Case Report

The Prone Reduction of a Sacroiliac Disruption with a Pelvic C-clamp

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Abstract The pelvic C-clamp traditionally is reserved for the temporizing stabilization of posterior ring injuries and reportedly has assisted in closed reduction of sacroiliac diastases, for patients who are in the supine position. We report a patient with a severely displaced Zone II sacral fracture and associated acetabular fracture who initially underwent fixation of the acetabulum in the prone position. By using the pelvic C-clamp as a tool for successfully reducing the sacrum, definitive closed fixation of the pelvic wing subsequently was performed without having to reposition the patient. In this case report, we review the literature on this device and for alternative reduction maneuvers for disrupted sacral injuries. The C-clamp may be a useful adjunct in select cases to facilitate closed reduction of sacral or sacroiliac joint disruptions, as may particularly apply in cases of severe displacement or when a reduction is hampered by obesity.

Introduction

The pelvic C-clamp traditionally is used to stabilize posterior disruptions of the pelvic ring in multiply injured and

hemodynamically unstable patients. While pelvic external fixators are limited in use primarily to pelvic injuries with anterior instability, the C-clamp device provides stability to the posterior pelvic ring [4, 9, 12]. Initially introduced by Ganz et al. [6] in 1991, this device is heralded for its ability to provide posterior stability and for its simplicity of use without interfering with subsequent laparotomies [2, 3, 5, 7, 10, 11].

For acute reductions of pelvic ring disruptions, Ganz et al. initially described applying the pelvic C-clamp in a supine position [6]. For application, an in-line axial incision is made between the anterior and posterior superior iliac spines. Once secured to the clamp, the pins are directed toward the posterior ilium and driven into the pelvic table with a mallet, and compression of the displaced or diastased sacroiliac (SI) joint was achieved by advancing the threaded bolts with a wrench.

We report the use of the C-clamp in a case of a severe SI disruption and associated acetabular fracture, where the device was applied with the patient in the prone position that also permitted us to use a Kocher-Langenbeck approach to address a contralateral acetabular fracture. Thus, both injuries were stabilized without the necessity for intraoperative repositioning.

Case Report

The patient was a 27-year-old obese woman with a body mass index of 34 who arrived at our Level I trauma center after being struck by a train.

Emergency medical services performed an endotracheal intubation for a critical airway and aggressive fluid resuscitation for a systolic blood pressure in the range of 70 to 80. Despite receiving an additional three units of packed

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Each author certifies that his or her institution has approved or waived approval for the reporting of this case, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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red blood cells through a right-sided large-bore femoral line, the patient remained hypotensive and tachycardic on arrival to the trauma bay.

Standard radiographic images were obtained at the trauma bay. An anteroposterior chest radiograph was remarkable for a right-sided pneumothorax and multiple bilateral rib fractures. Radiographs of the pelvis, including anteroposterior, inlet, outlet, and Judet views, revealed fractures through the right superior and inferior rami, a left transverse acetabular fracture with a fracture of the ipsilateral posterior wall, and a right Zone II sacral fracture with approximately 5 cm lateral displacement (Fig. 1A). There was also an avulsion of the right L5 spinous process. These pelvic injuries were confirmed with a CT scan (Fig. 1B).

While at the trauma bay, a focused assessment of the abdomen with sonography raised suspicion for free fluid, and within less than a half hour of arrival to the trauma bay,

Fig. 1A–B A preoperative (A) anteroposterior radiograph and (B) CT scan of the pelvis reveal a left transverse acetabular fracture with a fracture of the ipsilateral posterior wall, contralateral superior and inferior rami fractures, and a Zone II sacral fracture on the right side with marked displacement (approximately 5 cm.) There is also an avulsion fracture of the L5 spinous process.

the patient was taken to the operating room in a state of hemorrhagic shock for an emergent exploratory laparotomy. After just over an hour of exploration, the laparotomy revealed no evidence of trauma but a sizeable retroperitoneal hematoma in the true pelvis. The patient remained unstable in the operating room and was transferred to the angiographic suite within 20 minutes to undergo a diagnostic and therapeutic angiogram. During this procedure, the right superior gluteal artery was occluded and there was a bleeding branch of the inferior gluteal artery; the bleeding artery was successfully embolized. After normalizing the patient's cardiovascular status and correcting her hypothermia and coagulopathy, we performed definitive fixation of the pelvic ring and the acetabulum 10 days after presentation.

The acetabulum was addressed first, using a Kocher-Langenbeck approach with the patient in the prone position. An anatomic reduction of the transverse acetabular component was obtained and definitive fixation was achieved with an eight-hole reconstruction plate. After confirming a stable and congruent acetabulum and closing the wound, we addressed the contralateral hemipelvis.

With the patient still prone, the right sacral fracture and pelvic arches were reduced with a C-clamp (Fig. 2). The C-clamp pins were placed along the proximal medial border of the posterior pelvic ring, approximately 2.5 cm distal to the cranial border of the SI joint. The location of these pins was assessed intraoperatively via fluoroscopy using Judet projections. As the C-clamp was temporizing the anatomic reduction, the sacrum was predrilled in a percutaneous

Fig. 2 Intraoperative fluoroscopy obtained with the patient in the prone position shows reduction of the patient's injuries on applying the pelvic C-clamp. The right half of the image shows the fracture being reduced. Before addressing the sacral injury, the contralateral acetabular fracture (not seen in this fluoroscopic view) had been fixed.

Fig. 3A–B After reducing the sacral fracture with the pelvic C-clamp, the right pelvic wing and sacrum are predrilled. **(A)** This clinical image shows the patient lying prone with the C-clamp in place. The surgeon's index finger indicates the proximity of the percutaneous entry point through which the SI screw is to be inserted. **(B)** This intraoperative fluoroscopic image shows the position of the percutaneous pin, with a predrilling trajectory just above the clamp's pin.

fashion, starting approximately 2 cm above the right C-clamp pin, and this reduction was secured with an SI screw through a trajectory (Fig. 3). To prevent cutting through the pelvic wing of this morbidly obese patient, a two-hole plate was used. Rotation of the plate was secured with a monocortical screw in the second plate hole. After confirming a congruent reduction under fluoroscopic observation, the clamp was removed and an anterior external fixator was used to stabilize the anterior ring. The acetabular fracture then was stabilized through a Kocher-Langenbeck approach on the contralateral side.

Fig. 4A–B **(A)** An anteroposterior radiograph of the pelvis taken at 12 months' followup shows anatomic healing of the pelvic ring. **(B)** A postoperative CT scan obtained 4 months postoperatively shows an anatomic reduction of the sacrum, as can be appreciated by symmetry of the foramen just above the SI screw with its contralateral foramen.

Postoperatively, the patient's bilateral weightbearing status was touch-down weightbearing with pivot transfers for 12 weeks with instructions to be mobilized from bed to a chair at least twice daily. The patient then was advanced to partial weightbearing with a walker for another 4 weeks. On her next followup at 16 weeks, we advanced her to weightbear as tolerated with crutches and proceeded with gait training. At this time, the patient's surveillance films revealed a reduced SI joint and healing along the fractures of the acetabulum, rami, and sacrum.

At 12 months' followup, the patient subjectively stated she felt remarkably well and was pain free and walking without assists. She had a slight Trendelenburg lurch toward the side of the acetabular fracture. She remained neurologically intact bilaterally on her postoperative lower extremity sensory-motor examination, as she was preoperatively, and had radiographic evidence of bridging callus formation and a healed sacrum (Fig. 4).

Discussion

Previous reports have focused on closed reduction of the SI joint in the supine position, and this usually has been performed in the trauma bay. In the above-described scenario, the patient had been hemodynamically stabilized with a pelvic binder and, shortly thereafter, an angiographic coagulation of an intrapelvic source of hemorrhage. Thus, a delayed reduction in a hemodynamically stable patient was required.

We recognize the combination of a posterior acetabular injury and an SI joint displacement in a morbidly obese patient is rare. Closed manual reduction could have resulted in reduction of the SI joint; such manual maneuvers, however, can be difficult in patients with morbid obesity. We therefore believe our approach adds to the existing arsenal of reduction techniques for these types of injuries.

Wright et al. [15] described using the pelvic C-clamp for the closed reduction and definitive fixation of an SI diastasis. The method seems particularly useful in patients who are obese and in those with marked displacement of the SI joint or a sacral fracture. In these cases, adequate closed reduction can be difficult owing to intervening soft tissues or severe displacement and therefore might be treated more commonly in an open fashion.

Although used infrequently even in busy Level I trauma centers, the pelvic C-clamp may be applied with the patient supine, as reported by Wright et al. [15], or in the prone position, as we describe in our patient. We believe this was advantageous in our patient as it allowed us to perform definitive fixation of the pelvic wing and the acetabulum in this position.

Although concerns for loss of reduction or pin loosening exist with standard use of the C-clamp, its brief intraoperative utility for the sake of obtaining definitive fixation makes these final concerns virtually irrelevant.

Even though we describe use of this particular device for the care of patients, such as for our patient, alternative methods exist for obtaining a closed reduction in a prone position. These include applying longitudinal traction and rotation either manually or on a reduction table, and manual compression of the pelvis. Excessive manual compression, however, should be avoided to prevent endangering exiting nerve roots along fractures that extend into the sacral foramina [8]. Additionally, percutaneous manipulation of the pelvis can be performed by directing Schanz pins into the gluteus medius tubercle and thereafter compressing a displaced SI joint with a femoral distractor; whereas one pin often suffices for this approach, bilateral pins may be necessary for better reduction [13]. More recently, studies of minimally invasive CT-guided reduction and fixation of posterior ring injuries in the adult and

pediatric patient populations reported great precision of fixation and low risk for iatrogenic neurovascular damage [1, 14].

We believe the C-clamp may be a useful adjunct in selected cases to facilitate closed reduction of severe sacral or SI joint disruptions. This may apply in cases of severe displacements or when maintaining a reduction is hampered by severe obesity, as in the current patient.

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