



Case Report

Minimally invasive corpectomy and posterior stabilization for lumbar burst fracture

Jason C. Eck, DO, MS*

Department of Orthopedic Surgery, University of Massachusetts, 119 Belmont St, Worcester, MA 01605, USA

Received 5 October 2010; revised 6 March 2011; accepted 14 June 2011

Abstract

BACKGROUND CONTEXT: Surgical indications for lumbar burst fracture remain controversial. Potential indications for surgery include 50% canal compromise, 50% loss of vertebral height, 30° of kyphosis, and posterior element fracture or disruption of the posterior ligamentous complex. Different surgical approaches are available depending on fracture characteristics. It is possible that a minimally invasive approach could allow for a safe and effective treatment with fewer comorbidities than the traditional open technique.

PURPOSE: This is a report of an L3 burst fracture treated with a minimally invasive approach for anterior corpectomy and posterior pedicle screw fixation.

STUDY DESIGN: Case report.

PATIENT SAMPLE: Patient with L3 burst fracture.

OUTCOME MEASURES: Radiographs and computed tomography scans to evaluate for fusion and evaluation of pain and neurologic function.

METHODS: A 30-year-old male was involved in a head-on motor vehicle collision. Initial imaging revealed an L3 burst fracture with 60% canal compromise, 50% loss of vertebral body height, a large anteriorly displaced fragment consisting of 40% of the vertebral body depth, and a facet fracture. Surgical decompression and stabilization were recommended for this patient because of radiographic signs of instability. After medical clearance and consent, the patient underwent a minimally invasive L3 corpectomy and L2–L4 interbody fusion through a direct lateral approach with placement of a titanium mesh cage filled with local autograft and allograft bone matrix. The patient then underwent a percutaneous stabilization with pedicle screw fixation from L2 to L4.

RESULTS: The patient was ambulating on the first postoperative day, and pain was controlled with oral analgesics. Intraoperative blood loss was less than 100 cc. He was discharged to a rehabilitation facility on the second postoperative day. Postoperatively, he complained of some left lower extremity pain and numbness. The pain completely resolved by the 6-month follow-up visit. The numbness in the anterolateral left thigh was improved but not completely resolved at 12 months. He continued to have full strength in all extremities.

CONCLUSION: The traditional approach to an anterior lumbar corpectomy and posterior pedicle screw fixation involves significant postoperative pain and frequent ileus. This minimally invasive approach allowed for early mobilization, resumption of diet, and discharge from the hospital on postoperative day two. © 2011 Elsevier Inc. All rights reserved.

Keywords:

Lumbar burst fracture; Minimally invasive surgery; Corpectomy; Percutaneous fixation

FDA device/drug status: Approved (Medtronic Longitude pedicle screws; titanium cage). Not approved for this indication (Medtronic Direct Lateral Interbody Fusion technique).

Author disclosures: **JCE:** Speaking/Teaching Arrangements: Medtronic (B); DePuy (A); Stryker Spine (B).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

* Corresponding author. Department of Orthopedic Surgery, University of Massachusetts, 119 Belmont St, Worcester, MA 01605, USA. Tel.: (508) 334-9764; fax: (508) 334-9769.

E-mail address: jason.eck@umassmemorial.org (J.C. Eck)

Introduction

Lumbar burst fractures are a common injury resulting from motor vehicle accidents, falls from height, and other modes of trauma. Historically, the guidelines for operative treatment included greater than 50% loss of vertebral body height, greater than 50% canal compromise, greater than 30° of kyphosis, or the presence of a neurologic deficit. These radiographic criteria are felt to indicate mechanical instability, but were retrospectively derived, highly variable

among authors, and are not definitively proven to define instability. More recent studies have focused on the integrity of the posterior ligamentous complex in determining stability of lumbar burst fractures [1–3].

There are numerous options for the surgical treatment of unstable burst fractures or those with neurologic injury. Fractures can be approached through an anterior, posterior, or combined technique. The combined approach allows for the greatest stability, minimizes the number of levels fused, and allows for a direct decompression of the spinal canal. Unfortunately, this technique comes with a higher morbidity, frequent ileus, and longer recovery times. Newer techniques have attempted to use less invasive techniques to decrease the associated morbidity. These have included combining vertebral augmentation with pedicle screw instrumentation [4,5] and transpedicular corpectomy with expandable cage combined with pedicle screw fixation [6].

The purpose of the report is to present a case of an L3 burst fracture treated with a minimally invasive anterior and posterior fixation technique.

Case report

A 30-year-old male was involved in a head-on motor vehicle collision. Initial imaging revealed an L3 burst fracture with 60% canal compromise, 50% loss of vertebral body height, a large anteriorly displaced fragment consisting of 40% of the vertebral body depth, and a facet fracture (Fig. 1). At the scene, he had a sudden onset of complete loss of motor strength and sensation in bilateral lower extremities. On presentation to the emergency department, he had regained full motor strength but had some continued sensory deficits. The sustained sensory deficits did not correspond to a specific nerve root distribution and were

more likely the result of central canal stenosis from the fracture fragment retropulsion. The degree of disruption of the anterior and middle column support combined with a fracture through the posterior column in the facet joint suggested that this patient had a mechanical instability that warranted surgical decompression and stabilization. Anterior column reconstruction was recommended to the patient because of the comminution and displacement of the vertebral body. It was felt that short-segment posterior stabilization alone would not be sufficient. By reconstructing the anterior column, a shorter segment fusion could be performed and maximize the patient's remaining available motion segments.

After medical clearance and consent, the patient underwent a minimally invasive L3 corpectomy and L2–L4 interbody fusion through a direct lateral approach with placement of a titanium mesh cage filled with local autograft and allograft bone matrix. The patient was positioned on a radiolucent table with an inflatable beanbag in the left lateral position with the left hip and knee flexed to relax the psoas muscle. The beanbag was inflated to increase the available working space between the ribs and the iliac crest. This could also be accomplished with a bending table. Anteroposterior and lateral fluoroscopic images were achieved before prepping and draping the patient to verify adequate visualization. The center of the L3 vertebral body was identified. The skin and subcutaneous tissues were incised and the dissection carried through the abdominal muscles. The retroperitoneal space was reached under direct visualization. The psoas muscle was identified. The neuromonitoring probe was attached to a Jamshidi needle and then docked on and gently passed through the psoas muscle. Free-running and trigger electromyography (EMG) was used. If a response was generated from the EMG, the dissection was moved more anteriorly on the vertebral body

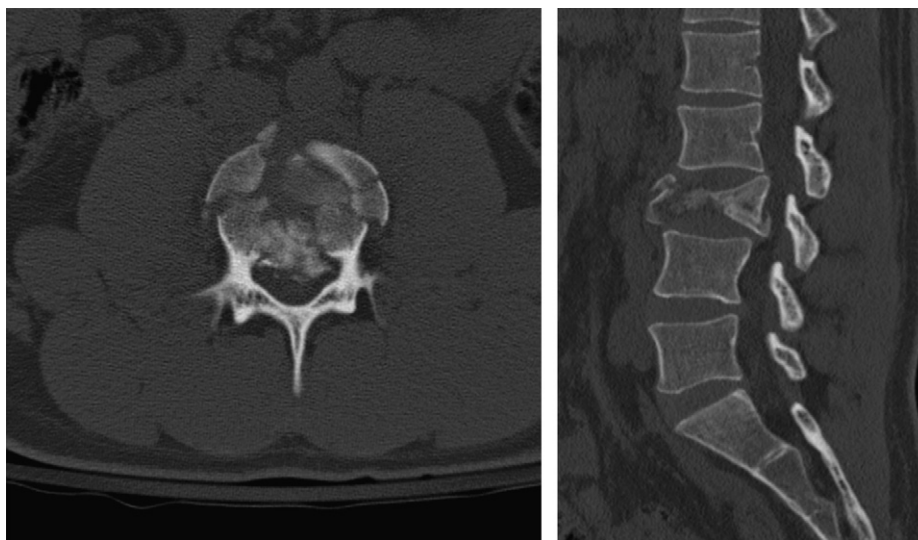


Fig. 1. Initial computed tomography scan (Left, axial; Right, sagittal) of the lumbar spine revealing an L3 burst fracture with 60% canal compromise, 50% loss of vertebral body height, a large anteriorly displaced fragment consisting of 40% of the vertebral body depth, and a facet fracture.

to avoid the genitofemoral nerve and exiting nerve roots. Once the lateral aspect of the vertebral body was reached with the monitoring probe, the Jamshidi needle was docked into the vertebral body. The inner stylet was removed, and a guide wire was passed through the outer cannula. Sequential dilation was performed with tubes over the guide wire while performing free-running EMG. A retractor system was then placed over the final dilating tube, and the tubes were removed, leaving the retractor in place. The retractor blades were then gently opened to span the distance from the inferior end plate of L2 to the superior end plate of L4. The EMG probe then verified a safe working area within the retractor blades. Pins were then placed through the retractor blades into the L2 and L4 vertebral bodies to hold it securely in place. The L2–L3 and L3–L4 discs were removed under fluoroscopic guidance to avoid penetrating beyond the contralateral annulus. The comminuted L3 vertebral body was then removed, decompressing the central canal. The end plates were decorticated. A caliper was used to determine the length of the graft. A titanium mesh graft was cut to size and packed with local autograft and gentle impacted into place under fluoroscopic guidance. The beanbag was released to add further compression of the graft. The retractors were removed. A layered closure was performed of the transversalis and external oblique fascia, subcutaneous tissue and skin. The patient was then turned to the prone position and underwent a percutaneous stabilization with pedicle screw fixation from L2 to L4 as described in detail elsewhere (Fig. 2) [7,8].

The patient tolerated the procedure well without complications. Total operative time for the combined procedures

was 3 hours. Intraoperative blood loss was less than 100 cc. The patient was ambulating on the first postoperative day, pain was controlled with oral analgesics, and was tolerating a regular diet. He used a lumbar corset for comfort when out of bed. The patient was ambulating well on flat surfaces after the first day, but he had numerous stairs to navigate at his home. He was not yet able to manage the stairs at this point, so he was discharged to a rehabilitation facility on the second postoperative day.

Postoperatively, his pain was markedly improved, but he did continue to initially complain of some left lower extremity pain and numbness. The pain completely resolved by the 6-month follow-up visit. The numbness in the anterolateral left thigh was improved but not completely resolved at 12 months. He continued to have full strength in all extremities. He had returned to all activities without restrictions.

Discussion

Although there are various options available for the surgical management of unstable lumbar burst fractures, many are associated with significant postoperative pain, hospital stay, and ileus. This case presents another potential surgical technique with less morbidity, blood loss, pain, and risk for developing an ileus.

Percutaneous pedicle screw instrumentation has been gaining rapid acceptance with expanding indications [7,8]. Reported benefits include decreased muscle damage, less postoperative pain, and decreased blood loss [9].

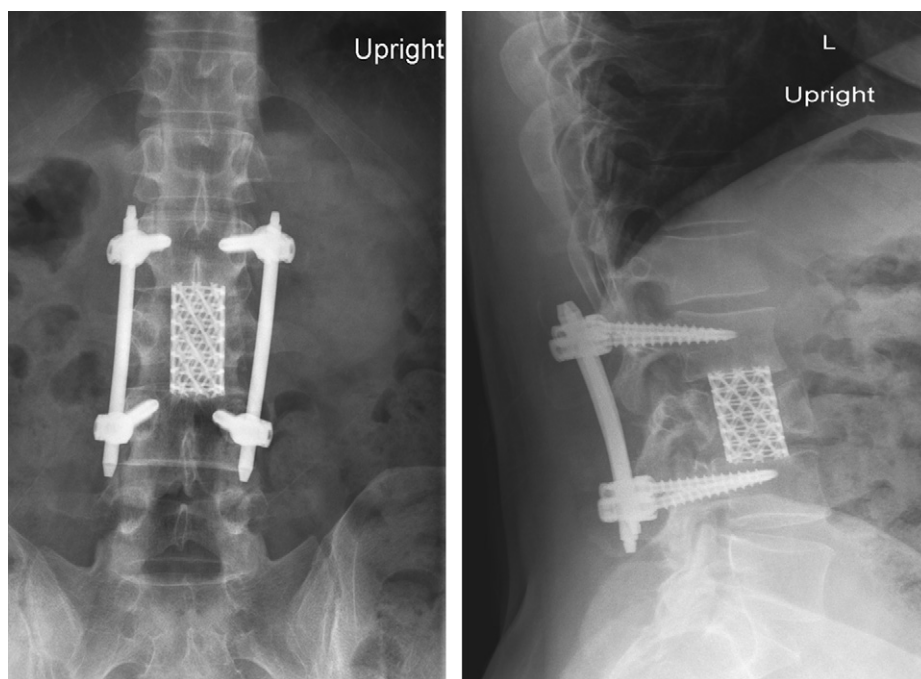


Fig. 2. Postoperative radiographs (Left, anteroposterior; Right, lateral) showing placement of the corpectomy cage and posterior pedicle screw fixation from L2 to L4.

Previous investigators have quantified the amount of muscle damage that occurs with spine surgery with measurements of creatine kinase [10,11]. Open lumbar fusions were found to result in significantly greater levels of creatine kinase than percutaneous techniques. Drawbacks of this technique include increased radiation exposure to the surgeon, staff, and patient, as well as an initially increased operative time during the learning curve [12].

Minimally invasive approaches to the anterior lumbar spine include mini-open techniques, laparoscopic-assisted transsacral and trans-psoas approaches. The lateral transpsoas approach to the lumbar spine allows for an anterior approach to the intervertebral disc through a small lateral incision for placement of a large interbody cage on the apophyseal ring. Benefits of this approach include avoiding the need for retraction of the retroperitoneal vessels and sympathetic plexus, less muscle dissection, and less manipulation of the abdominal contents, and subsequent ileus. One of the main disadvantages of the lateral transpsoas approach is the lack of direct visualization compared with the traditional open technique. Instead, the surgeon is dependent on fluoroscopy and EMG. Potential risks include injury to the exiting nerve roots. Anatomic studies have identified the location of the exiting ventral nerve roots in relation to the vertebral body [13]. The safe zone lays at the anterior to middle portion of the vertebral body. This zone narrows at the more caudal levels.

The patient in the current case presented with a mechanically unstable lumbar burst fracture. The degree of comminution and displacement of the anterior column were believed to suggest mechanical instability that could not be adequately controlled with bracing alone. Reconstruction of the anterior column was recommended to the patient in an attempt to minimize the number of fusion levels needed and maximize his postoperative motion segments. He had an initial neurologic deficit that improved significantly from the time of injury to presentation at the trauma center. He tolerated the minimally invasive procedure well. Postoperatively, he did complain of left thigh pain and numbness. The pain was completely resolved at 6 months, and the numbness was markedly improved but not completely resolved at the 1-year follow-up visit. It is uncertain if his thigh pain and numbness were related to the transpsoas approach or the result of his injury. There were no abnormal alerts from neuromonitoring at baseline or throughout the case to suggest an iatrogenic injury, but this does not rule out the possibility.

Another potential source of iatrogenic injury to the patient was during inflation of the beanbag to further open the space between the ribs and the iliac crest. This could have led to further migration of the unstable fracture fragments. The amount of necessary bending was minimized because of the L3 level being the most accessible. The beanbag was released after placement of the cage to minimize any iatrogenic scoliosis.

Although this technique is certainly not recommended for routine use in lumbar burst fractures, it was a safe

and effective approach for this patient and allowed for an expedited recovery compared with the traditional open techniques. The specific characteristics of this case that made it amenable to the less invasive approach were the patient size and the location of the fracture. The patient's vertebral body heights were approximately 24 mm, and the distance between the end plates of L2 and L4 was 27 mm. The smaller size of his vertebrae allowed access to the L3 fracture and securing the retractors to the neighboring end plates. During the approach, sequential dilation with tube dilators is performed up to 22 mm. An expandable retractor system is then inserted over the dilators and secured to the vertebrae. This retractor can be expanded to a final distance of 30 mm. Additionally, each blade can be angled up to 30°. In the present case, the titanium mesh cage was able to be directly inserted through the dilated retractor. The system would not allow for sufficient exposure for patients with larger vertebral body heights.

The location of the fracture at the L3 level was also advantageous. The lateral transpsoas technique is best used between L2 and L4. Caudal to that level, there is increased risk to the exiting nerve roots and limitations from the overlying iliac crest. Above that level, there is possible overlap of the diaphragm.

This case presents a novel minimally invasive technique for the treatment of certain lumbar burst fractures that allows for improved blood loss and muscle damage, with an expedited recovery period.

References

- [1] Vaccaro AR, Zeiller SC, Hurlbert RJ, et al. The thoracolumbar injury severity score: a proposed treatment algorithm. *J Spinal Disord Tech* 2005;18:209–15.
- [2] Vaccaro AR, Lee JY, Schweitzer KM, et al. Assessment of injury to the posterior ligamentous complex in thoracolumbar spine trauma. *Spine J* 2006;6:524–8.
- [3] Vaccaro AR, Rihn JA, Saravanja D, et al. Injury of the posterior ligamentous complex of the thoracolumbar spine: a prospective evaluation of the diagnostic accuracy of magnetic resonance imaging. *Spine* 2009;34:E841–7.
- [4] Korovessis P, Hadjipavlou A, Repantis T. Minimally invasive short posterior instrumentation plus balloon kyphoplasty with calcium phosphate for burst and severe compression lumbar fractures. *Spine* 2008;33:658–67.
- [5] Pflugmacher R, Agarwal A, Kandziora F, Klostermann C. Balloon kyphoplasty combined with posterior instrumentation for the treatment of burst fractures of the spine: 1-year results. *J Orthop Trauma* 2009;23:126–31.
- [6] Chou D, Wang VY, Gupta N. Transpedicular corpectomy with posterior expandable cage placement for L1 burst fracture. *J Clin Neurosci* 2009;16:1069–72.
- [7] Fuentes S, Blondel B, Metellus P, et al. Percutaneous kyphoplasty and pedicle screw fixation for the management of thoraco-lumbar burst fractures. *Eur Spine J* 2010;19:1281–7.
- [8] Harris EB, Massey P, Lawrence J, et al. Percutaneous techniques for minimally invasive posterior lumbar fusion. *Neurosurg Focus* 2008;25:E12.
- [9] Dickerman RD, East JW, Winters K, et al. Anterior and posterior lumbar interbody fusion with percutaneous pedicle screws: comparison to muscle damage and minimally invasive techniques. *Spine* 2009;34:E923–5.

- [10] Arts MP, Nieborg A, Brand R, Peul WC. Serum creatine phosphokinase as an indicator of muscle injury after various spinal and nonspinal surgical procedures. *J Neurosurg Spine* 2007;7: 282–6.
- [11] Kumbhare D, Parkinson W, Dunlop B. Validity of serum creatine kinase as a measure of muscle injury produced by lumbar surgery. *J Spinal Disord Tech* 2008;21:49–54.
- [12] Bindal RK, Glaze S, Ognoskie M, et al. Surgeon and patient radiation exposure in minimally invasive transforaminal lumbar interbody fusion. *J Neurosurg Spine* 2008;9:570–3.
- [13] Regev GJ, Chen L, Dhawwan M, et al. Morphometric analysis of the ventral nerve roots and retroperitoneal vessels with respect to the minimally invasive lateral approach in normal and deformed spines. *Spine* 2009;34:1330–5.