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IDEAS AND TECHNICAL INNOVATIONS

A technical case report on use of tubular retractors for anterior cervical spine surgery

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Abstract

Purpose The authors put-forth this technical report to establish the feasibility of performing an anterior cervical corpectomy and fusion (ACCF) and a two-level anterior cervical discectomy and fusion (ACDF) using a minimally invasive approach with tubular retractors.

Methods First case: cervical spondylotic myelopathy secondary to a large postero-inferiorly migrated disc treated with corpectomy and reconstruction with a mesh cage and locking plate. Second case: cervical disc herniation with radiculopathy treated with a two-level ACDF. Both cases were operated with minimally invasive approach with tubular retractor using a single incision. Technical aspects and clinical outcomes have been reported.

Results No intra or post-operative complications were encountered. Intra-operative blood loss was negligible. The patients had a cosmetic scar on healing. Standard procedure of placement of tubular retractors is sufficient for adequate surgical exposure with minimal invasiveness.

Conclusion Minimally invasive approach to anterior cervical spine with tubular retractors is feasible. This is the first report on use of minimally invasive approach for ACCF and two-level ACDF.

Keywords Tubular retractors · Cervical spine · Minimal invasive spine surgery · Anterior cervical discectomy and fusion · Spinal fusion

Introduction

Anterior approach to the cervical spine is used to treat numerous cervical disorders including degenerative [1, 2], traumatic, oncological, inflammatory, congenital [2–4] vascular, and infective etiologies [2]. Cervical spondylotic myelopathy (CSM) is a common cause of neurologic morbidity and can substantially decrease the quality of life [5]. Anterior cervical discectomy and fusion (ACDF) as well as anterior cervical corpectomy and fusion (ACCF) have become well-accepted surgical procedures for symptomatic cervical myelopathy. These are described as safe and sufficient procedures with excellent fusion rates [5–7]. Despite these procedures being highly successful, complications such as dysphagia, hematoma-formation, recurrent laryngeal nerve palsy and oesophageal perforation have been reported [8, 9]. In anterior cervical surgery, pre-vertebral muscle dissection for adequate visualization can induce neck discomfort, which can result in a slower recovery [10]. Minimally invasive spine surgery aims at faster recovery, which allows patients to resume their normal activities as soon as possible. Tubular retractor systems such as the METRx and MAST QUADRANT system (Medtronic SofamorDanek) have been extensively utilized to pursue and accomplish the goals of surgery with minimal access in posterior-based MIS procedures of the lumbar, thoracic and the cervical spine.

There is limited literature on the use of minimal access tubular retractors to decompress and reconstruct the anterior cervical spine [11–13]. Here, we report two cases in which the tubular retractor system was used in anterior cervical surgery. Unlike the previous published literature

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involving single-level surgery, the tubular retractors were utilized to perform a corpectomy and two-level discectomy using minimal access. These cases highlight the utilization of minimally invasive approach to accomplish the surgical goals of decompression and fusion for more than one-level pathologies in the cervical spine.

Case report

Case 1

A 49-year-old male patient, office worker, presented with neck pain and left upper limb radicular pain in the last 1 year; instability while walking, paraesthesia and subjective heaviness in both lower limbs for 3 months. Patient had tried all conservative measures with no relief of symptoms. On examination, patient had painful neck range of movements, myelopathic features in the form of hyper-reflexia and bilateral plantar extensor response. He also had mild weakness of wrist extension on left side. MRI revealed a large C4–C5 disc herniation with inferior migration behind the C5 body with significant cord compression and signal changes in the cord (Fig. 1a, b).

Surgical technique

Under general anaesthesia, patient in supine position with neck slightly extended segment to be operated was confirmed by intra-operative lateral C-arm radiography with a radio-opaque marker (metal ruler) placed on anterior surface of neck. A right-sided approach with a 3-cm transverse skin-crease incision was developed. The platysma was incised in the line of incision, and sub-platysmal structures were dissected bluntly using the index finger. Pushing the trachea or larynx toward the opposite side with the index and middle fingers, the surgeon then slipped the fingers inside towards the front of the vertebral body until the bony anatomy was felt, while the carotid was held laterally. The initial dilator was inserted into the wound between the fingers to palpate the bony anatomy and fluoroscopy shot taken to identify the positioning of the first dilator. The dilators with increasing diameters were sequentially placed over each other with rotatory movements and finally the expandable tubular retractor (22 mm diameter, 60 mm blade length) was inserted over the last dilator and locked in place with the flexible arm to the operating table side rail (Fig. 2a, b). Once the tubular retractor is introduced inside the wound, its blades are retracted in the vertical axis. The longus coli on both sides are elevated with a long-handle cautery. Following this, the blades of the retractor are collapsed and opened up again in the vertical axis such that the longus coli are retracted laterally on both

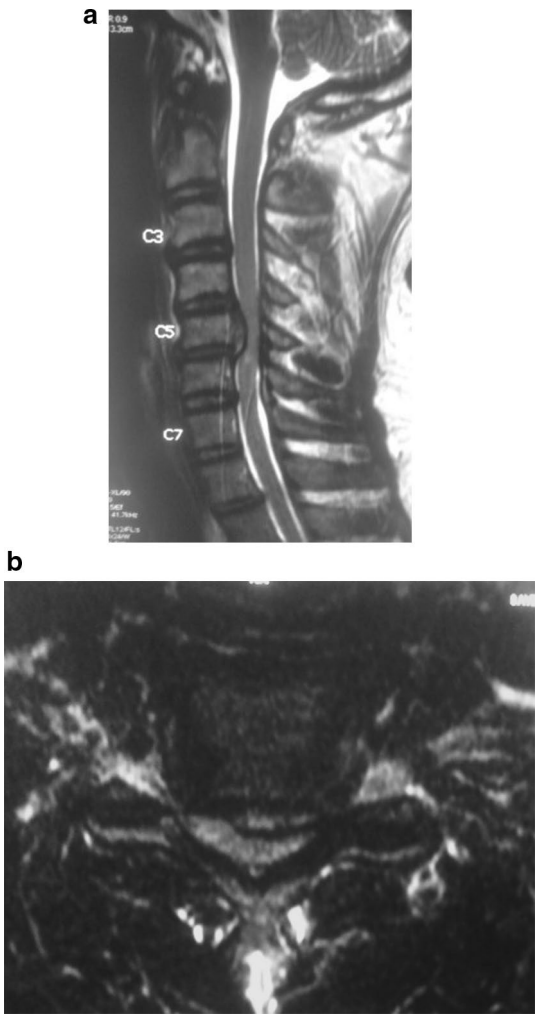

Fig. 1 **a** Sagittal MRI demonstrating significant spinal cord compression posterior to the C5 body. **b** Axial MRI section showing disc herniation with significant spinal cord compression posterior to the C5 body

sides. A final fluoroscopic confirmation of docking is done at this step before proceeding further.

Fixation of the tubular retractor to the operating table maintained correct working trajectory preventing movement out of the surgical field during the whole procedure without excessive tension on surrounding soft tissue often associated with manual retraction. Surgery was performed under microscopic assistance with the instruments inserted through the tubular retractor. The tube was docked initially on the C5 body and it was angulated cranially and caudally, respectively, during the procedure to access the C4–C5 and C5–C6 inter-vertebral discs. C4–C5, C5–C6 discectomy followed by C5 corpectomy was performed to excise the disc fragment lying behind the C5 body and the spinal cord in the entire length was decompressed. Mesh cage with autograft was used to bridge the defect left behind after corpectomy

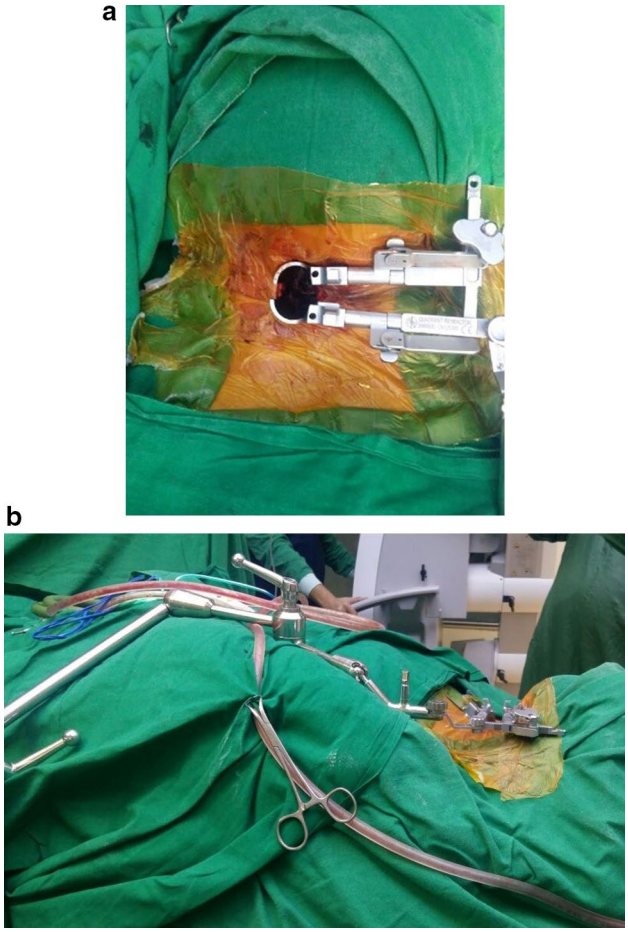

Fig. 2 **a** The tubular retractor in place mounted on the table attachment—top view. **b** The tubular retractor in place mounted on the table attachment—side view

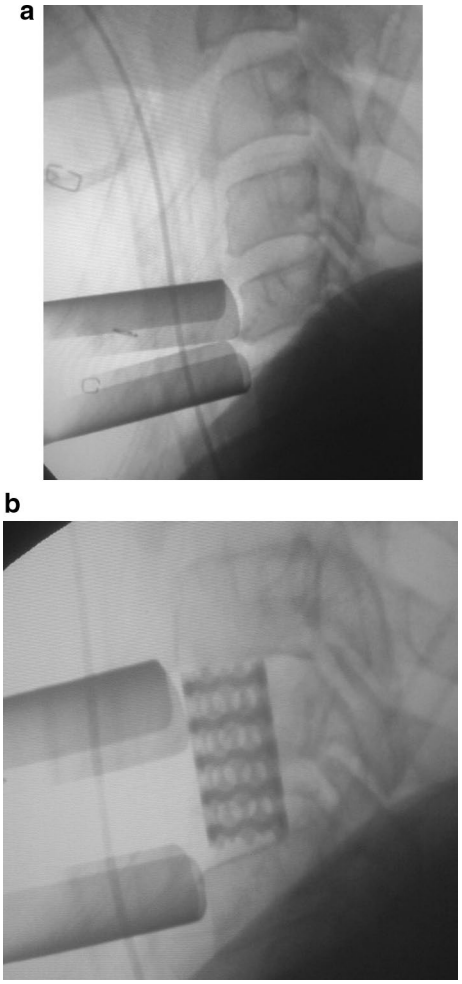

Fig. 3 **a** Tubular retractor docked over C5 body. **b** Tubular retractor expanded to execute C5 corpectomy and reconstruction with MESH cage

(Fig. 3). Locking plate was inserted through the tube and screws applied into C4 and C6 bodies. One of the other options of-course is discectomy at C4–5 and removal of the retro-vertebral disc using long nerve-hooks. If this was not successful, then combine that with a C5–6 discectomy and removal of the retro-vertebral disc piece-meal from beneath.

Results

No surgery-related complications were observed. Operative time was 145 min, intra-operative blood loss: 80 ml and nil post-operatively. The patient was relieved of his left upper limb pain and subjective heaviness improved. Wound healed without complications and patient had a cosmetic scar (Fig. 4a). Postoperative plain radiographs show good positioning of the cage and plate (Fig. 4b). Patient in the post-operative period did not have dysphagia which is one of the significant complaints in patients with anterior cervical spine surgery.

Case 2

A 34-year-old male presented with neck pain and bilateral upper limb radicular pain since 3 months with associated paraesthesia. The pain radiated to the proximal interscapular region, as well as to the shoulder and upper extremities. Patient had no relief with conservative management. On examination, patient had painful neck movements and Spurling's test positive on both sides. MRI depicted severe compression at C4–C5 and C5–C6 (Fig. 5a–c). A decision for two-level ACDF was made.

Making use of the surgical technique described above, the initial dilator was docked over the C4–C5 disc space and tubular retractor was attached retracting the longus coli vertically through a 3-cm skin-crease incision. After discectomy, adequate decompression and disc space preparation under microscope guidance, a stand-alone cage was inserted in the disc space and the same was confirmed under C-arm

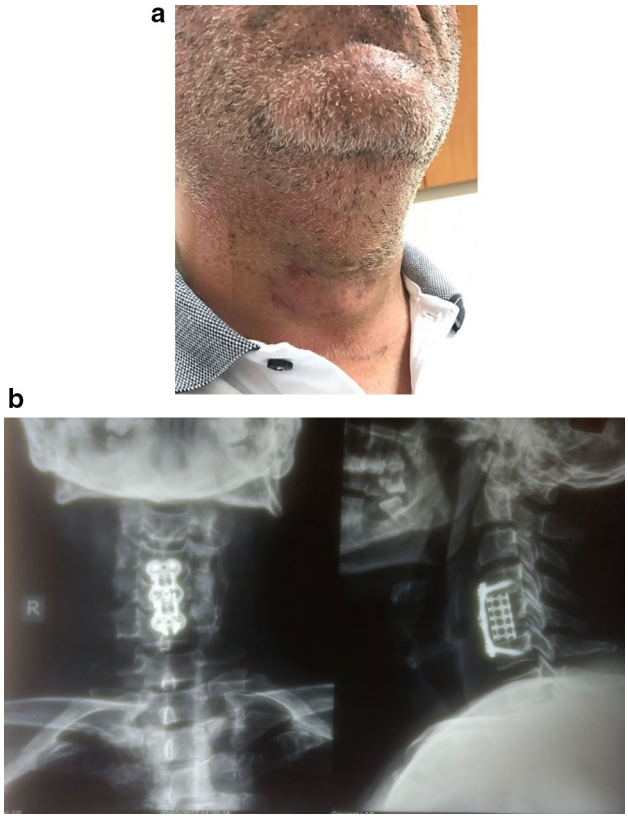

Fig. 4 **a** Cosmetic scar, final post op X-ray, AP and lateral views. **b** Final post-operative radiographs—AP and lateral views

guidance. Tubular retractor was removed and the initial dilator was re-introduced under C-arm guidance over the C5–C6 disc space through the same incision. After sequential dilation, retractor system was inserted, connected to the side attachment and ACDF with stand-alone cage was done at this level (Fig. 6a, b).

Results

The blood loss intra-operative and post-operative was 60 ml and nil, respectively, with an operative time of 110 min. Patient had significant clinical improvement. No postoperative dysphagia was seen. Postoperative radiographs showed accurate placement of the implants (Fig. 7a, b).

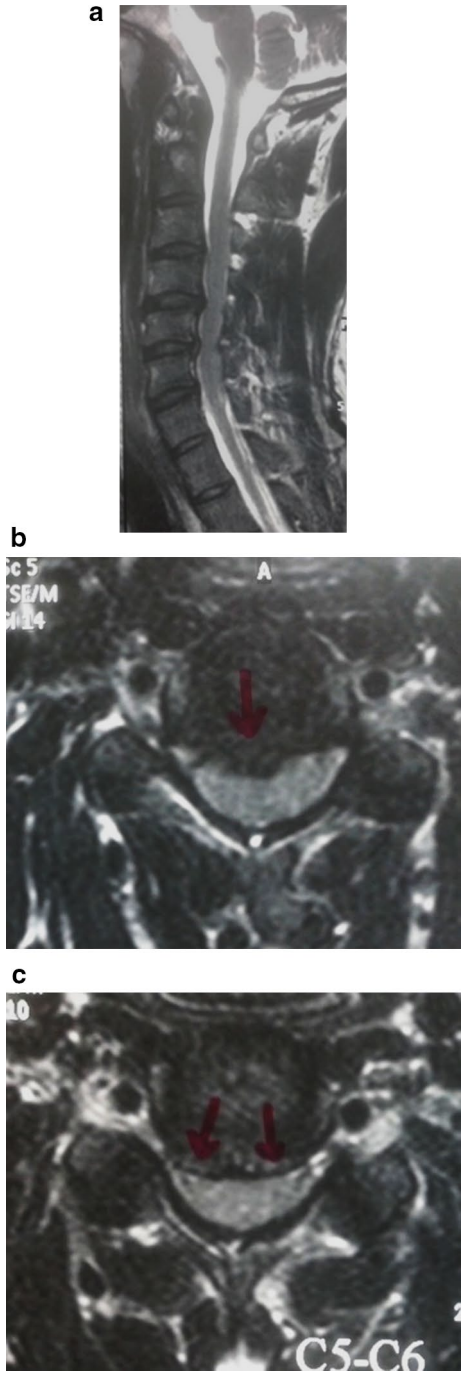

Fig. 5 **a** Sagittal MRI showing compression at C4–C5 and C5–C6. **b** Axial MRI showing compression at C4–C5. **c** Axial MRI showing compression at C5–C6

Discussion

Anterior cervical discectomy and fusion (ACDF) as well as anterior cervical corpectomy and fusion (ACCF) have been supported in the literature as effective treatment strategies of cervical disc degenerative disorders. The advantages of these procedures include direct decompression of spinal cord and nerve roots, establishment of immediate stability of the involved segments, restoration of cervical lordosis and anterior column reconstruction [7, 14]. However, complications such as dysphagia, hematoma, recurrent laryngeal nerve palsy and oesophageal perforation have been documented in the literature [9, 10, 16, 18, 19]. Minimal access surgery with its advantages of reduced blood loss, minimal

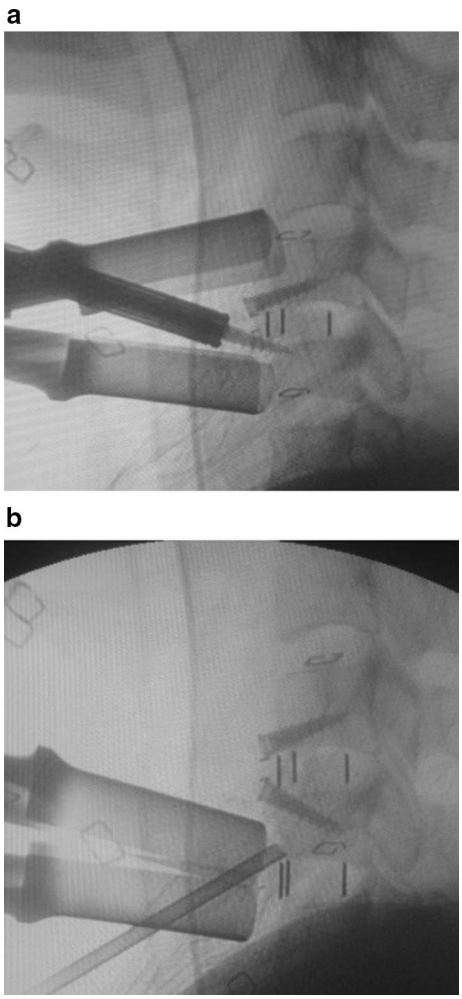

Fig. 6 **a** Anterior reconstruction at C4–5. **b** Anterior reconstruction at C5–6

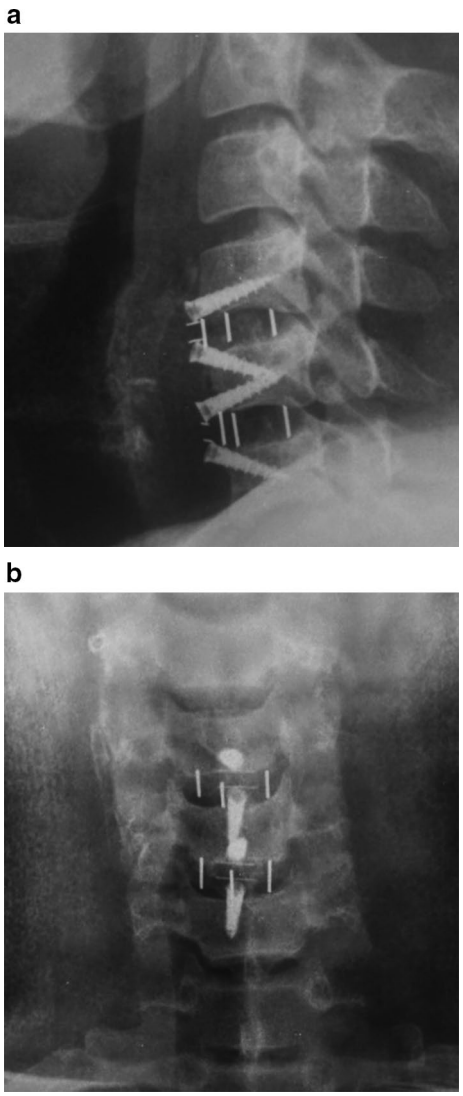

Fig. 7 **a** Post-operative lateral radiograph. **b** Post-operative AP radiograph

tissue dissection, cosmesis, and reduced postoperative pain is being increasingly used in spine surgeries [15].

Tubular retractors have been commonly used for posterior-based approaches to the lumbar, thoracic and cervical spine. The authors have in the past published a case report on the use of tubular retractors in the excision of osteoid osteoma of the C2 vertebra through posterior approach [17]. There are very few reports published on the use of these tubular retractors in anterior cervical spine surgeries. Yao et al. [11] published a full endoscopic technique of ACDF for single-level discectomy and concluded that endoscopic ACDF with a 2-cm port appears to be a safe and potentially advantageous augmentation to this already successful procedure. Here, the authors present two case reports on the use of tubular retractors in anterior cervical spine surgery. In the first case, a C5 corpectomy and reconstruction with a cage and plate was done through a tubular retractor. The expandability of the tubular retractor system allowed the procedure to be performed through this narrow corridor with minimal soft tissue injury which was reflected in the reduced postoperative pain, dysphagia and smaller scar of the patient (Fig. 4). The most common patient complaint after ACDF procedure is dysphagia; the reported incidence of which is up to 69% in the early postoperative period [18, 19]. The proposed causes of postoperative dysphagia include recurrent laryngeal nerve palsy, oesophageal ischemia and reperfusion injury, and local soft tissue swelling. Ratnaraj et al. [20] concluded that minimizing endotracheal cuff pressure, and minimizing the duration and pressure of intra-operative retraction may decrease the incidence of postoperative dysphagia. The utilization of tubular retractors allows the retractor to be fixed to the operating table, which maintains the correct working trajectory during the whole procedure, minimizing tension on surrounding soft tissue often associated with manual retraction during open spine surgery. Again,

as can be noticed in the lateral images (Figs. 3, 4, 5, 6), the blades of the retractors were opened in the cranio-caudal plane to accommodate for the distraction pins and to provide trajectory for the screws. This is in contrast to traditional method of side-ways retraction which makes the oesophagus prone to impingement by retractor blade if not placed properly. Interestingly, the blades maintain the medio-lateral retraction and restrict the lateral structures (longus coli, trachea and oesophagus, etc.) from obstructing the operating field. This probably helps in minimizing the incidence of post-operative dysphagia which was evidently absent in both the patients described here, making the technique less invasive and hence probably more effective.

In view of the steep learning curve for surgeons using MIS techniques, the narrow working corridor provided by the tubular retractors, and difficulties in distracting intervertebral space in severely degenerated segments, these procedures should be performed by experienced surgeons who are acquainted with the use of this system. Further validation of the benefits need to be done by comparison with a control patient group.

Conclusion

Complex anterior-based minimally invasive cervical procedures can be performed successfully with the use of tubular retractors. Minimally invasive approach to anterior cervical spine with tubular retractors minimizes soft tissue trauma and allows uneventful recovery of patients in the postoperative period.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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