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Commentary: Traumatic Spinopelvic Dissociation With Sacral Cauda Equina Syndrome— Demonstrating Fracture Reduction, Stabilization, and Transsacral Circumferential Nerve Root Decompression: 2-Dimensional Operative Video

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The authors present a case of a *U*-type sacral fracture associated with spinopelvic dissociation and sacral cauda equina syndrome.¹ The case entails L4, L5, and S1 pedicle screw placement, L2-alar iliac screw placement, L4-L5 partial facetectomies, sacral laminectomy, and circumferential cauda equina nerve decompression.

Sacral fractures commonly occur after motor vehicle accidents and falls. Although high-energy trauma is typically the mechanism of injury, low-energy falls may result in sacral fractures with an underlying bone disease, such as osteoporosis. Sacral fractures are frequently underdiagnosed because trauma patients are often asymptomatic during the initial hospitalization.² These patients can develop neurological deficits later, leading to a difficult recovery even after surgery.

Several classification systems are available for sacral fractures, and classifying sacral fractures is important in deciding appropriate treatment options. Examples include the Schmidek, Sabiston and Wing, and the Denis classification; the Denis classification is most widely used. The Denis classification was developed based on sacral dissections on 39 cadavers and a retrospective study of 236 sacral fracture cases.³ There are 3 zones identified by the Denis classification. Zone I fractures occur in the sacral ala, sparing the foramina and central sacral canal. Fractures in zone I do not typically cause neurological injury. However, fractures that are superiorly displaced can injure the L5 lumbar root. Zone II fractures involve the sacral foramina and/or ala. Denis et al³ found neurological deficits in 28.4% of patients with zone II fractures, associated with L5, S1, S2 nerve roots, or bowel and/or bladder dysfunctions. Zone III fractures occur in the central sacral canal, foramina, and/or ala as in *U*-shaped sacral fractures. Neurological deficits are most commonly observed with zone III fractures.

The mechanism of injury involving *U*-shaped fractures has a few important anatomic implications.⁴ First, a severe axial loading force on the spinal column causes bilateral vertical transforaminal fractures. The vertical instability forces the sacrum to rotate. Second, a horizontal fracture, commonly between S1 and S2, disrupts the posterior integrity of the sacrum. These fractures result in spino-pelvic dissociation in which the rostral segment of the sacrum is attached to the lumbar spine, while the caudal segment remains attached to the pelvic ring. This is the underlying mechanism that causes a high rate of neurological injuries in *U*-shaped sacral fractures.

In polytrauma patients, clinical signs and symptoms from sacral fractures can be insignificant. Anteroposterior x-ray may not adequately demonstrate sacral fractures. Therefore, clinicians need to be diligent in finding suggestive clinical findings, such as ecchymosis in the sacral region, tender points in the perineal area, decreased anal sensation, or decreased rectal tone.² A thin-cut computed tomography scan is the gold standard to evaluate sacral fractures. Magnetic resonance imaging can help in visualizing neural injury.

Minimally displaced fractures in zone I or II with a stable pelvic ring without neurological deficit on physical examination may be treated nonsurgically with bed rest and an orthosis.² Fractures below S2 may result in complete nerve root transection but rarely cause structural instability. Because of innervations to the bladder and bowel in this area, early surgical intervention is not recommended even in the presence of neurological deficits.⁵ Surgery can be considered for persistent pain and loss of neurological function for 6 months after injury. An L5 nerve root injury because of a displaced fracture fragment can be treated by fragment reduction or sacral laminectomy and foraminotomy.

Zone III fractures, including U-shaped fractures, tend to cause neurological deficits for which surgical interventions are recommended. Although low transverse fractures may be treated nonsurgically, high transverse fractures are usually unstable and require surgical stabilization. Decompression of the sacral spinal canal and nerve roots should be considered in the presence of neurological deficits.

Because of the low incidence and various presentations of zone III fractures, there is no definitive surgical approach at this point. Nevertheless, several surgical techniques have been performed. One of the surgical procedures is iliosacral screw fixation. Iliosacral screw fixation causes less operative time, blood loss, and wound complications. However, there is a 10% reported chance of erroneous iliosacral screw placement.⁶ In addition, patients with U-shaped fractures likely need surgical decompression for neurological deficits.

Triangular osteosynthesis is another technique and consists of lumbopelvic distraction osteosynthesis and transverse fixation using transiliac/transsacral plate or iliosacral screw. Although this technique carries high risk for postoperative complications, the construct can achieve multiplanar stability. Schildhauer et al⁷ conducted a study with 12 cadavers and assessed stability of triangular osteosynthesis vs iliosacral screw fixation for vertical transforaminal fractures. Under cyclic loads, triangular osteosynthesis showed statistically significant smaller displacements compared with those with iliosacral screw fixation. Bellabarba et al⁸ studied complications associated with neural decompression, open reduction, and internal fixation and found significant rates of wound complication (11%), infection (16%), instrumentation failure (31%), and unplanned reoperation (42%) connected to these procedures.

U-shaped sacral fractures are rare injuries, and they are frequently underdiagnosed. In fact, most complications associated with sacral fractures are due to failure of recognition.⁵ There are a scarce number of studies available to develop definitive treatment

options at this point. Nevertheless, this case report demonstrates successful surgical treatment for a U-shaped sacral fracture. We congratulate the authors on their publication to the journal.

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