Percutaneous CT-Guided Stabilization of Complex Sacroiliac Joint Disruption With Threaded Compression Bars

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Patients sustaining unstable pelvic fractures experience less than satisfactory results with nonoperative treatment. Posterior pelvic stability cannot be achieved or maintained through the use of the external fixator alone.1-4 In these patients the best results have been obtained through open reduction and internal fixation; however, the high incidence of complications with the open surgical technique has been a problem.1,5-7 In an attempt to minimize the surgical complications, the percutaneous technique utilizing either the image intensifier or CT guidance was developed and preliminary reports showed that percutaneous technique is associated with less complication rates.8,9

Most authors recommend additional anterior stabilization of the pelvis to supplement the posterior fixation.2,3,7

Compression sacral bars, anterior or posterior plates, sacroiliac lag screws, and cobra plates have been used for the fixation of the unstable posterior pelvic complex.2,5,8,13 All these standard open techniques are associated with high incidence of wound infection secondary to extensive soft tissue dissection, considerable amount of blood loss, and risk of injury to the nerve roots or cauda equina.1,5,7 The infection rate was reported to be up to 25%.5,6

The threaded compression bars technique has the unique advantage of easily being performed, and can be used in the majority of posterior pelvic complex fractures. The use of CT provides a precise image of the pelvic pathology and allows for a safe application of sacral bars using a percutaneous technique.

We present the technique used in the treatment of three patients with unstable pelvic fractures utilizing CT scan guidance for percutaneous placement of threaded compression bars.

Methods

The procedure can be performed on any CT scanner with a wide (75 cm) gantry and preferably with a scan time of 3 seconds or less. The patient is positioned prone on the CT table. Epidural or general anesthesia can be used for this procedure.

After the patient has been positioned on the CT table, the fracture is reduced by manipulation or skeletal traction and the reduction confirmed by a CT scout image. The sacroiliac joints are then scanned at 5 mm intervals to determine the amount of comminution and the optimal sites which provide the best bony purchase without violating the sacral canal. The direction of the bar and the optimal length are calculated using computer graphics available on the CT console. The skin entry site is determined in relation to an opaque marker taped on the patient’s skin prior to the sacroiliac joint scanning. The patient is prepped and draped after the entry site has been marked on the skin with an indelible marker.

The compression bar is prepared by placing locking nuts and a washer on one end (Fig 1). The bar length must equal the selected transiliac distance plus enough excess length to allow insertion of a washer and nut from the opposite end (Fig 2). A small incision is made at the skin entry site where the compression bar is inserted.
Fig 3: CT scan showing bar engaging proximal cortex of iliac crest. Changes in position and direction should be made at this time.

Fig 4: CT scan showing that bar has safely cleared sacral canal and is headed toward opposite iliac crest in good position.

along the predetermined angle into the outer cortex of the ilium. A repeat scan is taken at the level of the bar to check its position and direction (Fig 3). It is important to assure safe clearance of the sacral canal. If adjustments in the direction of the rod are necessary, they must be made before engaging the contralateral iliac crest (Fig 4). Once final placement of the rod is achieved, additional scans are obtained to confirm the placement and tip location of the bar and to assess reduction of the fracture. A washer and nut are then placed over the opposite end of the rod through a small incision. Care must be taken not to overtighten the nut. Excess rod can be removed with an end cutter. The same procedure can be repeated for the insertion of an additional bar.

Fig 5: AP pelvis radiograph, showing right sacral fracture (arrow) and diastasis of the symphysis pubis which measured 4 cm.

Fig 6: AP pelvis radiograph at follow up after external fixator had been removed and fracture had healed.

Case Reports

Case 1. A 40-year-old man was involved in a motor vehicle accident, sustaining multiple injuries, including a vertical shear fracture of the right hemipelvis. This consisted of a comminuted right sacral fracture and diastasis of the symphysis pubis measuring 4 cm (Fig 5). Because there was massive soft tissue injury posteriorly, the risk of infection was felt to be too great for open reduction and internal fixation (ORIF). It was felt that percutaneous placement of sacral bars combined with an anterior external fixator would offer safe, stable fixation (Fig 7). The sacral fracture healed and the patient resumed his preoperative level of activity and function.

Case 2. A morbidly obese 21-year-old man was involved in a motor vehicle accident, sustaining numerous orthopedic injuries, including a malalignment fracture of the right hemipelvis with severe sacroiliac joint disruption. The injury was complicated by a transverse fracture of the right acetabulum, avulsion of the right lumbosacral plexus, and severe ligamentous disruption of the left knee. The patient underwent ORIF of the acetabular fracture (Fig 6). Internal fixation of the unstable posterior complex was necessary to facilitate mobilization of the patient. Due to the obesity, CT-guided percutaneous pinning of the sacroiliac joint with Ace cannulated screws was selected. A percutaneous sacral bar was placed to augment fixation of the cannulated sacroiliac screws, thus avoiding the use of external fixation and the possibility of the spread of infection to the hip joint (Fig 8). All fractures healed; however, the patient remained wheelchair bound because of his obesity and other associated injuries.

Case 3. A 31-year-old man was involved in
an industrial accident and sustained an undisplaced fracture to his right acetabulum and disruption of the right sacroiliac joint in addition to a bladder rupture. Because there was massive soft tissue crush posteriorly, a percutaneous CT scan technique was done. A threaded compression bar and two lag screws were utilized to stabilize the posterior pelvic injury. An anterior external fixation frame was also utilized to achieve maximum fixation of the pelvis. At the completion of the treatment, the patient returned to his previous level of function.

**DISCUSSION**

Unstable pelvic fractures are best stabilized by internal fixation. Many techniques are currently used to stabilize the posterior pelvic lesion. The technique of threaded compression bars was made popular by Tile and has proven to be a reliable technique, particularly in sacral fractures. With this technique, overcompression of the fracture must be avoided. Open procedures are difficult and associated with a high incidence of infection, blood loss, neurologic injury, and soft tissue necrosis. To minimize these complications, a CT-guided or fluoroscopic-guided percutaneous stabilization of the unstable posterior pelvic complex was developed, and its preliminary results are encouraging.

Combining posterior fixation with anterior internal or external fixation has been recommended to restore pelvic stability. However, the use of the external fixator may be hazardous in patients with acetabular fracture surgery due to the risk of infection of the hip joint. Because one of the patients had internal fixation of the acetabular fracture, the external fixator could not be used to augment the posterior fixation, and the percutaneous, CT-guided, threaded compression bar was used as an alternative. Subsequently, the procedure was utilized in two patients with severe crush to the soft tissue posteriorly. In these two cases, open posterior techniques potentially would have been hazardous to the soft tissue.

In conclusion, percutaneous stabilization of pelvic fractures can be utilized in selected cases and threaded compression bars can be inserted percutaneously using CT scan guidance.

**REFERENCES**

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EDITORIAL DISCUSSION

ORTHOPEDICS: With anterior and posterior disruption, which do you reduce and stabilize first?

Ebraheim et al: Epidural or general anesthesia can be used for this procedure. The procedure is done with the patient lying prone on the CT table. The fracture is reduced by manual traction and reduction is confirmed by a CT scout image. This is followed by stabilization of the posterior pelvic complex prior to any anterior fixation.

ORTHOPEDICS: Do you apply the recommended anterior fixator in the OR or in the CT suite?

Ebraheim et al: Once the posterior fixation has been accomplished, the patient is turned supine and anterior external fixation is applied in the CT suite.

EDITORIAL COMMENT

Open surgical experience has shown that correction of the cephalad displacement is difficult. It requires considerable manipulation and use of special reduction forceps. The forceps maintain the reduction until fixation is completed. Less than anatomic reduction should not be accepted.

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TRAUMATIC FRACTURE-DISLOCATION OF THE HIP IN A 2-YEAR-OLD CHILD

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Traumatic fracture dislocation of the hip joint is an unusual injury in children,1,4 and posterior dislocations are more frequent than anterior.

Joint laxity and a shallow acetabular fossa in children less than 5 years old have been postulated to predispose to dislocation following relatively minor trauma,1,5 and late diagnosis is not infrequent.5,7 Prognosis is poor following late diagnosis or failed reduction.1,3,8 We present a case of late diagnosis of traumatic fracture dislocation of the hip joint in a 2-year-old child that was complicated by a failed open reduction.

CASE REPORT

A 2-year, 3-month-old girl was injured by a minor fall from a slide. She had no previous medical or surgical history, and had reached all developmental stages normally. The child initially presented to a local emergency room with ecchymosis and pain in the left knee. Subluxation of the left patella was diagnosed and the child was placed in a cylinder cast. Radiographs of the left knee and left hip were interpreted to be normal (Fig 1).

She could crawl, but not stand with the cast. The cast was removed 5 weeks following injury. She continued to be unable to ambulate or bear weight on her left leg. At 9 weeks following the injury repeat radiographs showed a left hip dislocation (Fig 2).

The child was then admitted to the hospital and placed in Bryant's traction for 4 days. Open reduction through the posterior approach was performed. Postoperative radiograph showed incomplete reduction. Closed reduction under anesthesia was attempted and a spica cast was applied. Three weeks after the procedure, radiographs showed incomplete reduction. Another attempt at closed reduction was unsuccessful.

The patient was first examined at The Hospital for Special Surgery 14 weeks following initial injury. Admission radiograph and computerized tomography (CT scan) demonstrated posterior dislocation with fracture of the posterior acetabular wall (Figs 3-4). The patient underwent an open reduction by the anterior iliofemoral approach. The acetabular fossa was nearly obliterated by soft tissues. No defects