CVJ Tuberculosis	2

One patient (14.3%) had atlanto-occipital assimilation along with atlantoaxial dislocation. The most common presenting symptom of the group was spastic quadriplegia and parasthesias involving all four limbs followed by neck pain and urinary symptoms. The symptomatology of presentation is outlined in Table 2.

**Table 2. Preoperative symptoms**

Serial No	Symptoms and signs	Number of patients
1	Spastic quadriplegia	5
2	Parasthesias	5
3	Restriction of neck movements	3
4	Neck pain	4
5	Urinary symptoms	4
6	Change in voice	1
7	Difficulty in swallowing	0
8	Imbalance while walking	3
9	Breathing difficulty	2

All patients were operated through transoral-transpharyngeal approach and all of them underwent occipito-cervical fusion subsequently. 3 (42.8%) out of 7 patients underwent occipitocervical fusion under same anesthesia and 4 (57.2%) patients were operated on a separate sitting for occipitocervical fusion. In one patient with CVJ tuberculosis, after removing the C1 anterior arch adequate tissue was got for confirming diagnosis and cultures. As there was no cord compression, the odontoid process was not removed. 5 (71.4%) out of 7 patients had symptomatic improvement postoperatively. One patient (14.3%) required tracheostomy postoperatively for prolonged ventilation and he was discharged on BIPAP. However he expired after three months of surgery due to ventilator associated pneumonia. One patient (14.3%) had transient hoarseness of voice and difficulty in swallowing postoperatively for which he required nasogastric feeds. He was started on oral feeds after removing NG tube after two weeks. He remained asymptomatic at 10 month follow-up. One patient developed deep venous thrombosis which was managed with intravenous heparin. Two patients (28.6%) developed wound infection at occipitocervical fusion site at one month follow up. The pus culture grew MRSA and pseudomonas respectively which was treated by wound debridement and culture sensitive antibiotics. However there were no cases of pharyngeal wound dehiscence. One patient was re-operated at 15th postoperative day as there was implant extrusion following occipito-cervical fusion,

evidenced in the postoperative CT scan. There were no dural breach or CSF leaks in our series. The postoperative complications are outlined in Table 3.

**Table 3. The postoperative complications in our series**

Serial No	Complications	Number of cases
1	Tracheostomy	1(14.3%)
2	Wound infection at posterior fusion wound site	2(28.6%)
3	Difficulty in swallowing	1(14.3%)
4	DVT	1(14.3%)
5	Implant extrusion	1(14.3%)

The mean follow up of our series was 18.4 months. One patient was lost to the follow up. One patient expired 3 months following surgery due to ventilator associated pneumonia. The remaining 5 patients were symptom free at follow up. Cervical spine x-rays were done in all of these patients at follow up, and MRI cervical spine was done in 3 out of 5 patients at follow up. Cervical spine x-ray showed bony fusion with realignment of spine in all of them and the MRI spine at follow up showed adequate decompression of CVJ. The functional score improved from mean Nurick grade 1.9 preoperatively to Nurick grade 0 and mean im JOA score improved from mean 13.5/19 to mean 19/19 at follow up. The results are summarized in Table 4.

**Table 4. Functional status of patients in the preoperative period and at follow-up**

Cases	Preop Nurick grade	Preop im JOA score	Follow up Nurick grade	Follow up im JOA score
Case 1	3	13	0	19
Case 2	1	16	0	19
Case 3	0	19	0	19
Case 4	2	14	0	19
Case 5	1	16	0	19

Preoperative and postoperative CT and MRI images of a patient who underwent transoral odontoidectomy with occipitocervical fusion for irreducible AAD is shown in Figure 1 A and B. The postoperative MRI and CT scan done at follow up

visit showed adequate reduction of AAD with restoration of cervical spine alignment.

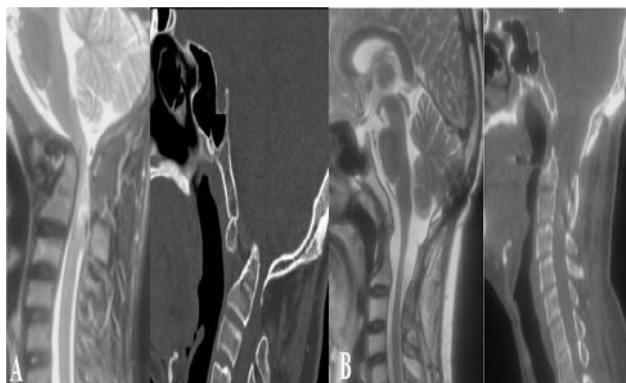


Figure 1 A) Preoperative MRI T2 weighted sagittal section of cervical spine and CT cervical spine sagittal section showing atlantoaxial dislocation compressing the CVJ ventrally causing T2 weighted changes of the cord. B) Postoperative CT and MRI cervical spine showing reduction of AAD with restoration of normal alignment. Note: The postoperative MRI cervical spine is showing adequate decompression of the cervical cord with widening of dorsal and ventral subarachnoid spaces.

## DISCUSSION

The transoral approach has been used in the past for dealing with extradural compression at CVJ due to bony abnormalities and tumors. <sup>[4]</sup> <sup>[5]</sup> Kanavel <sup>[6]</sup> in 1917 used this approach for removal of bullet fragment from the anterior arch of atlas. Since then this approach has been used in treatment of various intradural and extradural pathologies causing ventral compression of CVJ. Mullan et al <sup>[7]</sup> used this approach as early as in 1966 in excising a ventrally placed intradural tumor.

The ventral transoral–transpalatopharyngeal route to the craniocervical border was meant to be effective in irreducible ventral bony abnormalities associated with compression of the cervico-medullary junction. It is an alternative effective approach reserved for extradural bony and soft tissue masses and a few intracranial intradural tumors which are ventrally located and the access is extremely difficult for posterior and posterolateral approaches. <sup>[8]</sup> The initial reports of infection, limited exposure, CSF leakage and unacceptable patient morbidity and mortality have limited the use of this approach. <sup>[5]</sup> <sup>[9]</sup>

We feel that, our series has shown transoral approach is an effective, safe and rapid method in addressing the extradural compressive pathology of the ventral craniovertebral junction. Endoscopically assisted procedures and frameless stereotaxy are gaining popularity in the recent past for better visualization and thereby reducing operative morbidity. <sup>[10]</sup> <sup>[11]</sup>

However our series showed equally good results without the use of these intraoperative adjuncts. The use of flexible endotracheal tube secured distally by Dingman retractor which gave a wide exposure in combination with use of red rubber catheters to retract the uvula and soft palate superiorly and use of microscope which provided high magnification and illumination was the most important surgical adjunct which helped in avoiding the perioperative morbidity. The immediate postoperative transient neurological worsening was observed in only 1 patient in our series and there were no cases of dural breach or CSF leak.

The indications for transoral transpharyngeal approach to CVJ have to be fairly clear before attempting surgery. Sometimes more than one radiographic procedure has to be attempted to address the pathology and mechanism of compression. <sup>[12]</sup> All our patients underwent x-rays in neutral and extension position preoperatively and all of them were evaluated with a CT cervical spine with 3D reconstruction in neutral and extension, along with MRI. Flexion and extension studies will indicate the presence or absence of reducible ventral cervico-medullary junction compression. <sup>[13]</sup> Identifying the ventral pathology and not attempting for reducing it by any other methods does not fall into the criteria for choosing this approach. <sup>[14]</sup> In our series of 7 patients, cervical traction was attempted preoperatively in 5 patients for reduction and in 2 patients we attempted intraoperative manual reduction after posterior exploration. In 2 patients, transoral surgery was directly attempted as the pathology suspected was tuberculosis and located ventral to the CVJ.

The advantage of transoral transpharyngeal approach to CVJ in irreducible pathologies in comparison with other operative approaches is that, there is direct access to the bony compression and the granulation tissue that accompanies the chronic instability. Also positioning in mild extension reduces the angulations on brain stem during surgery. <sup>[15]</sup> Operating through the avascular median raphe and gravity aided drainage of blood gives a clear field to the operating surgeon.

The postoperative radiographic assessment of patients undergoing transoral decompression is mandatory to evaluate the adequacy of decompression and assessment of instability. <sup>[16]</sup> It also helps in evaluating the upper airway patency due to the postoperative edema. All our patients underwent posterior stabilization surgeries and they were evaluated by plain x-rays and limited CT scan through upper CVJ and upper cervical spine. One patient had implant extrusion, evidenced in the postoperative CT scan and was re-exploration and occipitocervical fusion. There was symptomatic improvement in 5 (71.4%) patients in our series while 1 (14.3%) patient showed transient neurological worsening and there was no remarkable improvement in another (14.3%) patient. Our follow up rate (N=5) was 71.4% and about 60% of these patients were evaluated with MRI cervical spine which showed adequate decompression of CVJ. Cervical spine x-ray done in all the 5, showed

radiological features of reduction with bony fusion and restoration of alignment in all our patients at follow up.

## CONCLUSION

Transoral odontoidectomy is a safe and efficacious approach for the treatment of selected patients with compressive pathology of the ventral brain stem and upper cervical cord. Patients must be selected judiciously and a detailed radiological testing is advised preoperatively to define fully the extent of compression, reducibility, and instability present in an individual patient.

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