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CASE REPORT

Single-level transforaminal interbody fusion for traumatic lumbosacral fracture-dislocation : A case report

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L5S1 fracture-dislocations are rare three-column injuries. The infrequency of this injury has led to a lack of a universally accepted treatment strategy. Transforaminal lumbar interbody fusion (TLIF) has been shown to be an effective approach for interbody fusion in degenerative indications, but has not been previously reported in the operative management of traumatic lumbosacral dislocation. The authors report a case of traumatic L5S1 fracture-dislocation in a 30-year-old male, presenting with a right-sided L5 neurologic deficit, following a street sweeper accident. Imaging revealed an L5S1 fracture-dislocation with fracture of the S1 body. Open reduction with TLIF and L5S1 posterolateral instrumented fusion was carried out within 24 hours of injury. Excellent reduction was obtained, and maintained at long-term follow-up, with complete resolution of pain and neurologic deficit. In this patient, L5S1 fracture-dislocation was treated successfully, with an excellent outcome, with a single level TLIF and instrumented posterolateral fusion at L5S1.

Keywords : trauma ; lumbosacral fracture-dislocation ; transforaminal lumbar interbody fusion ; TLIF ; fusion.

INTRODUCTION

Traumatic fracture-dislocations of the lumbosacral spine are rare injuries. When L5S1 fracture-dislocation does occur, it frequently results in neurologic deficits, and is invariably the result of severe forces which result in significant instability. Maintenance of reduction can be difficult, particularly if the facets are fractured. Moreover, treatment is hindered by the lack of established protocols.

Fewer than 80 patients with traumatic L5S1 fracture-dislocations have been reported in the literature. Treatment for these injuries has ranged from bed rest and immobilization in an unreduced position (*32,44,52*) or in a spontaneously reduced position (*4,25*), to closed reduction by manipulation followed by immobilization (*3,5*), or open reduction and stabilization. Surgical methods have included open reduction obtained with or without facetectomies, followed by instrumented or non-instrumented posterior-only fusion, posterior decompression and fusion with posterior lumbar interbody fusion (PLIF), or posterior fusion with a second stage anterior lumbar interbody fusion (ALIF).

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Certain authors have restricted to an L5S1 fusion and have obtained excellent results. However, even with an injury isolated to L5S1, there is inconsistency in the number of segments included in the posterior fixation. Longer-segment posterior instrumentation with fusion has been used in an effort to mitigate the reduced strength of pedicle screw fixation in a deeply slipped L5 body (*24,35*), or to protect the L5 vertebra from the shear stresses of weight bearing (*8,35*).

Interbody fusion with an anterior column structural spacer reinforces the load bearing capacity and stability of the injured motion segment. The increased segmental stability, the large interbody fusion surfaces and the positive effect of fusion under compressive loading anteriorly, all facilitate successful fusion of the injured segment. The indications for interbody fusion in lumbosacral fracture-dislocations have not been clearly delineated in previous reports, and range from cases with concurrent evidence of disc disruption on preoperative MRI (*18,46*), or bilateral (as opposed to unilateral) facet dislocations (*1*), to the necessity of substantial posterior bony resection for neural decompression (*46*). Interbody fusion for traumatic lumbosacral fracture- dislocation has been reported by other authors either via an ALIF, or a PLIF. ALIF requires a separate anterior incision, and can increase the morbidity in a polytraumatized patient. PLIF requires substantial retraction of already contused nerve roots and dural sac. Transforaminal lumbar interbody fusion (TLIF) has been utilized for degenerative disc disease and degenerative spondylolisthesis (*27*), but has not been previously reported in the management of patients with traumatic spondylolisthesis L5S1. The authors report a case of traumatic fracture-dislocation L5S1, treated acutely with single level TLIF and instrumented posterolateral fusion L5S1.

CASE REPORT

A 30-year-old male was driving a mechanized street sweeper when it spun out of control and rolled over. The roof of the vehicle was crushed, pinning the driver inside the cab of the vehicle. Examination in the emergency department revealed a large individual, 6'4" (193 cm) tall and weighing 285 pounds (129 kg) (BMI 34.7), with a primary complaint of lumbosacral pain. Neurological examination revealed a right-sided L5 deficit. A computerized tomography (CT) scan (Fig. 1, 2) and magnetic resonance imaging (MRI) (Fig. 3) showed a 35% spondylolisthesis L5S1. The L5S1 facet joint was dislocated on the left side (Fig. 1A, 3A). On the right side the patient had a fracture of the S1 superior articular process, sacral ala and sacral body (Fig. 1C, 2, 3C). The ligamentum flavum, the posterior longitudinal ligament and the posterior disc were completely disrupted at the L5S1 level (Fig. 3B). In addition to his spinal injury, the patient had a small intra-abdominal bleeding which was treated with observation.

The patient underwent surgical intervention on the day of injury. Intraoperatively, he was noted to have a large subcutaneous haematoma, lacerated lumbodorsal fascia and complete disruption of the interspinous ligaments and ligamentum flavum at L5S1, with the dural sac completely exposed at this level. Partial removal of the right-sided L5 inferior articular process and S1 superior articular process allowed thorough decompression of the right L5 nerve root. Reduction of the facet dislocation on the left was obtained by complete resection of the inferior articular process of L5 and superior articular process of S1. Large diameter pedicle screws (7.5 mm and 8.1 mm in diameter respectively) were inserted bilaterally into L5 and S1, with a deliberate attempt to capture and stabilize the anterior S1 body fracture using the right pedicle screw at S1. Both sacral pedicle screws were inserted bicortically into the S1 body to increase strength of fixation.

Gentle distraction was applied to the pedicle screws on the left side, while the L5 and S1 nerve roots were identified and protected. Through a left transforaminal approach, complete discectomy was carried out at L5S1. After reduction, a 12 mm tall polyetheretherketone (PEEK) spacer was inserted into the mid-portion of the L5S1 disc space. Local autogenous bone grafts were packed within and anterior to the spacer in the disc space. Rods were inserted connecting the pedicle screws and tightened in compression to fix the interbody spacer. Additional autogenous bone grafts were packed in

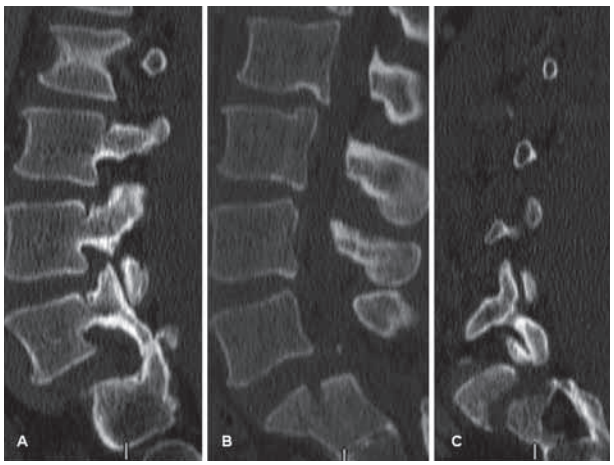

Fig. 1. — Sagittal CT reconstruction showing (A) left inferior articular process of L5 lying anterior to superior articular process of S1, (B) grade 2 spondylolisthesis of L5 on S1, widened interlaminar space and fracture of anterior body of S1, and (C) right superior articular process of S1 fractured at its base and displaced anteriorly along with the inferior articular process of L5.

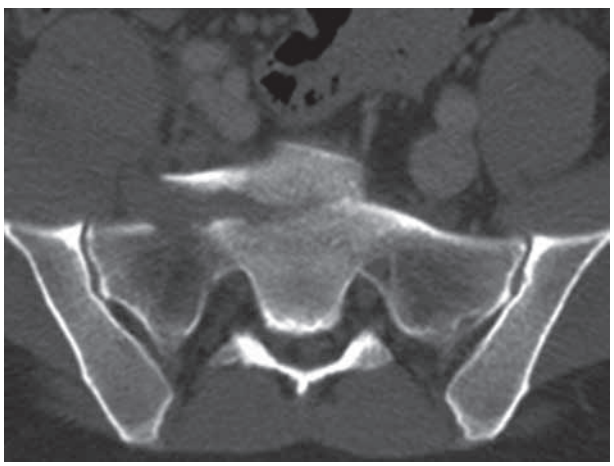

Fig. 2. — Axial CT image through S1 body showing right-sided ala and promontory fracture.

the lateral gutters to complete the fusion. The patient showed gradual recovery of the neurologic deficit over the next few months with progressive evidence of fusion. At the four years follow-up, the patient had complete recovery of motor and sensory deficits and had minimal back pain intermittently. Radiographs showed excellent alignment L5S1 and a solid fusion at this level (Fig. 4).

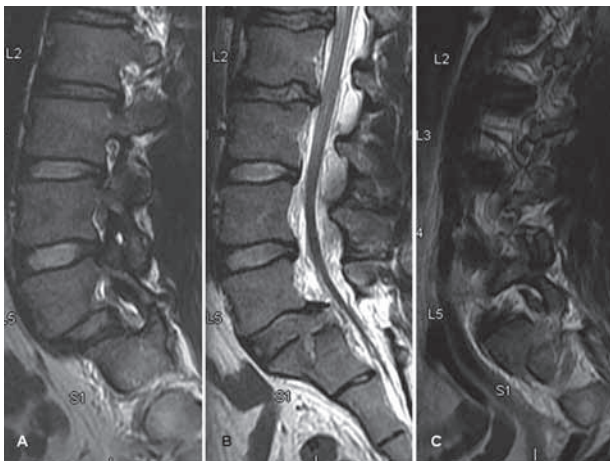

Fig. 3. — Sagittal T2-weighted MRI showing (A) dislocation of the left L5S1 facet joint, (B) disruption of the ligamentum flavum, posterior longitudinal ligament and posterior disc, and an intact-looking anterior longitudinal ligament at the L5S1 junction, and (C) fractured right superior articular process of S1 displaced anteriorly compromising the neural foramen.

DISCUSSION

Lumbosacral dislocations are rare injuries with fewer than 80 cases reported in the literature. The intrinsic stability of the coronally oriented L5S1 facets, the recessed level within the pelvic brim and the strength of the iliolumbar ligaments (*12*) make lumbosacral junctional injuries rare. These injuries show substantial morphological variability, with a spectrum ranging from facet subluxation to lumbosacral spondyloptosis. With the exception of Watson-Jones (*47*) in 1940, who described lumbosacral dislocations as being secondary to hyperextension forces, most authors associate these injuries with hyperflexion and rotation mechanisms (*3,18*).

Specific problems

The infrequency of the injury, the severe tissue disruption which results from it, and the anticipated loading at the lumbosacral junction face the treating physician with multiple challenges. Issues frequently associated with the management of this injury in previous reports include : 1) multi-system trauma delaying surgical management of the spine injury (*14,34,49*) ; 2) missed or delayed diagnosis,

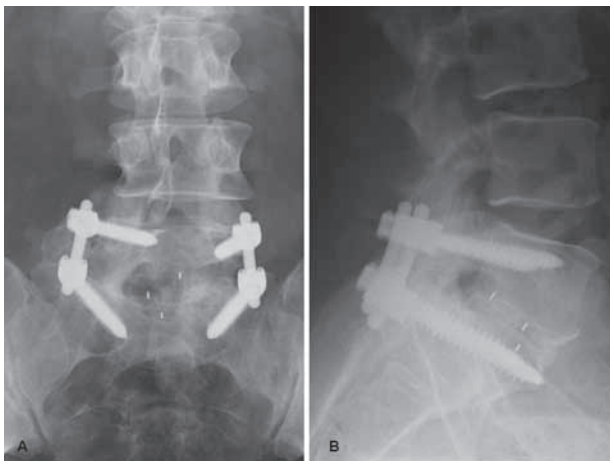

Fig. 4. — AP (A) and lateral (B) postoperative radiographs 4 years after surgery, showing anatomically aligned lumbosacral junction, maintenance of anterior column height, and complete fusion at L5S1 motion segment.

particularly in patients with minimal spondylolisthesis and in the presence of major associated systemic injuries (*21,41,43,44*) ; 3) difficulty in obtaining reduction by closed (*16,36*) or open means without facet resections (*11,51*) ; 4) marked instability (*19*) and difficulty in maintaining the reduction (*4*), especially in presence of fractured or resected facets (*25*) ; 5) lack of consensus on extension of the fixation to higher lumbar levels or to the pelvis ; and 6) uncertainty on whether supplemental interbody fusion should be carried out or not.

Reduction

Although reduction of a lumbosacral dislocation by closed means has been reported in a 5-year-old child by Beguiristain *et al* (*3*), this entails the risk of neurological deterioration and is generally not attempted in adults. Gentle manipulation by flexion of the operating table has been used by some authors to help in the reduction by distraction (*34,49*), but even this has been discouraged by other authors due to the risk of posterior disc migration and neurologic deterioration (*46*). Operative reduction of the facet dislocation, without facet resection, has been attempted by distraction over a rod following placement of pedicle screws (*51*). This carries the risk of neurologic deterioration and can be difficult, particularly in large patients. In our patient intraoperative reduction of the lumbosacral dislocation was safely achieved by resection of the articular processes on both sides. This simultaneously facilitated thorough inspection and decompression of bilateral exiting and traversing nerve roots.

Multilevel posterior instrumentation?

The severity of lumbosacral fracture-dislocations has led many surgeons to extend the proximal fixation to L4 or even higher. The authors identified eleven patients in the literature (*6,10,21,28,29,30,33,46*) with this injury, in whom the fusion was extended proximally to as high as L2. These authors based their decision on 1) presence of proximal injury, 2) difficulty in achieving fixation in a deeply slipped L5 vertebra (*24*), or in the presence of a fractured L5 pedicle (*1*), 3) the need to shield the L5 vertebral body from the shear stress of weight bearing (*35*), 4) the need to perform proximal laminectomies for repair of proximally extending dural tears (*6*), or 5) no specific reason (*21,26*). But increasing the length of a lumbar fusion results in lumbar stiffness, low back pain, and eventually long term adjacent segment deterioration (*7,9,17,31,50*). While individualization of treatment decisions is no doubt required, based on specifics of the injury and patient, the excellent outcome achieved in our patient, despite high anticipated physical loading in a patient of his size (BMI 34.7), pleads for a single level fusion, particularly with good restoration of local alignment, and with simultaneous anterior column support through a TLIF.

Interbody fusion

Review of the literature revealed 10 previously reported patients (*1,13,21,23,24,41,43,46*) who were treated with a posterior fusion followed by a separate anterior fusion done at the same stage (*43*) or at a later date. We also identified 14 patients (*2,10,15, 18,34,39,40,42,45,46*) who underwent posterior lumbar interbody fusion (PLIF), 6 (*10,34,39,40,45,46*) of whom had insertion of morselized bone grafts (no cage) in the interbody space. Authors favoring PLIF approach cite the advantage of being able to perform

a 360 degrees fusion in a single stage procedure. Nine out of the 14 patients who underwent PLIF had a preoperative neurologic deficit. Out of these, only 3 showed complete recovery, while the rest showed persistent neurologic deficit postoperatively. Although no surgery-induced radiculitis was reported in any of these patients, this complication has also been reported following PLIF for non-traumatic indications owing to the extensive neural retraction (*22*). The use of a TLIF in these fracture-dislocations has only been reported in one previous patient with this injury, in a revision procedure for a failed prior posterior-only fusion (*26*).

The use of the TLIF technique in spinal trauma has been reported rarely, and generally involves thoracolumbar burst fractures (*37,38*). TLIF avoids the risk of radiculitis by retraction of contused nerve roots (*22*), and simultaneously permits anterior column structural support, height restoration and fusion (*20*). The use of a structural interbody cage as opposed to morselized bone grafts alone provides immediate and long term stability, restores and maintains disc height and spinal alignment (*48*), and may help in achieving reduction of the spondylolisthesis through ligamentotaxis with an intact anterior longitudinal ligament. The authors' approach provided excellent anterior column access and fusion, stabilized all three columns, and obviated a second stage procedure through an abdominal approach with disruption of the anterior longitudinal ligament. TLIF in our patient, as well as in the patient reported by Lim *et al* (*26*), was followed by complete recovery of neurologic deficit and radicular pain. This technique is to be recommended as an option when treating similar patterns of lumbosacral fracture-dislocation.

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