L5 Nerve Root Decompression After Malunion of Surgically Managed Vertically Unstable Pelvic Ring Injuries

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Abstract

We describe the outcomes of late decompression of the L5 nerve root after malunion of surgically managed pelvis injuries.

Four patients underwent decompression of the L5 nerve root. Surgery included hemilaminotomy with facetectomy at L5–S1 followed by decompression of the L5 nerve root laterally from the surrounding displaced sacral ala. L5–S1 fusion was not performed. Radiographs and Oswestry Disability Index (ODI) scores were obtained for each patient at latest follow-up.

In all patients, adequate decompression required removal of bone to the anterior aspect of the sacral ala inferiorly to the level of the superior endplate of S1, and there was resolution of L5 radicular pain. Late decompression of the proximal course of the L5 nerve root provided pain relief without resultant radiographic pelvis or L5–S1 instability.

Unstable pelvis injuries generally result from high-energy trauma. Neurologic compromise is not uncommon, particularly in the presence of a vertical shear component or spinopelvic dissociation. The rate of neurologic injury in unstable vertical shear fractures can be 50% or higher, depending on the anatomical area involved; the cauda equina, individual nerve roots, and peripheral nerves, including the lumbosacral plexus, can be affected.[1-4] Treatment of this combination of injuries typically consists of reduction and fixation of the fracture with resultant indirect decompression of the neural elements, with further direct decompression if necessary. Neurologic recovery varies, and the end result is often compromised by a residual neurologic deficit.[1,5,6]

L5 nerve root compromise can result from direct compression by the vertically displaced sacral ala.[1] Maintaining reduction of this injury can be difficult, particularly in the presence of significant sacral comminution.[7] Residual displacement and/or loss of reduction can lead to continued L5 compression and pain.

Repeat reduction and/or revision of pelvis fixation can be challenging, particularly in the setting of early union. An alternative approach is direct decompression of the nerve root without pelvis realignment. In this study, we evaluated the outcomes of 4 patients treated with late decompression of the L5 nerve root after malunion of a surgically treated pelvis injury.

The patients provided written informed consent for print and electronic publication of their case reports.

Methods and Materials

After obtaining internal review board approval for this case series, we retrospectively identified 4 consecutive patients who had undergone direct decompression of the L5 nerve root after sustaining a vertically displaced pelvic ring injury with associated sacral fracture. Demographic and neurologic examination information was obtained, and the Orthopaedic Trauma Association (OTA) system was used to classify the injuries.[8] We contacted all 4 patients, and they returned for follow-up evaluation with the Oswestry Disability Index (ODI) questionnaire, neurologic examination, and radiography.[9] Final inlet–outlet pelvis radiographs, standing anteroposterior pelvis radiographs, and standing flexion-extension lateral radiographs of the lumbar spine were obtained and were compared with preoperative studies.

Case Series

There were 4 patients: 3 women and 1 man. Age at decompression ranged from 16 to 44 years. Mechanisms of injury were motor vehicle accident (3 patients) and bicycle-versus-vehicle accident (1 patient). Fracture types were OTA 61-C1.3, ca[2] (3 patients) and OTA 61-C2.3, b[2], ca[3] (1 patient). All patients had some sacral comminution. The pelvises were stabilized in different ways (**Table I**). Iliosacral screws were unilateral without gaining purchase in either the contralateral ala or sacroiliac joint. In patients A and B, reduction was lost with recurrence of L5 radiculopathy, and revision reduction and fixation did not alleviate symptoms.

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Table I. Initial Methods of Pelvis Stabilization After Injury

Patient	Initial Surgery for Pelvis Stabilization
A	Open reduction and internal fixation of pubic symphysis
	Closed reduction and percutaneous pinning of right sacral fracture
B	Closed reduction and percutaneous pinning with iliosacral screw placement
C	Posterior stabilization of sacral fracture with percutaneous iliosacral screw
	Application of external fixation to anterior pelvis
D	Open reduction and internal fixation with 2 sacroiliac screws and ilioiliac plate

Table II. Patient Preoperative Imaging Before Decompression of L5 Nerve Root

Patient	Preoperative Imaging
A	CT lumbar spine and MRI lumbosacral
B	CT lumbar spine and pelvis
C	CT lumbar spine and pelvis
D	CT pelvis and MRI lumbar spine

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging.

In patients C and D, reduction was incomplete, and indirect decompression of the L5 nerve root was insufficient. All 4 patients had residual compression documented and lack of other compressive pathology confirmed with preoperative lumbar and pelvic computed tomography (CT) and/or lumbar magnetic resonance imaging (**Table II**). As their disabling radicular pain was persistent, all 4 patients elected to undergo direct L5 nerve root decompression. Time from initial injury to surgery ranged from 2 to 17 months.

The patients' neurologic presentations varied. Patient A presented with 4/5 strength of the extensor hallucis longus (EHL). This deficit was unchanged after surgery. Patient B presented with 4/5 strength of EHL and decreased sensation on the lateral portion of the calf and dorsum of the foot. These deficits resolved after surgery. Patient C presented with a known lumbosacral plexus injury, a flail foot, and a diffuse sensory deficit. Selective nerve root block at L5 confirmed the symptomatology. After surgery, the radicular symptoms improved. Motor and sensory deficits were unchanged. Patient D presented with 3/5 strength of EHL and 4/5 ankle dorsiflexion. After surgery, EHL strength improved to 4/5 and ankle dorsiflexion improved to 5/5.

Surgical Technique and Outcomes

All L5 decompressive surgeries were performed by the senior author (MDR). Each patient was placed in the prone position, and a standard midline exposure of the posterior lumbosacral junction was used with extension over the facet to the displaced ala on the affected side. Then, hemilaminectomy of L5 was performed, and the L5 nerve root was identified. After a unilateral L5–S1 facetectomy was completed, the displaced ala was debulked inferiorly, creating a cavity to allow for careful inferior leveraging of bone off the L5 nerve root under direct visualization. The decompression then followed the course of the L5 nerve root. In all 4 patients, adequate decompression required removal of bone to the anterior aspect of the sacral ala to the level of the superior endplate of S1 (**Figure**). The L5 nerve root was intact though attenuated in all 4 cases. Two patients had remaining fracture fixation removed, and all 4 patients appeared to have a well-healed sacral fracture. L5–S1 motion was subjectively assessed by grasping the spinous processes of L5–S1 with a clamp and manually stressing the interspace; the motion noted was minimal. L5–S1 arthrodesis was not performed.

Mean follow-up was 56 months (range, 33-72 months). Complications included 1 deep wound infection. L5 radicular pain was resolved in all 4 patients. ODI scores ranged from 2 (minimal pain/disability) to 28 (moderate), primarily from low back/posterior pelvis pain. In all patients, residual vertical displacement was unchanged from displacement on preoperative radiographs, angular motion was minimal, and there was no L5–S1 spondylolisthesis on flexion-extension radiographs.

Discussion

Neurologic deficit after a vertically unstable pelvis fracture is not unusual—rates are 24% to 60%, depending on fracture location—and it is a common cause of long-term disability after disruption of the pelvic ring.[1-6] One cause of L5 nerve root lesions in pelvis injuries is direct compression by the superiorly displaced sacral ala.[1]

Compression of the L5 nerve root by the sacral ala can be managed with reduction and fixation.[1,6] Displacement may recur, depending on fixation used and amount of comminution present,[7] or the initial reduction may be inadequate. Repeat reduction may be attempted, but interval healing can make this difficult, necessitating formal osteotomy. Formal osteotomy is a procedure of considerable magnitude, and the residual displacement that results in L5 nerve root compression may not be of a degree that otherwise would mandate attempts at realignment.[10,11] In the present study, localized decompression of the L5 nerve was found to be an acceptable alternative. To our knowledge, it has not been described in the literature until now.

At time of surgery, a considerable amount of ala resection was required to completely decompress the nerve root. All cases required removal of bone anteriorly and inferiorly to the level of the normal anatomical superior anterior corner of the sacral ala, at the level of the S1 endplate. This has the po-

tential to result in pelvis instability, particularly in early malunion. However, in no case did further radiographic pelvic displacement occur.

The unilateral facetectomy required for nerve root exposure theoretically could lead to L5–S1 instability.[12,13] For all our patients at time of surgery, motion at the L5–S1 level seemed minimal, presumably related to posttraumatic fibrosis. Arthrodesis was not performed, and there was no evidence of excessive motion on flexion-extension radiographs at final follow-up.

Reduction difficulties and fixation loss are issues in the treatment of vertically displaced pelvis fractures, particularly in the presence of sacral comminution.[6,7,14] Advances in technique, especially spinopelvic fixation, have led to improved reduction and maintenance of alignment in these fracture patterns.[5,6,15] The clinical scenario reported in this article will likely become even more rare. However, patient factors, particularly soft-tissue injuries, may preclude use of spinopelvic fixation, and the salvage technique described here may continue to play a role.

This study had several limitations. It was a retrospective case series without a matched control. Sample size was small. The natural history of symptomatic L5 compression in these injuries without reduction or decompressive surgery is not well defined, and it may have been that, with continued nonoperative treatment and time, symptoms could have improved.

In patients with this unusual clinical presentation, however, the technique described provided long-term relief of L5 radicular symptoms without significant complications.

Figure. (A) Initial injury radiograph with superior displacement hemipelvis. (B) Redisplacement after iliosacral screw fixation. (C) Probe shows extent of ala removal. (D) Six-year follow-up.

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15. Schildhauer TA, Josten C, Muhr G. Triangular osteosynthesis of vertically unstable sacrum fractures: A new concept allowing early weigh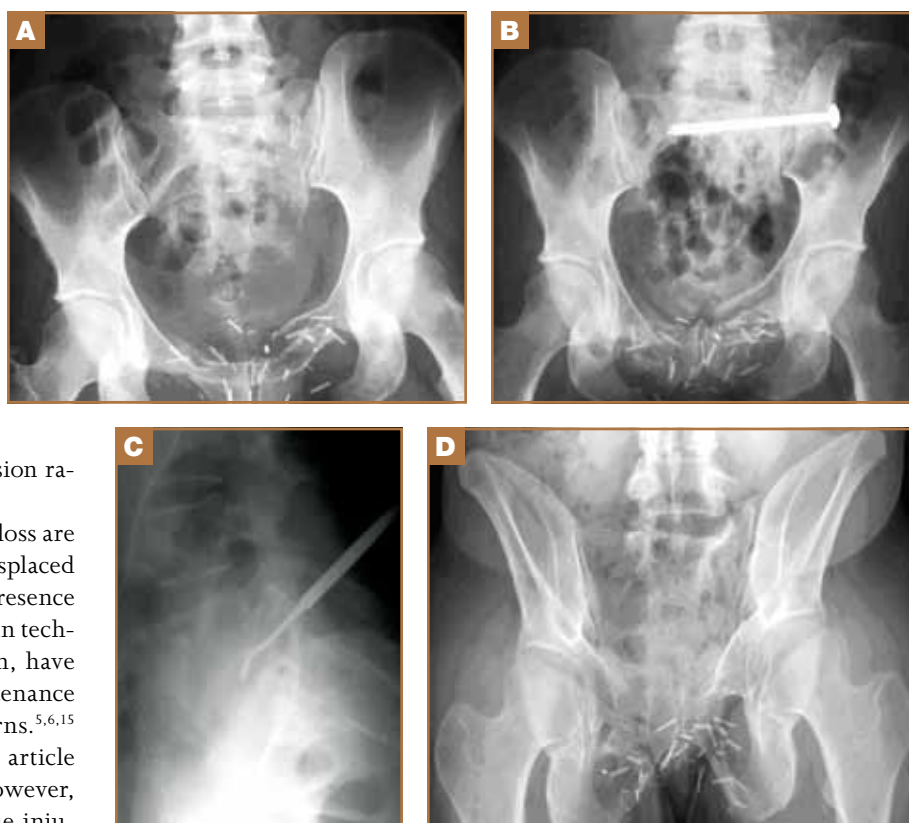t-bearing. *J Orthop Trauma.* 1998;12(5):307-314.