Trumatic spondylolisthesis of the lumbar spine: a report of three cases

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INTRODUCTION

Only 8 cases of traumatic spondylolisthesis (from the cranial to lumbosacral joint) have been reported to date.1–6 Recovery of neurological function is dependent on the time of decompression and stabilisation.6–8 We highlight the effects the difference in the time to decompression and surgical technique have on neurological recovery and implant durability.

CASE REPORTS

Case 1

In December 2005, a 48-year-old Chinese man was hit by a 100-kg barrel and injured his head, chest and abdomen. He complained of weakness and patchy sensory loss over both lower limbs, but was alert and conscious. A step-like deformity and 0.5 cm puncture wound were noted in his lumbosacral region and

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his pelvis was unstable. A neurological examination demonstrated grade-3 power in both lower limbs, except for big toe flexion and extension that were grade 4. His perianal sensation was intact, but his anal tone was lax.

Plain radiographs showed anterolisthesis of L5 on S1 and an open-book pelvic fracture (Fig. 1a). Computed tomography (CT) demonstrated fractures of the left L5 inferior articular process and the right S1 superior articular process with moderate (60%, grade 3) anterior subluxation of L5 on S1 (Fig. 1a). There was severe canal narrowing (70%) at this level.

The patient was haemodynamically unstable and an urgent external fixation of the pelvic fracture and debridement of the open L5/S1 fracture-dislocation was performed. Two days after injury, he underwent internal fixation using the Monarch stabilisation system (DePuy Spine, Raynham [MA], USA). An incision was made through the open wound, and pedicle screws were inserted bilaterally into L4, L5 and S1, as well as posteriorly into the iliac crests (from the posterior to the anterior inferior iliac spine). The pedicle screws were connected with rods and the listhesis reduced to grade 1 from grade 3 (Fig. 1b). Posterolateral fusion was also performed.

Postoperatively, his lower-limb power increased to grade 4, but the right extensor hallucis longus power decreased to grade 0. An urgent lumbosacral CT scan confirmed that the pedicle screws were not encroaching on the spinal nerves. The patient was

![Figure 1](image.png)

**Figure 1**  Patient 1: a computed tomographic scan and radiographs showing (a) grade-3 anterolisthesis of L5 on S1 and severe canal narrowing, (b) reduction to grade 1 after decompression, and (c) breakage of both rods and progression of the anterolisthesis of L5 on S1 at the 3-year follow-up.
then discharged to a rehabilitation centre for mobility exercises.

At the 18-month follow-up, the patient had recovered fully and had no lower-limb neurological deficit. He was lost to further follow-up but returned 3 years postoperatively with low back pain radiating to his left lateral leg. The rods were found to be broken (Fig. 1c), and the listhesis had progressed to grade 3 from grade 1. He underwent revision surgery and a L5/S1 transforaminal lumbar interbody fusion. At the 42-month follow-up, he was well with no neurological deficit.

Case 2
In November 2007, a 41-year-old Chinese man presented with severe low back pain after a 600-kg container fell onto his back. He was unable to ambulate and urinate, but was alert and conscious with normal vital signs. A step-like deformity was noted in the lumbar region. A digital rectal examination revealed lax anal tone with saddle anaesthesia. An abdominal examination revealed a palpable bladder so a urinary catheter was inserted. A neurological examination graded power at his hip, knee and ankle joints at grade 3, 4 and 2, respectively. His flexor and extensor hallucis longus power level was grade 0 bilaterally. He had bilateral lower limb hypertonia with hyporeflexia of the knee and ankle reflexes and had reduced sensation over his right lateral leg.

Plain radiographs showed a grade-2 spondylolisthesis of L4 on L5 and a fracture of the left transverse process of L4 (Fig. 2a). Magnetic resonance imaging (MRI) demonstrated an avulsion fracture of the anterior-superior corner of L5 associated with a Chance-type fracture-dislocation through the L4/5 disc space and bilateral perched facets with grade 2 spondylolisthesis of L4 on L5 (Fig. 2a). The cauda equina was severely compressed. An anterior epidural haematoma extending from the L2/3 to L5/S1 level was identified.

Four hours after presentation, the patient underwent urgent decompression and stabilisation (Expedium, Depuy Spine, Raynham, MA). Pedicle screws were inserted bilaterally into L4 and L5. The right transforaminal lumbar interbody was fused at the L4/5 level and the left lateral recess was decompressed at the same level. The right L2/3 level was then decompressed and a posterolateral fusion was performed.

Postoperatively, the patient regained full power of his hip, knees and ankles, although his urinary retention persisted. His flexor and extensor hallucis longi were found to have power grades of 4 and 2.
respectively. He was able to tolerate ambulatory physiotherapy and was discharged to a rehabilitation centre for mobility exercises and bladder and bowel training. At the one-year follow-up, he had regained full urinary continence and had fusion at L4/5 (Fig. 2b).

Case 3
In December 2007, a 56-year-old Chinese man presented with pain in his lower back, left hip and left shoulder after falling from a height of 2 metres. He had tenderness and bruising from L2 to L5 but no step-like deformity. He had no neurological deficits in his lower limbs. The left acromioclavicular joint was tender with a step-like deformity.

Plain radiographs showed a grade-2 subluxation of the left acromioclavicular joint and a comminuted fracture of L5 and grade-1 anterolithesis of L4 on L5 (Fig. 3a), with extensive marrow oedema at this level. A sagittal MRI revealed high signal intensity in the lumbar interspinous ligaments, indicating acute injury (Fig. 3a).

24 hours after presentation, this patient underwent posterior decompression and stabilisation (Expedium, DePuy Spine, Raynham [MA], USA). Pedicle screws were inserted bilaterally into L3, L4, L5 and S1, and a rod was inserted on the left for temporary reduction. The right L4/5 transforaminal lumbar interbody was then fused, and another rod was inserted on the right side for complete reduction (Fig. 3b). Posterolateral fusion was not performed.

The patient recovered without complications and was discharged 5 days after surgery. At the one-year follow-up, he remained well.

DISCUSSION
There are 5 types of spondylolisthesis: dysplastic, isthmic, degenerative, traumatic, and pathologic.9 Traumatic spondylolisthesis is a fracture of the posterior elements, rather than the pars interarticularis, leading to instability and listhesis.9 Only a few cases of traumatic spondylolisthesis of the lumbosacral joint have been reported.10–16

Early decompression promotes recovery of neurological function. The timing of decompression and the degree of spinal canal narrowing are the main factors affecting neurological recovery.9 In patient 1, decompression was delayed because of the need to stabilise the pelvic fracture with external fixation. He had persistent neurological deficits. Patients 2 and 3 underwent decompression within 24 hours and their

Figure 3 Patient 3: magnetic resonance images and radiographs showing (a) a comminuted fracture of L5 associated with grade-1 anterolithesis of L4 on L5, high signal intensity on the interspinous ligament indicating acute injury, and severe spinal canal narrowing, and (b) reduction of the anterolithesis.
American Spinal Injury Association impairment scale improved from B to D.

When decompression of the spinal cord was performed at 24 hours in dogs, the improvement in somatosensory evoked potentials was only 26%, compared to the 85% and 72% improvement achieved when decompression was carried out immediately and one hour after injury, respectively. This may be due to the persistent reduction in blood flow seen in delayed decompression. The blood flow through the injured spinal cord region is inversely related to the duration of compression. In dogs with decompression performed 30 minutes after injury, the spinal blood flow was 49.1±3.1 ml/100 g/min, compared to 19.8±6.2 ml/100 g/min in those with decompression performed after 180 minutes. In dogs who had the same duration of spinal cord compression, those who achieved recovery of evoked potential conduction showed a higher regional blood flow after decompression.

We postulate that the reason for implant failure in patient 1, who had both connecting rods broken, was the lack of interbody fusion for stabilisation. Similarly, the use of Harrington and sacral rods for reduction and posterior stabilisation without fusing the concomitant L4/L5 complete fracture-dislocation was also insufficient, and the L4 vertebra was displaced 2 months postoperatively. Interbody fusion provides a larger surface area for bone graft incorporation, achieving an indirect reduction of foraminal stenosis by using the graft to restore the height of the intervertebral disc, improving lumbar lordosis, and ablating the degenerated disc. Interbody fusion is superior to posterolateral fusion for preventing non-union, reducing slippage and improving back pain using the Kirkaldy-Willis criteria. Interbody fusion is more predictable for maintaining correction and achieving union. We recommend early decompression with posterior instrumentation and interbody fusion for maximum recovery of neurological function and stability of the spine.

REFERENCES