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Case Report

Management of severe traumatic flexion-distraction injuries in a multisystem trauma patient: A case report

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ABSTRACT

Study design: Case report and relevant literature review.*Objective:* To discuss the management of severe flexion-distraction injury of the subaxial cervical spine in a multisystem trauma patient.*Summary of background data:* Traumatic cervical spine injury from flexion-distraction injury can cause significant instability requiring extensive instrumentation complicated by vascular and soft tissue injuries.*Methods:* The medical record of a patient who suffered traumatic flexion-distraction injury was reviewed for relevant clinical and radiology data. A literature review on the management of traumatic cervical injuries was performed using the PubMed database.*Results:* We report a case of 21-year-old woman who suffered a C5–C6 flexion-distraction injury. After she underwent anterior cervical discectomy and fusion (ACDF), her care was transferred to the senior author (S.K.) due to the severity of the distraction. The patient returned to the OR the next day and underwent removal of implants at C5 and corpectomy with anterior and posterior instrumentation.*Conclusion:* There are many ways to manage a flexion-distraction injury of the cervical spine. In a polytrauma patient, the surgical strategy can become complex. We present a surgical option with an acceptable outcome.

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Introduction

Flexion-distraction injuries account for 61% of all subaxial cervical injuries [1]. There are many ways to treat flexion-distraction injuries, including an anterior, posterior, or combination decompression and

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Fig. 1. CT and MRI of cervical spine at presentation. There is a 3 mm retrolisthesis of C5 on C6 with widening of the disk interspace and interspinous distance indicating ligamentous injury. There is facet distraction bilaterally at C5/C6 level indicating instability of cervical spine at this level. Sagittal view of an STIR-weighted image demonstrates extensive ligamentous injury and soft-tissue edema/hematoma with widening of the C5–C6 disk and interspinous space. Small anterior epidural hematoma is also noted at this level.

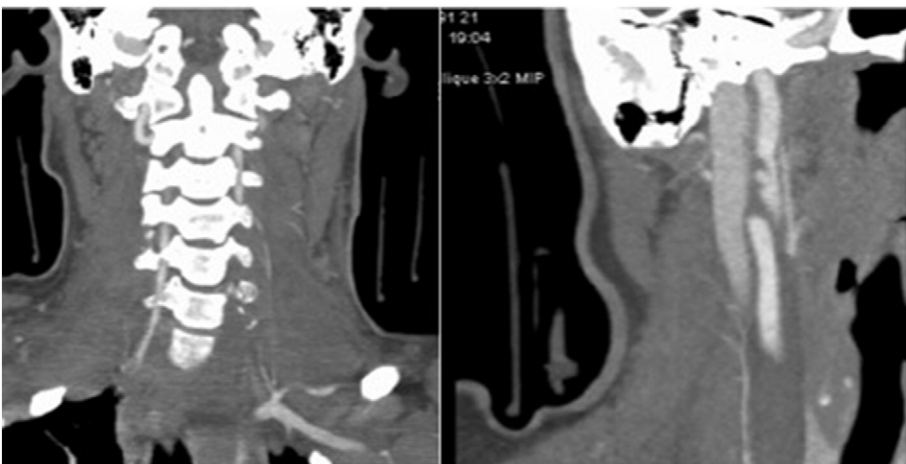


Fig. 2. CTA of the neck demonstrates a fracture of the C6 left transverse process with an associated loss of opacification of the left vertebral artery at the levels of C4–C7 (left). There is an intimal flap with a small 4 mm pseudoaneurysm in the distal right cervical internal carotid artery (right).

stabilization. In patients who sustained severe polytrauma, the management of their cervical spine injury can be confounded by vascular injury, soft-tissue injury, and dural rent.

Case report

We report a 21-year-old woman who suffered a motor vehicle accident and who initially presented with full strength on motor examination; however, she quickly decompensated with decreased strength in upper extremities (deltoid 4/5 B, bicep 4 –/5 B, triceps 2/5 R 3 +/5L, wrist 3 –/5 B, grasp 1/5 R 4/5 L and interosseous 1/5 R 3/5L). CT of the cervical spine demonstrated widening of the interspinous space at C5–C6 with 3 mm retrolisthesis of C5 on C6. Cervical MRI demonstrated kyphosis and extensive ligamentous disruption (Fig. 1). Even though there were no bony injuries noted on the CT of cervical spine, there was significant ligamentous damages including a complete disruption of anterior longitudinal ligament (ALL), disk space, posterior longitudinal ligament (PLL) and facet capsules at C5–C6 bilaterally. This extensive soft tissue damage indicated an unstable flexion-distraction injury at C5–C6 level. CT angiography (CTA) demonstrated a complete occlusion of the left proximal vertebral artery and 70% stenosis of the right distal carotid (Fig. 2). The patient underwent emergent C5–C6 ACDF for neurological deterioration. Cerebrospinal fluid leak was noted intraoperatively. The placement of an appropriate-size graft was increasingly difficult due to significant soft tissue injury, continuous distraction, and lack of purchase by interbody graft (Fig. 3). The patient was placed in a halo



Fig. 3. Intraoperative x-ray after C5–6 ACDF demonstrates lucency between the graft and the endplates, indicating that the graft is not well opposed to the endplates despite using a large interbody graft. Facets are distracted significantly at C5–6 level compared to the levels above and below.

and the senior author (S.K) was consulted. She underwent removal of implants and C5 corpectomy with placement of an ADDplus™ (Ulrich Medical, Ulm, Germany) expandable cage. The height of the expandable cage was adjusted under continuous motor-evoked potential (MEP) and somatosensory-evoked potential (SSEP) monitoring. Posteriorly, she underwent C6 laminectomy and left-sided instrumented fusion (Fig. 4). The patient was started on Plavix postoperatively for right carotid artery dissection after the lumbar drain was discontinued. She remained in a halo until postoperative day 52. On one-year follow-up, she remained neurological intact with stable construct on CT (Fig. 5).

Discussion

When there has been an extensive flexion-distraction injury to subaxial cervical spine resulting in a three-column injury, cervical stabilization and realignment is necessary. There are many surgical options to stabilize a three-column injury of cervical spine. In our case, anterior cervical discectomy and fusion (ACDF) was performed emergently with a plan to add further stabilization with unilateral lateral mass screws from the posterior approach as a second stage operation. In the setting of extensive ligamentous disruption, we encountered lack of graft purchase due to severe distraction. We decided to revise the ACDF with corpectomy and the placement of an expandable cage with anterior fixation screws to address one major concern: graft dislodgement into the canal. There are both limitations and benefits to this system.

The lucency between the graft and the endplates and significant distractions of bilateral facets at C5–C6 were noted on intraoperative x-rays, however using a larger graft only lead to further distraction. During the second operation, utilization of an expandable cage by the senior author (S.K.) allowed for better apposition of graft to the endplates, preventing dislodgement and improving bony fusion across the endplates without further distraction [2–4]. In addition, the ADDplus™ expandable cage has an attached anterior plating system, which allows direct fixation of the cage to the vertebral body above and below, further preventing graft migration into the canal. In addition, we intentionally left the posterior wall of the C5

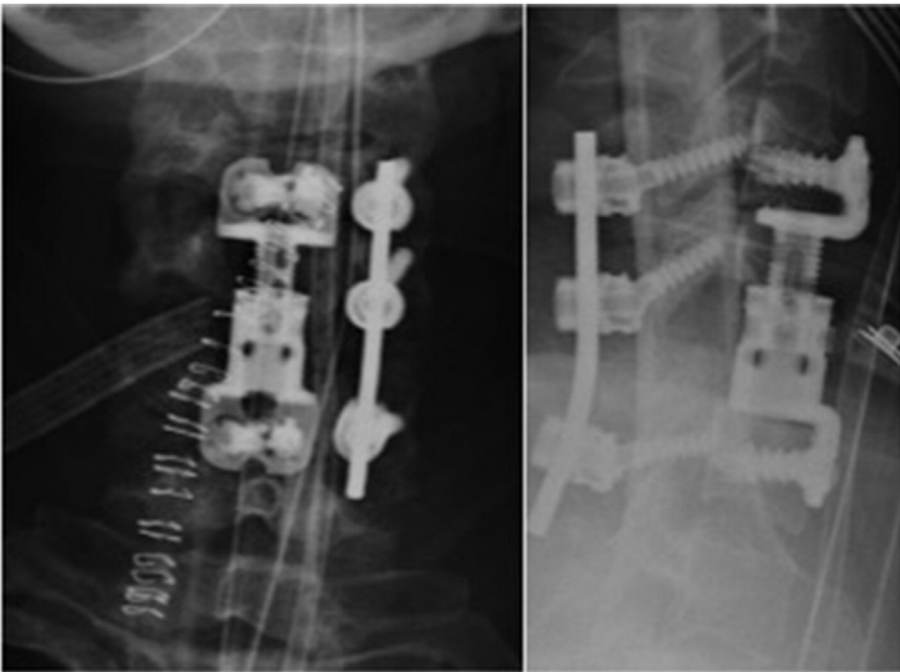


Fig. 4. Postoperative day 1 cervical x-ray after the patient underwent C5 corpectomy and the placement of the expandable cage with a built-in anterior cervical plating system. Unilateral lateral mass screws were placed on the left side. The expandable cage is well opposed to the endplates.

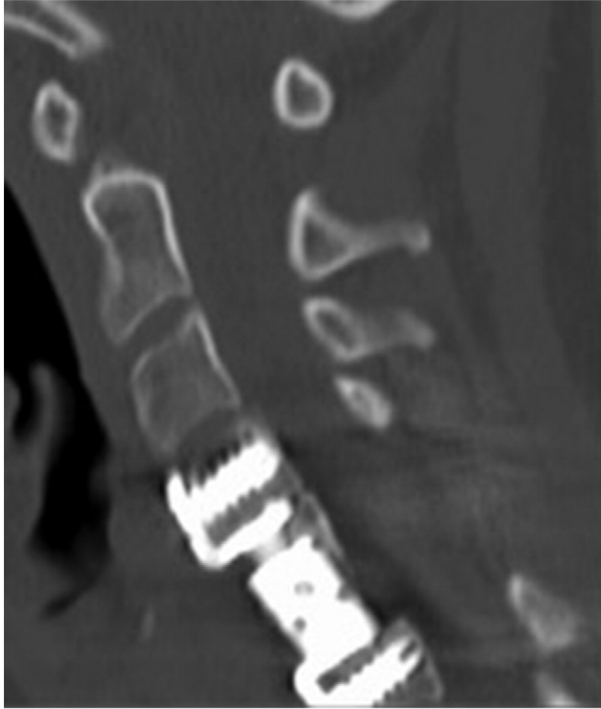


Fig. 5. The postoperative CT at one year demonstrates a satisfactory placement of expandable cage at C5 without evidence of migration. The remnant of the posterior wall of the C5 vertebral body can be appreciated.

vertebral body intact (Fig. 5) to prevent graft dislodgement toward the canal as well as to allow a larger surface area for bony fusion to take place anteriorly.

Meta-analysis of fusion rates for one-level ACDF and one-level corpectomy were found to be comparable at 97.1% and 92.9%, respectively [5]. Other studies report 79% to 100% fusion rates for a single and multilevel cervical corpectomy and fusion using an expandable cage [6]. Cabraja et al. reports the fusion rate of 89% in expandable cage with anterior fixation screws group while it was 100% in expandable cage with a separate dynamic plate in a series of patients undergoing cervical corpectomy and fusion [7]. Payer, Woiciechowsky, Arts and Peul all report fusion rates of 93% to 100% with the ADDplus™ expandable cage at follow-up [2,3,8]. Thus, an expandable cage is an acceptable alternative graft option with comparable fusion rates to ACDF if there is a pathology that deems ADDplus™ superior such as prevention of graft migration. There are instrumentation limitations and challenges that do not make this the desired system uniformly.

Conclusion

For traumatic flexion-distraction injury with three-column ligament disruption, a combined anterior and posterior fusion can be utilized to decompress and stabilize cervical spine. The placement of an expandable cage with an anterior fixation system after corpectomy may be an acceptable option to prevent graft dislodgement in a case where severe distraction is present in the disk space.

Conflict of interest

Dr. Keshavarzi has a consulting agreement with Orthofix.

References

- [1] K. Radcliff, B.G. Thomasson, Flexion-distraction injuries of the subaxial cervical spine, *Semin. Spine Surg.* 25 (2013) 45–56.
- [2] C. Woiciechowsky, Distractable vertebral cages for reconstruction after cervical corpectomy, *Spine* 30 (2005) 1736–1741.
- [3] M. Payer, Implantation of a distractible titanium cage after cervical corpectomy: technical experience in 20 consecutive cases, *Acta Neurochir.* 148 (2006) 1173–1180 (discussion 80).
- [4] M. Morlock, J. Strandborg, K. Sellenschloh, R. Nassutt, K. Puschel, C. Eggers, Comparison of different vertebral body prosthesis with reference to migration and primary stability in dorsoventral spondylodesis after corpectomy with and without laminectomy, *Orthopade* 31 (2002) 514–521.
- [5] J.F. Fraser, R. Hartl, Anterior approaches to fusion of the cervical spine: a metaanalysis of fusion rates, *J. Neurosurg. Spine* 6 (2007) 298–303.
- [6] B.D. Elder, S.F. Lo, T.A. Kosztowski, C.R. Goodwin, I.A. Lina, J.E. Locke, et al., A systematic review of the use of expandable cages in the cervical spine, *Neurosurg. Rev.* (2015).
- [7] M. Cabraja, A. Abbushi, S. Kroppenstedt, C. Woiciechowsky, Cages with fixation wings versus cages plus plating for cervical reconstruction after corpectomy – is there any difference? *Cent. Eur. Neurosurg.* 71 (2010) 59–63.
- [8] M.P. Arts, W.C. Peul, Vertebral body replacement systems with expandable cages in the treatment of various spinal pathologies: a prospectively followed case series of 60 patients, *Neurosurgery* 63 (2008) 537–544 (discussion 44–5).