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Percutaneous Fixation in Pelvic and Acetabular Fractures: Understanding Evolving Indications and Contraindications ☆

Arvind von Keudell, MD,[*,#] Daniel Tobert, MD,[*,†] and Edward K. Rodriguez, MD, PhD[†,#]

Percutaneous fixation technique for the management of pelvic and acetabular fractures is gaining wider acceptance in the orthopaedic trauma community. The development of new surgical techniques for antegrade and retrograde placement of pelvic and acetabular columnar screws, and the increased access to advanced imaging and navigational tools have resulted in an increased application of the technique. With its increased use in tertiary trauma centers, newly trained traumatologists are rapidly embracing the advantages of percutaneous fixation perhaps at the cost of a decreased emphasis on the traditional exposures and approaches. Furthermore, consensus on what constitute definitive indications or contraindications remains unclear. Although the technical aspect of percutaneous fixation can have a steep learning curve, the technique may offer advantages over traditional open reduction and internal fixation in certain specific situations. This review discusses evolving indications in the treatment of certain fracture patterns and patient populations.
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Introduction

Pelvic and acetabular fractures most commonly result from high-energy trauma in younger populations and low-energy falls in elderly patients with osteoporotic bone.[1,2] In pelvic fractures secondary to high-energy blunt trauma, concomitant head, thoracic, or abdominal injuries often contribute to the increased morbidity and mortality.[3,4] However, the potential hemorrhage associated with pelvic fractures and subsequent circulatory compromise can be a primary factor in mortality. Early fixation of pelvic and acetabular fractures plays an important role in reducing further blood loss, decreasing pain, and facilitating early mobilization to improve short- and long-term patient outcomes. Surgical methods for definitive fixation have traditionally involved open reduction with internal fixation (ORIF), which can impart additional morbidity in a debilitated or improperly resuscitated patient with tenuous physiology. Complications can also be associated with wide surgical exposures and dissection. In recent years, less invasive procedures such as percutaneous fixation with cannulated screws have been advocated for certain fracture patterns. Stabilization of the posterior pelvic ring with iliosacral screws under intraoperative image guidance was originally described by Matta and Saucedo.[5] With the advent of cannulated screw systems and improved imaging systems, percutaneous fixation techniques have become the standard of care for posterior pelvic ring injuries and increasingly common in anterior ring injuries and other columnar acetabular fractures. In the future, improved fluoroscopic imaging or computed tomographic (CT) imaging in addition to computer navigation may help further decrease the learning curve of performing these technically challenging procedures

*Harvard Combined Orthopaedic Residency Program, Boston, MA.
†Department of Orthopaedic Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA.
#Harvard Medical School Orthopedic Trauma Initiative, Boston, MA.
☆Investigation performed at the Beth Israel Deaconess Medical Center, Boston, MA.
*Address reprint requests to Edward K. Rodriguez, MD, PhD, Department of Orthopaedic Surgery, Beth Israel Deaconess Medical Center, 330 Brookline Ave, Stoneman 10, Boston, MA 02215. E-mail: ekrodrig@bidmc.harvard.edu

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in more complex pelvic and acetabular fracture patterns.[6-8] The decrease in blood loss, wound complications, and hospital length of stay have garnered increasing acceptance of minimally invasive pelvic and acetabular fixation techniques within the orthopaedic community.[9-11] This review focuses on describing evolving indications in the treatment of acetabular and pelvic fractures with minimally invasive techniques and understanding some contraindications.

Pelvic Ring Fixation

Posterior ring injuries including the ilium, sacroiliac joint, and the sacral ala or body are often amenable to percutaneous reduction and fixation. The iliosacral screw, first described by work performed by Routt et al[12] and Matta and Saucedo[5] has become the standard of care for posterior pelvic ring fixation (Fig. 1). Ideally suited for the fixation of sacroiliac dissociation, this technique is also indicated for fixation of uncomplicated zone I sacral ala, zone II transforaminal, and zone III sacral body fractures. Although iliosacral joint fixation is usually performed with partially threaded screws extending into the body of S1 and S2, osteoporotic bone may sometimes require longer screws extending into the contralateral ala, or more than a single screw. Fractures involving zone II require care to properly assess root entrapment before applying compression with partially threaded screws. The use of fully threaded screws can provide adequate fixation and avoid unnecessary compression along a comminuted sacral zone II or III fracture.

Care should be taken to avoid the risk of neurologic injury during placement of sacroiliac screws.[13,14] Screws positioned in the first sacral body have a significantly lower incidence of neurologic deficit compared with screws positioned in the second sacral body.[15] Intraoperative use of stimulus-evoked electromyography may decrease the risk of iatrogenic injury to the nerve roots during operations on the pelvic ring.[16]

A possible contraindication to percutaneous fixation of posterior pelvic ring injuries is sacral dysmorphism.[17,18] Much has been written about these anatomical variants, and proper imaging is required in the preoperative planning stage to avoid penetration into the foramina, extrusion anteriorly or into the L5-S1 disk and the risk of nerve root damage. A thorough understanding of the fracture pattern and proper reduction is paramount as an improperly fixed posterior ring injury may result in chronic pelvic pain. Relative contraindications also include morbid obesity, abundant bowel gas, or intra-abdominal contrast agents that may hinder intraoperative fluoroscopic imaging making percutaneous fixation difficult and dangerous. Open reduction is also preferred in sacral fractures with foraminal debris and associated neurologic injuries as it allows simultaneous decompression of nerve roots and debridement.[10]

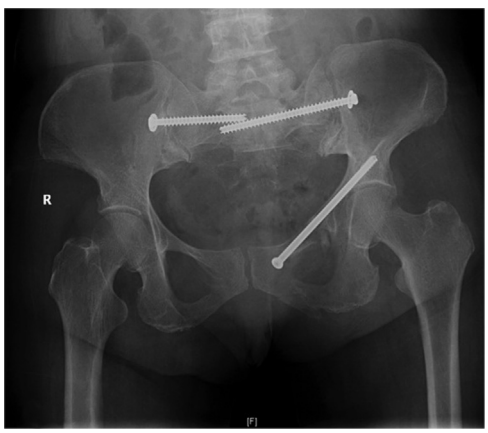

Figure 1 Unstable bilateral zone 2 sacral fractures managed with 7.3-mm fully threaded cannulated screws posteriorly to prevent compression of comminution. Left anterior rami fracture was fixed with a 6.5-mm partially threaded screw applied in a retrograde manner.

Anterior ring disruptions such as a symphyseal disruption are ideally suited for anterior plating, but some anterior ring fractures involving the superior rami are amenable to rami fixation with retrograde rami screws (Figs. 1 and 2). Proper indications involve single side or bilateral superior rami fractures with sufficient bone on each side of the fracture to allow for effective screw purchase. A lateral fracture of the superior ramus close to the acetabulum may not achieve sufficient distal bone purchase for a short retrograde screw. These fractures behave more like low anterior column fractures and are more amenable to management with longer anterior column screws applied either antegrade or retrograde and extending from the lateral iliac cortex into the anterior column. Similarly, rami fractures immediately adjacent to the symphysis may not offer sufficient bone purchase for the effective use of either retrograde or antegrade screw. These fractures are best treated with plating techniques.

Some geriatric pelvic fractures patterns normally treated with nonsurgical care, such as the common low-energy lateral compression type 1 (LC1) pelvic fracture, can be amenable to percutaneous fixation in patients with severe pain-limiting early mobility. A recent study suggests that the outcome of the LC1 pelvic fractures in the elderly are associated with a significant mortality that has previously been underappreciated.[19]

Acetabular Fixation

The Frail Geriatric Patient

With the increased longevity of our population, pelvic and acetabular fractures in the elderly are of increasing occurrence. Low-energy trauma related to a fall from standing, in conjunction with osteopenic and osteoporotic bone, may result in pelvic or acetabular fractures.[20] These patients typically have several comorbid medical conditions, resulting in higher perioperative risk of complications with more invasive ORIF methods. Percutaneous fixation techniques may provide safe and effective fixation in the old and debilitated patient.[1,21]

Patients with marked comminution or impaction of the articular surfaces associated with a displaced fracture of the acetabulum often progress to degenerative arthritis necessitating subsequent total hip arthroplasty (THA).[22-25] Percutaneous fixation of acetabular fractures can act as a bridge to THA in those patients unable to undergo immediate management with THA. Furthermore, stabilization of some fracture patterns in