



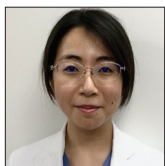
Technical Notes

Transdural reduction of a bone fragment protruding into the spinal canal during surgical treatment of lumbar burst fracture: A case report

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ABSTRACT

Background: There have been many reports on the clinical, radiographic, and surgical management of thoracolumbar burst fractures attributed to high-energy trauma. Interestingly, few reports have described how to extract bone fragments associated with these injuries protruding into the spinal canal contributing to significant neurological deficits.

Methods: An 18-year-old male presented with a severe L3-level paraparesis (i.e., loss of motor/sensory function below L3 lower extremity hyporeflexia, and sphincter dysfunction: American Spinal Injury Association [ASIA] Impairment Scale B) following a high-speed crash. The computed tomography and magnetic resonance studies revealed a L3 burst fracture with bone fragments protruding into the spinal canal causing marked cauda equina compression. Following a L3-L4 laminectomy, and opening of the dorsal dura, the bone fragments were ventrally impacted into the fractured L3 vertebral body a pedicle/screw L1-L5 fusion was then completed.

Results: One month later, the patient recovered to an ASIA Scale of C, (i.e., residual proximal 3/5 and distal 2/5 motor deficits, with partial sensory sparing).

Conclusion: Transdural ventral impaction of protruded bone fragments attributed to high speed lumbar burst fractures contributing to significant cauda equina compression can be safely/effectively accomplished.

Keywords: Cauda equina injury, Lumbar burst fracture, Spinal fixation, Transdural decompression

INTRODUCTION

Lumbar burst fractures caused by high-energy trauma, can result in vertebral body bone fragments protruding into the spinal canal, resulting in significant cauda equina/root injuries.^[3,5,7] Here, the authors showed that posterior transdural impaction of ventrally extruded lumbar vertebral bone fragments could be safely/effectively accomplished utilizing a L3-L4 laminectomy followed by a pedicle/screw/rod instrumented fusion.

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MATERIALS AND METHODS

History and examination

An 18-year-old male fell from a height of 10 m resulting in an L3-level paraparesis (i.e., complete motor loss, partial sensory loss, and sphincter dysfunction: American Spinal Injury Association Impairment Scale B) [Table 1]. The magnetic resonance/computed tomography (MR/CT) studies showed the L3 vertebral body burst fracture fragments protruding into the spinal canal resulting in marked cauda equina compression [Figure 1a and b].

Operative procedure

Performing a L3-L4 laminectomy, revealed his dorsal dura was lacerated, with several damaged nerve rootlets herniating through the traumatic durotomy [Figure 2a]. Through the dorsal durotomy, the ventrally extruded L3 body bone

Table 1: The neurological findings before and after the surgery were revealed. At 1 month after the surgery, all the symptoms were mild and the ASIA Scale improved to C.

Neurological examination	Preoperative	Postoperative; on month later
Strength	Loss below L3	Recovered to 3/5 at proximal muscles, 2/5 at distal one
Sensory	Loss below L3 including perineal, slight residual touch, and pain in the right toe	Slight recovered to the lower limbs and perineal region
Deep tendon reflexes	Absent	excessive
Bowel and bladder	loss	recovery
ASIA Impairment Scale	B	C

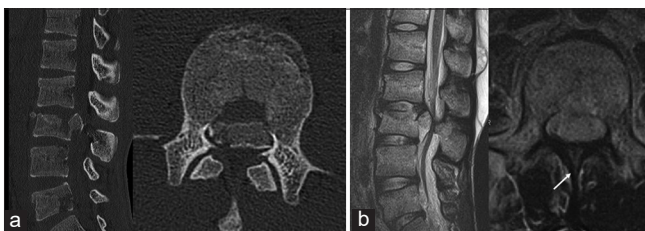


Figure 1: Preoperative computed tomography (CT) and magnetic resonance imaging (MRI). (a) CT revealed a fracture of the L3 vertebra. (b) Sagittal and axial T2-weighted image demonstrated severe dural sac impingement between a protruded bone fragment of the vertebral body and a fractured spinous process, with remarkable compression of cauda equina. The spinous process was fractured and the rootlets were deviated (white arrow).

fragments were impacted back into the fractured vertebral body [Figures 2b, 3a and b]. This was followed by a primary dorsal dural repair about 5 cm in length by stitch suture to the watertight. This was followed by percutaneous pedicle screw fixation from L1 to L5.

RESULTS

One month postoperatively, the patient's proximal (3/5) and distal (2/5) motor strength improved along with bladder and bowel dysfunction completely. Further, the postoperative CT and MRI studies confirmed adequate canal decompression with just a slight residual ventral shift in the protruded bone fragments [Figure 4a and b].

DISCUSSION

Several studies have reported the removal of bone fragments protruding into the spinal canal in patients who have sustained lumbar burst fractures with resultant cauda equina syndromes.^[1,2,4,6,8,9] Typically this was achieved utilizing either an anterior or posterior microscope-assisted approach, rather than through a traumatic dorsal durotomy [Table 2].

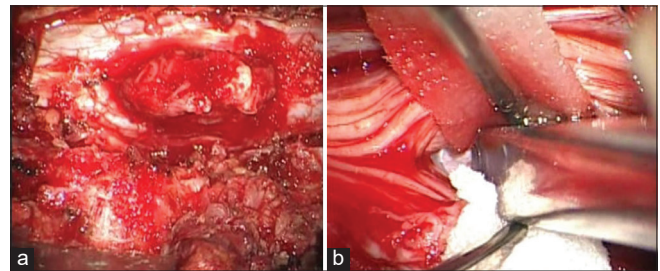


Figure 2: Intraoperative photographs. (a) The dorsal dura mater was found to be lacerated and several damaged rootlets herniated from the point of the ruptured dura mater. (b) The protruded bone fragment was pushed back into the ventral side by transdural tapping using an impactor, while protecting the cauda equina.

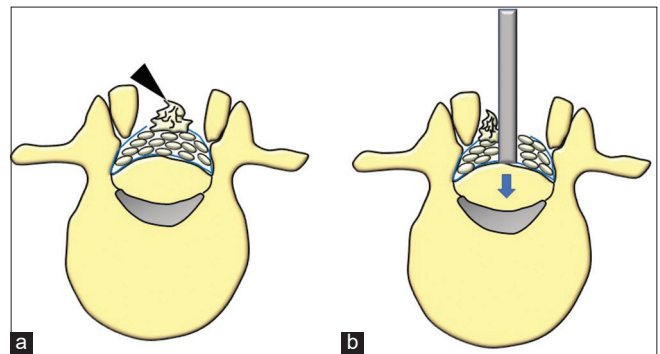


Figure 3: Illustrations demonstrating the transdural tapping approach. (a) The dural sac was elevated due to the bone fragment from the ventral side. The dorsal dural sac was injured and the rootlets was deviated (arrow head). (b) Transdural tapping, which involves pushing the bone fragment back into the vertebral body.

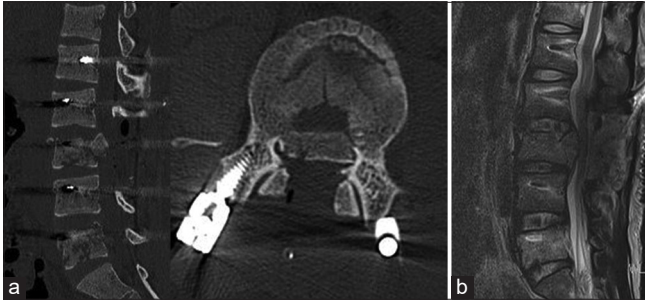


Figure 4: Postoperative CT (a) scan and MRI (b) demonstrated a slight ventral shift in the protruded bone fragment ventrally with acceptable decompression of the dural sac.

Table 2: The advantages and disadvantages of each approach.

Approach	Advantage	Disadvantage
Anterior approach	Bone fragments can be removed under direct vision Improving vertebral height	Highly invasive Dural repair is difficult
Posterior approach	Bone fragments can be removed in a full circle Dural repair is easy. Preserve the facet	Resection of remaining normal support structures Risk of inadequate decompression
Minimally Invasive Surgical approach		Dural repair is difficult
Transdural approach	Minimally invasive to supportive structures	Risk of spinal fluid leakage and cauda equina injury

Advantages of posterior versus anterior approach

There are pros and cons for posterior versus anterior approaches to lumbar burst fractures with ventrally extruded/fractured bone fragments contributing to cauda equina syndrome. The posterior approach allows for ventral fragment removal (i.e., tamping down into the fractured vertebral body) while also facilitating direct dorsal dural repair.^[2] Although the anterior approach allows for direct bone fragment removal/decompression, the major disadvantage is the difficulty in repairing the ventral dural defect.^[6,9]

Dural injury due to lumbar vertebral burst fractures

Yoshiiwa *et al.* found that the cauda equina notch sign was a predictable MR finding of cauda equina entrapment (i.e., due to greenstick lamina fractures), but in many cases this is just found intraoperatively.^[10] Here, the patient clearly had a greenstick laminar L3 fracture responsible for the dorsal dural injury.

Surgery

Minimally Invasive Surgical (MIS) Approaches: MIS surgical approaches are ineffective when dealing with dorsal dural injuries attributed to lumbar burst fractures. Chen *et al.* reported ventral packing of fractured fragments under endoscopy with vertebroplasty.^[1] However, this risked inadequate decompression and neural damage when bilateral bone fragments extended in the spinal canal, while also making dorsal dural repair extremely more difficult.^[1,8]

Transdural Approach to Impaction Vertebral Body Burst Fracture Fragments Contributing to Cauda Equina Compression.

One study discussed impaction of ventral vertebral body bone fragments utilizing a transdural approach in a case in which there was a traumatic dorsal durotomy.^[7]

CONCLUSION

Transdural reduction of protruded lumbar bone fragments through a posterior traumatic durotomy following a L3 burst fracture was safely/effectively accomplished.

Ethical approval

This study was approved by the Medical Ethic Board of Fujieda Heisei Memorial Hospital (approved number FHR2020-6).

Declaration of patient consent

Institutional Review Board (IRB) permission obtained for the study

Financial support and sponsorship

Nil

Conflict of Interest

The authors declare that they have no conflict of interest.

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