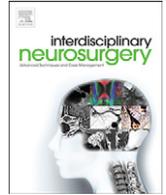




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Technical Note & Surgical Technique

Use of a tubular retractor for transoral odontoidectomy of upper cervical epidural phlegmon extraction and abscess drainage

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ABSTRACT

Anterior epidural abscess of the superior cervical cord with odontoid osteomyelitis is a rare but potentially devastating condition due to the potential for severe and irreversible neurological injury. Early and aggressive neurosurgical intervention and medical management is usually indicated in cases with symptomatic spinal cord compression and may be associated with superior clinical outcomes. Access to the craniovertebral junction for decompression of the upper cervical cord is complicated by the proximity of critical anatomical structures. The transoral approach is considered to be the standard for treating lesions of the odontoid and anterior epidural space of the superior cervical spine. The use of a tubular retractor for procedures of the craniovertebral junction has been described for several approaches to this region but its use has yet to be described for the transoral approach in a live patient. This report describes the novel use of a tubular retractor for cervicomedullary decompression via transoral odontoidectomy for abscess drainage and phlegmon resection in a patient with progressive cervical myelopathy. The tubular retractor serves to retract the pharyngeal wall flaps and expose the anterior arch of C1, odontoid, and inferior clivus. This variation of the transoral approach eliminates the need for stay sutures for these purposes and may be used for lesions of the odontoid and anterior epidural space of the superior cervical spine.

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1. Introduction

Epidural abscess of the superior cervical spine with odontoid osteomyelitis is a rare condition but can produce severe and permanent neurological deficits without surgical intervention [1]. There is currently no consensus on the ideal timing of surgery, however, strong indications for early surgery include progressive neurologic deterioration [1]. The combination of surgical intervention and antibiotic treatment for spinal epidural abscess in general are associated with better neurological outcomes [1–3].

Decompression of the cervicomedullary junction is challenging due to the proximity of several critical neurovascular structures that limit access to the craniovertebral junction (CVJ). As a result, numerous approaches have been described, the most common of which and their advantages and limitations were summarized in Riley et al. [4] Numerous modifications of transoral approach continue to be generally regarded as the standard for access to the structures within the anterior CVJ [4].

Tubular retractors are commonly used in minimally invasive spine surgery for discectomy, decompression, instrumentation, and tumor

resection [4–12]. They have also been used in atlantoaxial fusion, spinal dural arteriovenous fistula ligation, and synovial cyst resection [13–15]. Use of tubular retractors for procedures to access the upper cervical spine have been limited to the anterior approach for screw fixation, and the posterior and transcervical approaches for odontoid and retro-odontoid pathologies such as abscesses, tumors, and pseudotumors [4, 16–22]. In this case report we describe the novel use of a tubular retractor for transoral odontoidectomy for cervical cord epidural abscess decompression.

2. Case report

2.1. History

A 57-year-old male with a history of baseline paraplegia secondary to Guillain-Barre Syndrome was found down and transported to the emergency department. Imaging revealed a pathological cervical spine fracture, osteomyelitis of the cervical spine, and meningitis. On admission to the ICU he presented with altered mental status, difficulty breathing, cervical neck pain, and headache. Physical exam revealed new onset symptoms consisting of pain to palpation over the posterior cervical spine, 3/5 shoulder shrug bilaterally, 4/5 deltoid and biceps brachii strength bilaterally, 3/5 triceps, grip, and interosseous strength bilaterally, as well as baseline deficits consisting of 0/5 strength in all

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lower extremity muscle groups bilaterally, absence of light touch sensation in the lower extremities bilaterally, bladder and bowel incontinence, and diminished rectal tone. The remainder of his neurological exam was unremarkable. CT imaging revealed phlegmon and abscess posterior to the dens causing mass-effect on the cervicomedullary junction and leftward subluxation of C1 on C2. MRI revealed findings suggestive of osteomyelitis at C1–C2, anterior epidural abscess posterior to the dens causing mass effect and moderate canal stenosis at the cervicomedullary junction, and prevertebral edema from the skull base to the C3 level (Fig. 1).

2.2. Surgical technique and approach

The patient was positioned in the supine position and secured in the Mayfield headholder. His anatomical surface markers were matched to his preoperative CT scan using Brainlab for intraoperative image guidance. The transoral approach was utilized. The tip of the C2 vertebra was exposed with a tubular retractor, which was positioned via image guidance. The incision site was prepared and draped in sterile fashion. The tubular retractor was repositioned to expose the arch of the C1 vertebra and the dens (Fig. 2). The incision was made in the posterior oropharynx and the arch of the C1 vertebra was exposed. The soft palate was obstructing the surgical corridor, and retraction with splitting was considered. Rather than perform this, a tubular retractor system was brought into the operative field and the soft palate reflected with the tubular retractor to allow access to the surgical corridor without direct

trauma to the soft palate. Intraoperative image guidance was used again to confirm correct location and positioning of the tubular retractor. A high-speed drill was used to drill off the anterior arch of C1 and the tip of the dens, providing access to the phlegmon and pus in the anterior epidural space. The pus was drained and submitted for culture and the phlegmon tissue was partially resected and submitted for pathology. The phlegmon was partially resected due to significant adhesion to nearby tissues. The epidural space was adequately decompressed, antibiotic irrigation was administered, and the wound was closed.

2.3. Post-operative course

The postoperative course was unremarkable. Tissue culture results were positive for *Pseudomonas aeruginosa* and he was administered appropriate antibiotic therapy. At six-week follow-up, his upper extremity muscle strength recovered to 5/5 bilaterally in all muscle groups except for 4/5 in right grip strength, his lower extremity muscle groups remained at baseline 0/5 strength, and sensation remained at baseline with intact sensation to the L1 level and total loss of sensation below this level. The patient could not tolerate MRI study due to anxiety so a CT of the cervical spine was performed instead that demonstrated resolution of the abscess and reduction in the size of the phlegmon tissue (Fig. 3). The cervical collar was removed and he was referred for physical therapy. He continued antibiotic therapy for osteomyelitis and

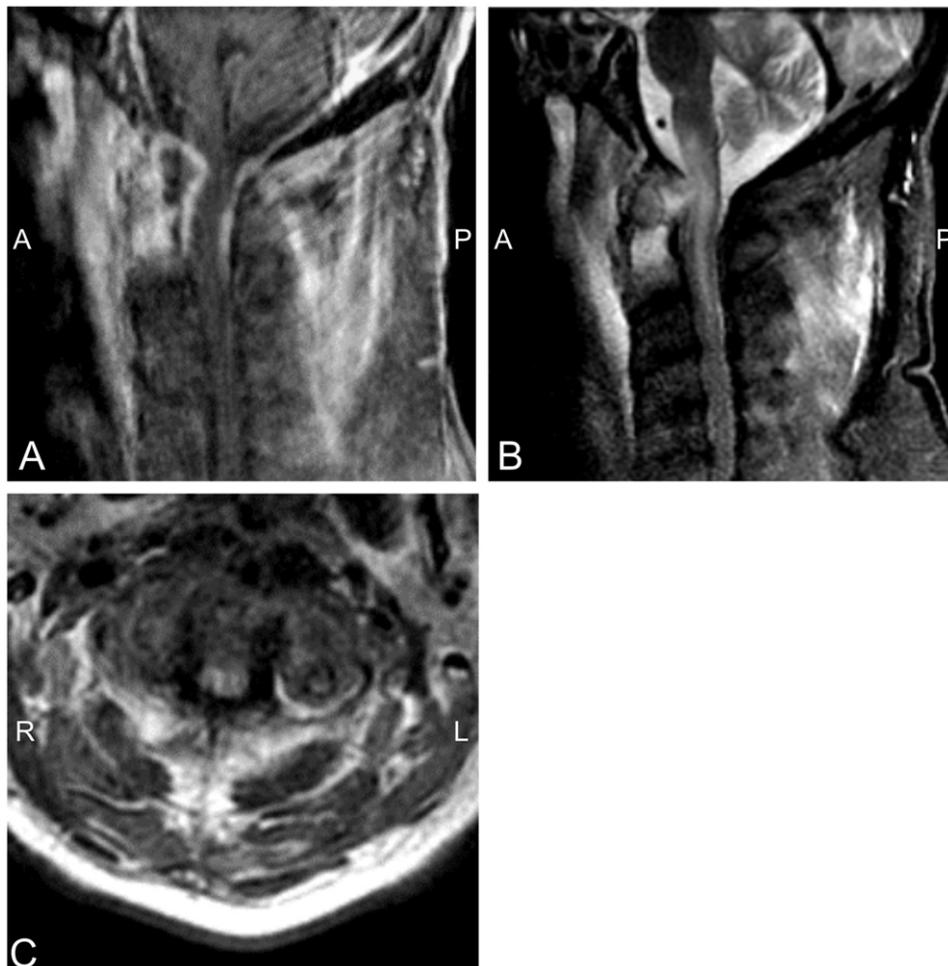


Fig. 1. Pre-operative MRI imaging reveals epidural abscess, osteomyelitis, and compression of the cervical spinal cord. A) T1 sagittal view demonstrates a 2.2×2.0 cm rim-enhancing lesion in the anterior epidural space posterior to the tip of the dens causing compression of the cervicomedullary junction. Osteomyelitis is present at the C1 and C2 vertebrae. B) STIR sagittal view demonstrates severe cord compression at the cervicomedullary junction abnormal cord signal from the inferior medulla to the C3 vertebral level. CSF flow is severely obstructed anteriorly and minimal posteriorly. C) T1 axial view reveals cord compression anteriorly by the phlegmon mass at vertebral level C1.

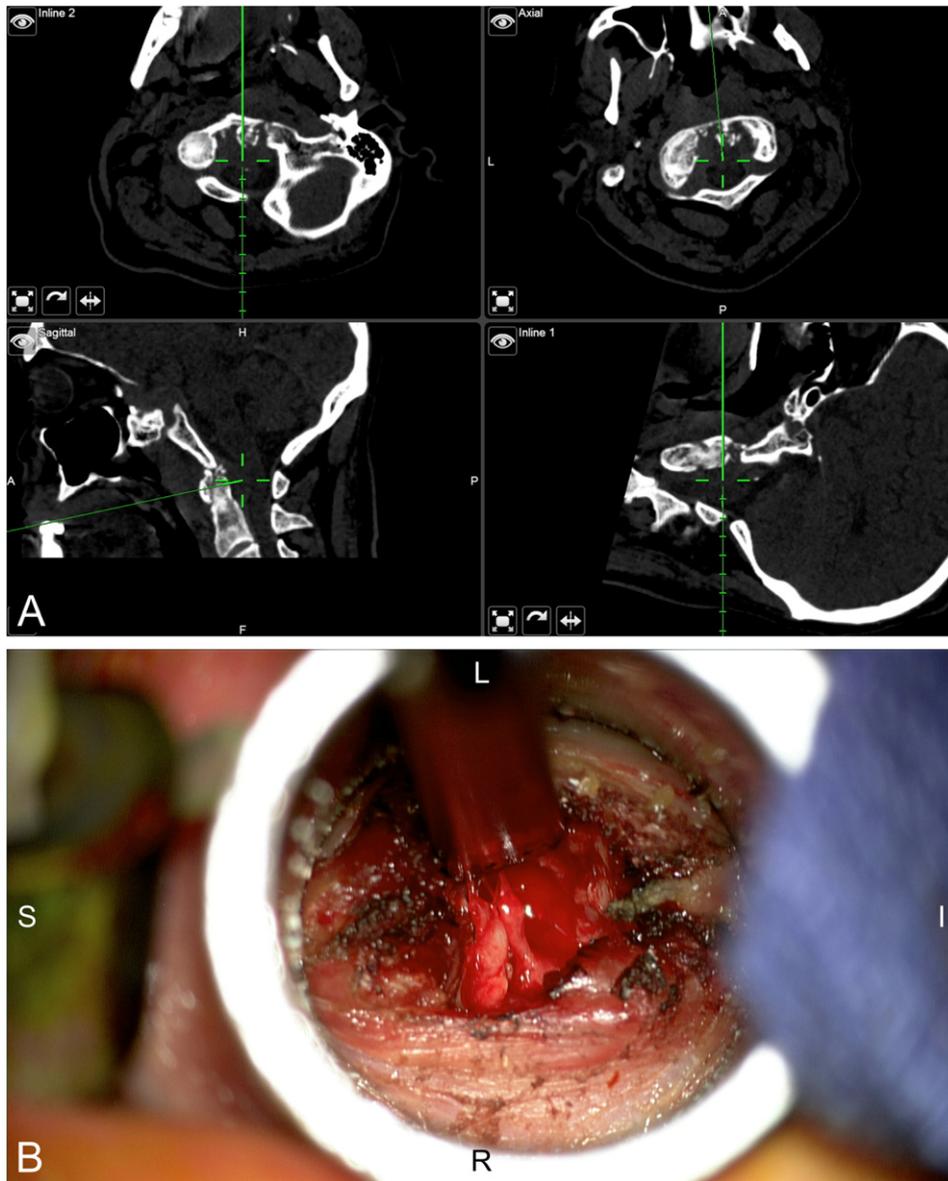


Fig. 2. Intraoperative view of the surgical site. A) Brainlab images demonstrate the approach to the mass and compression of the cervicomedullary junction. B) Transoral view of the surgical site at the posterior pharynx with view of the odontoid and the anterior arch of C1. Supine position. Left = superior, right = inferior, up = left, down = right.

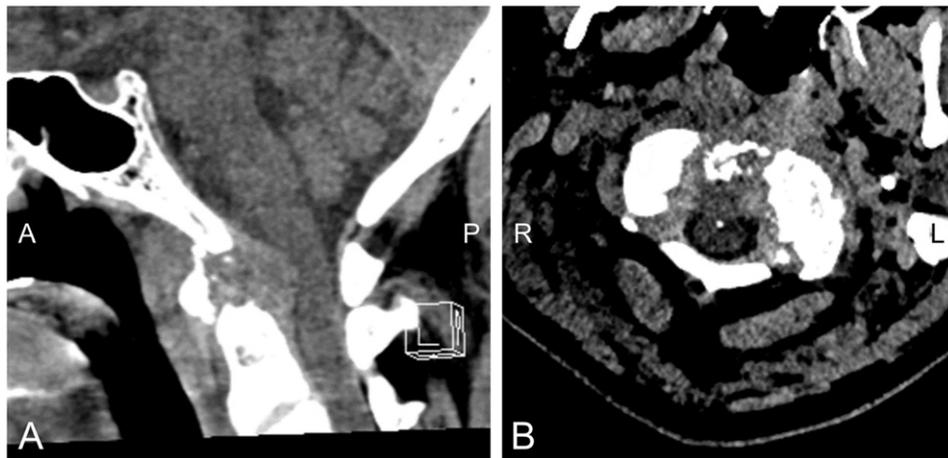


Fig. 3. Post-operative CT imaging reveals reduction in lesion size. A) Sagittal view demonstrates a 1.7 × 1.3 cm rim-enhancing lesion and phlegmon in the anterior epidural space at the C1 vertebra causing cervical cord indentation. B) Axial view demonstrates cervical cord indentation at the C1 vertebra, paracentral laminectomy of the anterior arch of C1, and partial resection of the right aspect of the dens.

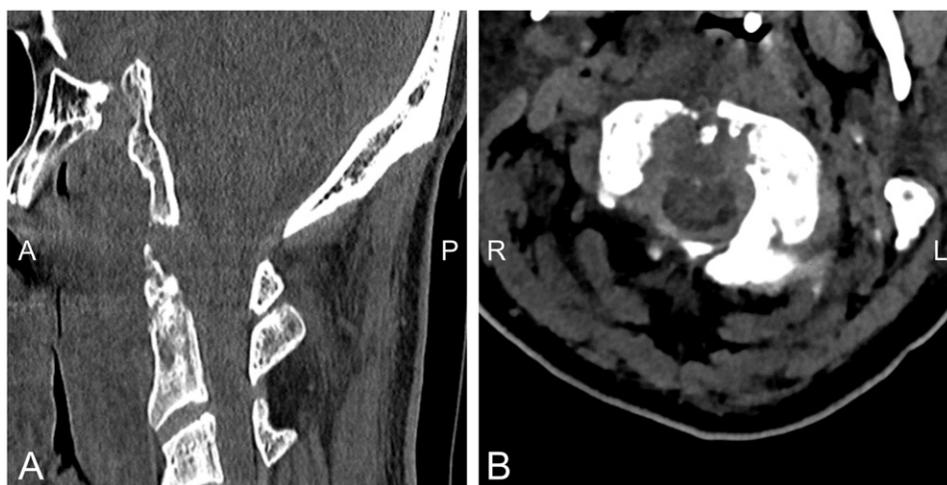


Fig. 4. 6-Week follow-up CT demonstrates resolution of both lesion and cervical cord indentation. A) Sagittal view demonstrates resolution of the abscess and reduction of phlegmon size in the anterior epidural space of the C1–C2 vertebrae. Cervical cord indentation is resolved and CSF is present throughout the cervical spinal canal anteriorly and posteriorly. B) Axial view demonstrates absence of cervical cord indentation at the C1 vertebra. A ring of CSF encircles the cord.

meningitis. CT at 2-month follow-up revealed resolution of canal stenosis with evidence of cerebrospinal fluid encircling the spinal cord (Fig. 4).

3. Discussion

Access to the craniovertebral junction is complicated due to the surrounding neurovascular structures. As a result, many approaches to access the CMJ have been established and described, each with inherent advantages, limitations, and possible complications. The transoral approach and its variations continue to be considered the standard approach [4]. Mouth-retractors are commonly used in this approach to maintain patency of the oral cavity. However, they are cumbersome and may not be available at every medical center. This case report demonstrates a novel variation of the transoral approach with the procedure being performed through a tubular retractor positioned under CT image-guidance [23,24].

In the standard transoral approach, stay sutures are used to retract the pharyngeal wall flaps to expose the anterior arch of C1, odontoid, and inferior clivus after incision of the uvula and posterior pharyngeal wall. This increases exposure and prevents damage to the eustachian tube orifices. Placement of the tubular retractor eliminates the need for stay sutures by retracting the pharyngeal wall flaps. Positioning the retractor under CT image-guidance ensures proper placement for the surgical site.

Use of tubular retractors for procedures to access the superior cervical spine in patients has been limited to the anterior approach for screw placement, and the posterior and transcervical approaches for odontoid and retro-odontoid pathologies such as abscesses, tumors, and pseudotumors [4,16–22]. A similar technique to ours was described by Baird et al. in a cadaver study with the use of the Dupuy Pipeline retractor. The retractor was used in similar fashion, to laterally retract the pharyngeal flaps and expose the surgical site [25]. Use of tubular retractors for anterior approach screw fixation has been described, but none of these were via a transoral approach [17,18]. Wolinsky et al. described the use of a tubular retractor for a transcervical approach to the odontoid, but this approach has the disadvantages of narrow working angles, long working distances, and an increased likelihood of pharyngeal retraction [18,21]. Use of a tubular retractor from the posterolateral approach was described for a similar case of superior cervical abscess and odontoid osteomyelitis, however this technique requires neck manipulation for full exposure and carries the small risk of damage to the C2 nerve and vertebral artery [4]. Similarly, Archavlis et al. also used tubular retractors for posterolateral approach for partial odontoidectomy

[19]. Use of a similar tubular retractor system as described in Riley et al. was used in Shalayez et al. through a lateral transcondylar approach [16].

Use of a tubular retractor for the transoral approach presents advantages over the standard method. First, the tubular retractor serves to retract the soft palate, eliminating the need to split the soft palate. This prevents the significantly increased complication rate associated with splitting of the soft palate and therefore complications such as infection, nasal escape and regurgitation, changes in phonation, prolonged nasogastric tube feeding, and prolonged postoperative intubation [26–28]. Second, it eliminates the need for oral retractors to maintain patency of the oral cavity and therefore the complications associated with them such as lip laceration and traumatic contusion [29].

This variation of the transnasal approach has some limitations. The narrow workspace within the tubular retractor may require the use of specialized instruments, the field of view and light may be diminished or impeded by the instruments or due to the depth of the field, and the surgeon must have the appropriate skills and experience to operate through the device [5]. However, most spine surgeons have extensive experience with minimally invasive techniques including the use of tubular retractors. In contrast, they are not accustomed to operating with the use of oral retractors. This variation also likely does not reduce the potential complications of this approach, such as cerebrospinal fluid leaks, spinal instability, meningitis, sepsis, wound infection, dysphagia, prolonged or re-intubation, or the need for tracheostomy or reoperation [30]. However, many of these complications overlap with those of other approaches in addition to complications specific to each individual approach [4].

One approach in particular, the endoscopic transnasal approach, is proving to be a feasible alternative the transoral approach for lesions at the CVJ and clivus [31]. The advantages of this approach over the transoral approach are a larger and more magnified surgical field, better illumination, and less virulent flora than that of the oropharynx [31]. However, this technique is challenging even for a well-trained surgeon [31]. Additionally, caudal exposure can be limited by bone and soft tissues of the nasal passage and palate [31]. Importantly, each approach to the CVJ has been found to have certain advantages and disadvantages, and electing a particular approach should be based on multiple factors such as patient anatomy and degree of caudal exposure needed [4,31]. The transoral approach, and therefore our variation using a tubular retractor, remains a valuable and appropriate one for certain patients.

This variation of the transoral approach with the use of a tubular retractor for exposure of the surgical site and lateral retraction of the pharyngeal wall flaps was an effective technique for access to the anterior

arch of C1, odontoid, and inferior clivus in this case. It presents the advantage of eliminating the complications associated with soft palate splitting and oral retractors in the standard technique and may be considered for pathology of the odontoid and anterior epidural space of the craniovertebral junction. Further study of this technique is warranted to determine its overall effectiveness.

4. Conclusions

This case represents a novel use of a tubular retractor in accessing the anterior epidural space at the craniovertebral junction via the transoral approach on a live patient. In patients for whom the transoral approach is best, this variation offers the advantage of eliminating the need for stay sutures of the posterior pharyngeal wall and maintains exposure of the surgical site. In this report, this technique was used for odontoidectomy with phlegmon resection and abscess drainage from the anterior epidural space and it may serve for access to other pathologies in this location as well.

Disclosures statement

We declare that:

All authors of this research paper have directly participated in the planning, execution, or analysis of this study.

All authors of this paper have read and approved the final version submitted.

The contents of this manuscript have not been copyrighted or published previously.

Conflicts of interest

The authors of this manuscript have no conflicts of interest to disclose.

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