TRAUMATIC SPINAL FRACTURE DISLOCATION WITH NEUROLOGICAL DEFICIT IN A 14-YEAR-OLD BOY: MANAGEMENT BY SPINE DECOMPRESSION, POSTERIOR FUSION, AND CONTINUED-SHORT-SEGMENT INSTRUMENTATION

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Abstract

Thoracolumbar fracture-dislocation by definition is a three-column injury, according to the Denis three-column concept, which may yield an unstable spinal column and neurological deficit. Treatment of fracture-dislocation of the thoracolumbar and lumbar spine remains controversial. Although conservative treatment has been beneficial, the inherent instability of this injury usually requires surgical intervention utilizing an anterior or posterior approach for long-term stabilization. We report a 14-year-old boy exhibiting a traumatic L1 fracture-dislocation sustained after jumping from a building’s third floor. Severe low back pain, lower extremity weakness, and urine retention were addressed by nerve decompression and continued-short-segment fusion from the posterior approach. Excellent clinical outcome and no failure of hardware was reported at the six-month follow-up.

Key words: Fracture-dislocation, Spinal, Segmental instrumentation

Introduction

The three-column Denis model of spinal instability divides the spine into anterior, middle and posterior regions.¹ The anterior column comprises the anterior longitudinal ligament and anterior half of the vertebral body. The middle column comprises the posterior half of the vertebral body and posterior longitudinal ligament. The posterior column comprises the pedicles, facet joints and supraspinous ligaments. The Denis model remains an important tool by which to classify thoracolumbar injuries, because each class of fracture requires a different treatment approach. A subsequent classification proposed four categories of major spinal injuries: compression fractures, burst fractures, flexion-distraction injuries, and fracture-dislocations,² where the fracture-dislocations are defined as failure of all three columns with subluxation or dislocation. The relation of mechanical instability with fracture implies that the spine is unable to carry out its physiological loading and additional neurological deficit.
Case Report

A 14-year-old boy was referred to our emergency department with severe low back pain, swelling of the bilateral wrists and left lower leg pain. The injuries were reportedly sustained following a leap from the third floor of a building after an altercation with a teacher. A small forehead abrasion was also sustained. He did not lose consciousness upon impact.

On physical examination, the patient appeared well and exhibited normal vital signs. He was conscious and lucid. In spite of the severe swelling and erythematous over the bilateral wrists and left lower leg, the extremities were freely movable. Neurological examination revealed full muscle power of the upper limbs but slightly decreased power of the lower limbs. Light touch sensation, temperature, vibration and position were intact in the corresponding dermatome. His major complaints were severe low back pain and absence of urination for the eight hours since the fall.

A routine radiograph demonstrated fractures of the bilateral radius, ulna head, pubic ramus, left tibia shaft and L1 vertebral body. A thoracolumbar computed tomography scan revealed L1 fracture-dislocation with spinal cord compromise (Fig 1A) and L2 vertebral body compression fracture (Fig. 1B).

Upon consultation with an orthopaedist concerning a spica cast, we performed a laminectomy and continued-short-segment pedicle screw fixation (Instrumentation T12, L1, L2, and L3, which includes the segment of L1 fracture-dislocation and L2 compression fracture). After the operation, the patient condition was stable and thoracolumbar lordosis was restored. He also regained full lower extremity muscle power and urinary function. At the six-month follow-up, no hardware failure was evident (Fig 2).

Surgical Techniques

The operation was performed under general anesthesia with the patient in the prone position. The thoracolumbar spine was slightly extended to restore lumbar lordosis. A midline incision was centered slightly superior to the spinous processes of the involved levels, and the incision

Fig. 1. Consecutive axial thoracolumbar CT scans.
Panels A and B demonstrate L1 fracture-dislocation with cord compression. The white arrow indicates the failure of all three columns (anterior and middle columns ruptured, widening of right facet joint, and horizontal laminar fractures). L2 compression fracture was also noted in parasagittal reformat CT scan (back arrow)
was extended proximally and distally to include the levels above and below to ensure adequate exposure. Electrocautery was used to divide the fascia and strip the paraspinous muscles subperiosteally from the spine. The T12 to L3 laminas were exposed, with facet joints preserved carefully.

Once the level was confirmed, dissection progressed laterally to the transverse processes. Deep retractors were repositioned as needed throughout the dissection. Entrance points of pedicles were chosen and guide pins were inserted via the pedicles into the vertebral bodies. An intraoperative radiograph was obtained to determine the accuracy of the pedicle screw pathway.

L1 laminectomy, and T12 and L2 partial laminectomies were performed with Leksell and Kerrison rongeurs. The inferior articular process of L1-2 facet joints was removed because of severe subluxation. The flavum ligament was removed to allow decompression of the central and lateral canals, and neural foramina.

Post-laminectomy, the pedicle hole was tapped and probed following the direction of the guide pins. T12, L1, L2, and L3 pedicle screws were inserted into their bodies; entry points and pathways of the pedicles were monitored grossly from the post-laminectomy spinal canal, especially the bilateral L1 fractured pedicles, to avoidance of damage to the nerve roots and dura sac.

Another intraoperative radiograph was obtained as the construct was assembled with rods and connectors to confirm the accuracy of the pedicle screw pathways.

Discussion

Fracture-dislocations represent up to 50% of all thoracic spine fractures. These injuries occur with failure of all three columns, usually in response to shearing forces, so they are inherently unstable. Fracture-dislocations may involve ligamentous structures only, bony structures only, or both. For example, a purely ligamentous injury may result in bilateral facet dislocations. Facet dislocations are less likely to occur in the upper thoracic spine because of the coronal orientation

Fig. 2. Six-month follow-up X-ray.

Plain X-rays obtained at the six-month follow-up demonstrated a good alignment of the thoracolumbar spine and absence of hardware failure.
of the facet joints and the support provided by the ribs. This displacement often results in severe spinal canal compromise with resultant spinal cord injury. It has been reported that approximately 90% of patients with fracture-dislocations of the thoracic spine sustain spinal cord injuries, 84% of which are complete.

Fractures of the spine in children are uncommon, comprising <5% of all reported spinal injuries. Spine fractures typically result from high-energy trauma as incurred by passengers in motor vehicles, pedestrians struck by moving vehicles, or falls from significant heights, and often coexist with other major skeletal and visceral injuries. Thoracolumbar fracture-dislocation more likely occurs in older children or adolescents than in younger children, who frequently sustain significant spinal cord injury.

Regardless of a patient's neurologic status after a fracture-dislocation injury, the inherent instability of this injury usually requires surgical intervention for long-term stabilization. In most cases, proper stabilization is achieved using a combined anterior and posterior approach for fracture repair. In the present case, we tried to use posterior fixation alone to achieve proper adequate spine decompression and stabilization.

Continued-short-segment fusion of T12, L1, and L2, in which fixation includes the fracture segment, was our first consideration. However, we ultimately performed T12, L1, L2, and L3 segmental fusion because in addition to L1 fracture-dislocation, a L2 compression fracture was also apparent.

In treating a patient with fracture-dislocation injuries, the surgeon must determine the length of the fusion. Although discontinued-short-segment fixation (instrumentation one level above and one level below the damaged vertebra) has become more widespread in the management of burst fracture or fracture-dislocation, a high rate of hardware failure and major postoperative loss of fracture reduction has been found in this group. In addition, restricted levels of fusion provides limited implants, which can break with uncontrolled loading.

Discontinued-long-segment fusion (two levels above and two below, or more) of the thoracolumbar spine significantly increases the fusion rate. However, long segment fusion in the lower thoracic spine, thoracolumbar junction, or lumbar spine markedly restricts patient mobility, and can significantly increase the stress and motion at more distal segments, adding additional strain to more caudal aspects of the axial skeleton, leading to pelvic wing-sacrum stress fracture.

The treatment of thoracolumbar fracture-dislocation by anterior methods has emerged as a distinct treatment option, because the instrumentation systems have improved and alternatives to structural autologous bone grafting have proved reliably safe, effective, biomechanically. Nevertheless, anterior thoracolumbar fracture treatment may be associated with significant complications resulting from the proximity of great vessels and other vital organs. Acute anterior management of unstable thoracolumbar injuries remains a challenging procedure performed preferably by experienced surgeons. Benefits of more complete anterior decompression with restoration of an anterior weight-bearing vertebral column must be weighed against the potentially devastating complications attendant with this procedure.

Our young patient underwent continued-short segment fusion with transpedicle screw and two-rod distraction construct from posterior approach, giving us the experience in management of severe thoracolumbar burst fractures, which typically occur in adult or elderly patients. Follow-up examinations conducted over two years with such patients has demonstrated satisfactory to excellent outcomes without instrumentation failure.

The major advantages of a posterior approach are its relatively safe nature, familiarity of most spine surgeon for the involved region, and the ability to reconstruct the posterior tension band. In addition, decompression can be done adequately from the posterior approach. Although presently the bilateral L1 pedicles were fractured, we successfully inserted the pedicle screw in an
accurate pathway via the broken pedicles into
the vertebra body. A laminectomy was performed
prior to insertion of pedicle screw to give the
access for the subsequent risky procedure under
direct vision of the medial wall of pedicles.

In our opinions, continued-short-segment
fusion is sounder biomechanically than discon-
tinued-short or long-segment fusion.

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fixation for thoracolumbar burst fracture: six-year
一個 14 歲男孩脊椎外傷性骨折脫位併神經缺損：以神經減壓和連續性短節數後融合固定處理

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摘要

胸腰椎骨骨折位被定義為脊椎三個 column 的受傷，根據 Denis 3-column 的觀念，此傷害也許會造成椎體的不穩定和神經的缺損。目前，治療胸腰椎和腰椎的骨骨折位仍有許多爭議。雖然有些作者建議對此骨折位採取保守性治療，然而，此種傷害所造成椎體內在的不穩定性則常常需要手術的介入做長期的固定。手術的方式包括前或後融合固定後已被許多醫療院所報告。我們報告一個14歲第一腰椎外傷性脫位骨折的男性病患，他因爲從三棲躍下，造成嚴重的下背痛，兩下肢無力以及尿液滯留。我們決定採取神經減壓術和連續性短節數的後融合固定。經過一年的追蹤，病人癒後非常好，至目前為止，並沒有固定的鬆動。

關鍵詞：骨折脫位，脊椎，後融合固定

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