

# Spino-pelvic Fixation for Vertically Unstable Type C Fractures of the Pelvis

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## Abstract

**Background:** Evaluating the radiological and functional results of surgical treatment of unstable pelvic injuries by spinopelvic fixation. The purpose of this study was to find out whether the surgical technique can reduce fractures of the sacrum and dislocations of the sacroiliac joint and provide pelvis with stable fixation.

**Methods:** Ten vertical shearing pelvic fractures were treated by pedicular screw placement in L5 vertebra and in the wing of the ilium. According to Tile's classification system, there were 10 type C fractures (8 type C1, one type C2 and one type C3). The patients were evaluated by plain radiographs at a mean follow-up period of 2 years (range 1-3 years) after surgery.

**Results:** The patients had a mean age of 37.3 years at the time of surgery. The fracture was reduced by skeletal traction under general anesthesia and in prone position. A pedicular screw was placed in L5 vertebra on the same side of the fracture. Another screw was placed into the pelvic wing from PSIS (posterior superior iliac spine) toward AIIIS (anterior inferior iliac spine). A molded titanium rod connected these two pedicular screws.

**Conclusion:** This study supports the use of screw and rod system for posterior fixation of the VS injuries of the pelvis.

**Keywords:** lliolombar fixation; Ilium screw; Pelvic fracture; Sacroiliac rupture

## Introduction

Type C fractures of the pelvis are unstable both rotationally and vertically. Vertical shear (VS) injuries are one of the type C pelvic fractures.<sup>1</sup> VS injuries account for 5% of all pelvic fractures. Fractures of the pelvic ring that include disruption of the SI joint require healing of the SI joint for a satisfactory outcome. Healing, in turn, requires immobilization over time in a near-anatomic position. Anatomic reduction may be accomplished by closed traction, but in the presence of both vertical and horizontal instability, it cannot be held without fixation. More recently, anterior external fixation has improved outcomes in patients with open-book fractures. However, experience<sup>2</sup> has shown that unstable

(VS) pelvic injuries cannot be stabilized with anterior external fixation alone.<sup>3</sup> Unstable pelvic ring injuries occur after a high-energy mechanism and are commonly associated with multiple injuries. Several studies have found internal fixation to be superior to both external and conservative treatment in managing unstable pelvic ring disruptions.<sup>4-7</sup> Many types of internal fixation have been promoted in recent years. These include sacral bar, cobra plates, anterior plates or iliosacral screw for posterior disruptions.<sup>3,8</sup>

This paper intends to introduce a new technique for unstable VS injuries of the pelvis and to analyze the quality of reduction, rate of union and incidence of early complications, motion restriction and neurological complications.

## Materials and Methods

Ten patients with unstable VS pelvic fractures from

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Received: December 2, 2007 Accepted: September 1, 2008

the Orthopaedic Department of the university hospitals of Mashad, during the period of October 2001 to June 2004 who were under treatment entered the study. Their mean age was 37.3 years. Seventy percent of them had associated skeletal fractures. Two cases were polytraumatized. The same procedure was carried out for all patients in the study. All the fractures were reduced under direct vision, using a posterior approach.

In this new surgical technique for VS injuries of the pelvis, the patients were prone with a radiolucent support placed under the rib cage and pelvis. Through a midline incision, the soft tissues and muscles over the lamina and facet joint of ipsilateral L5 vertebra were dissected. The sacroiliac joint is exposed inferior and lateral to the sacrum. We applied axial skeletal traction through the distal femur. Checking the reduction directly, we placed a pedicular screw into the pedicle of L5 in the same side of SI or sacral fracture. Then, we inserted another screw through PSIS (posterior superior iliac spine) of the ilium. The reduction was once more checked and then we connected these two screws by a molded titanium rod. We could reduce the fracture by distraction forceps. The average hospital stay was 10 days and the average time to start mobilization was 7 days after operation.

We did not revise the nerve roots during the surgery. These patients with unstable pelvic ring injuries were treated by open reduction and internal fixation. All the patients were observed until the formation of union and the minimum follow-up time was 1 year. All the patients were operated within 15 days of injury (average 8 days). Six patients had associated injuries that required surgery. Displacement was measured as the maximum point to point distance between the fragments or separated portions of the pelvis on the outlet view of the pelvis.

There were two patients with open fractures, both from the anterior pelvis. Two patients sustained neurological injuries. One had signs of L5, S1 and the other S1, S2 root damage; both had transforaminal fractures.

There were 2 associated acetabular or anterior pelvic fractures that were treated operatively. Five patients had additional pelvic fracture and there were two pelvic fractures in need of fixation. One patient had an acetabular fracture that was approached from the anterior section. The second patient sustained bilateral rami fractures and a right iliac fracture.

For evaluation, the anteroposterior, inlet and outlet

radiographic views of the pelvis were available for all patients. Displacements were measured to the nearest millimeter on all 3 views.

Leg length discrepancy was measured as the difference in the height of the femoral head from a line perpendicular to the long axis of the sacrum on the AP view. Reductions were graded by the maximal displacement measured on the outlet view of the pelvis: excellent under 6 mm, good (6-10 mm), fair (10-20 mm) and poor (>20 mm). Wound infection, displacement in serial x-rays in 2, 4, 8, 12 weeks and 4, 6, 12 months, union of fracture, neurological examination and pain were recorded.

## Results

The mean age of the patients at the time of surgery was 37.3 years (range=20–50 years). The largest preoperative displacements measured on the outlet view of the pelvis were recorded.

Displacements preoperatively averaged 33 mm (range=3-95 mm). Postoperative displacements averaged 5.9 mm, using the grading system described. There were 7 excellent, 2 good and 1 fair reduction. The patient with fair reduction was operated 14 days after the trauma and reduction was difficult to do. There were no urinary tract infections, but one deep vein thrombosis.

Operative complications included only one superficial skin infection that occurred posteriorly. The infection resolved after incision and drainage and treatment with antibiotics. There were two cases with neurological deficit prior to operation in which the root injury did not resolve after the surgery. Two patients required fixation of additional components of their injury that were not fixed at the index procedure. One patient had a symphysis dislocation, a left ilium fracture, and opening of the right sacroiliac joint that measured 15 mm. No patient had loss of fixation. No fatigue fracture of the system occurred. All the patients healed. No iatrogenic nerve damage was seen after the surgery.

One patient had 4 mm displacement 5 weeks after the surgery. This patient had bilateral rami fractures, an acetabular fracture, and 8 mm of sacroiliac widening plus 25 mm upward displacement of hemi pelvis prior to surgery. There was no further loosening or displacement. All other patients healed without any displacement or hardware failure. There were no instances of neural impingement caused by maximally

compressing sacral fractures. No implant was removed and hence no patient required revision of fixation.

## Discussion

Non-operative treatment of unstable pelvic ring disruptions requires prolonged immobility and yields poor results.<sup>9,7</sup> External fixation is used in the acute phase after injury to add bony stability during transport, to decrease the pelvic volume, and to allow patients to avoid recumbency. However, external fixation of the pelvis can not adequately maintain the alignment of posterior injuries and is not biomechanically as strong as internal fixation. In addition, it risks pin tract infection.<sup>10</sup>

Van Gulik et al. found that leg length discrepancy was an important factor in the outcome.<sup>10</sup> For these reasons, recent authors have recommended internal fixation of unstable pelvic ring disruptions.<sup>3,10,11</sup> Kellam defined an acceptable reduction to be less than 10 mm posteriorly and less than 20 mm anteriorly, but did not describe the radiography used to evaluate the reduction.<sup>12</sup> Slatis and Karaharju graded their reductions only by posterior displacement as measured on an AP film as excellent less than 5 mm, good 5 to 10 mm, and poor greater than 10 mm.<sup>13</sup> Semba et al. evaluated 53 Malgaigne fractures and found that initial combined anterior and posterior displacement of greater than 10 mm leads to a high rate of severe low back pain.<sup>14</sup>

The authors critically analyzed preoperative and postoperative AP views of 10 patients with unstable pelvic ring injuries to assess the reductions and the ability to maintain them. Reductions were graded based on the largest displacement measured on the outlet views.

A clear understanding of the AP view allows the safe placement of the screws. Pedicular screw must be in the middle of the 5th vertebral pedicle. The other screw must be in the ilium above the acetabulum from PSIS to AHS. In addition to fluoroscopic guidance, the surgeon must develop a feeling for where the screw is as it passes through the two layers of the ilium. Using the operative techniques described, reductions were obtained within 6 mm in 70% and within 20 mm in 100% of cases. All the cases were operated within 2 weeks of injury. Leg length discrepancy was also decreased to less than 10 mm in all patients. Goldstein et al. had an 18% infection rate in fractures fixed early and 27% in those fixed late.

However, other authors have reported much lower infection rates by using percutaneous fixation technique.<sup>3,15</sup>

There were no deep infections in the present series and it is thought that open reduction of the fracture site needs not to be considered as a high-risk procedure. Spinopelvic fixation technique, which uses iliac and L5 pedicle screws, is a new and good technique for type C fractures of the pelvis. There was not any hardware failure. In addition, the main stress of the posterior pelvis during weight bearing is in vertical shear, and our system is supported against this stress by the entire length of the rod against the pedicle. We believe that this technique is a good way for such unstable pelvic fractures. However, we do not reject the iliosacral technique.

Screws with 50 mm length of thread are used so that this stress is borne almost exclusively by the thick shank of the screw. Longer screws, of course, provide better fixation because there is more resistance to toggle. The system works like normal iliolumbar ligament. Posterior reduction and internal fixation is preferred whenever possible. The strength of the anterior fixation is weaker than sacroiliac screws, particularly when stressed in the cephalad direction. Visualization of the cephalad portion of the joint is good, but the posterior joint may open when the plates are placed. More traction is placed on the L5 and S1 nerve roots by retractors and the L5 root is extremely close to the operative field. Finally, anterior plate fixation must not be used when there is any injury to the sacral ala. Loss of reduction will occur by pulling out the sacral side fixation.

In a review of 50 patients who underwent percutaneous ilio-sacral screw, Jonnetti et al. reported 7 iatrogenic nerve damages.<sup>4,16</sup> We did not have any iatrogenic nerve damage. This study supports the use of screw and rod system for posterior fixation of the VS injuries of the pelvis, including 10 patients who had posterior fixation without anterior fixation. Most of the rami fractures occur through a lateral compression injury, leaving the inguinal ligament intact. This ligament helps to support the reduction of the rami once the posterior portion of the injury is reduced and fixed. Additionally, because of the excellent soft tissue sleeve, the rami heal quickly. Thus, internal fixation should be considered only in severely displaced rami fractures. In an attempt to reduce and fix these complex injuries, the surgeon must be familiar with all the techniques and be able to apply them confidently. Malunion and nonunion are not problems

when open reduction is properly done.

Mashhad University of Medical Sciences for financial support and Ali Peivandi in helping us with the translating and editing.

## Acknowledgement

The authors are grateful to the Deputy of Research of

**Conflict of interest:** None declared.

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