Evaluation of Closed Reduction and Percutaneous Iliosacral Cannulated Screw Fixation for Sacroiliac Disruption or Sacral Fractures; A preliminary Study

Ali Bakir Al-Hilli

ABSTRACT:

BACKGROUND:

High energy pelvic ring fractures are serious injuries result from motor vehicle accidents or fall from height, unstable pelvic ring injuries usually associated with sacroiliac disruptions or sacral fractures. The ideal treatment for unstable pelvic fractures remains a matter of debate. The main purpose of the treatment is to save the patient s life and then to achieve an excellent functional outcome. Percutaneous fixation of Sacroiliac joint disruption or sacral fractures is evolved recently as a minimal invasive technique with low complication rate and morbidities.

OBJECTIVE:

A preliminary study to evaluate prospectively the effectiveness of the percutaneous cannulated screws fixation of posterior pelvic ring injures in unstable fractures with associated injuries .

PATIENTS AND METHOD:

Six patients have been treated in Medical City/Baghdad (during the period of Jan.2012 till July 2012) by one surgeon, four males and two females with mean age 27 years (range 20-36 years), who have unstable pelvic ring injuries associated with other skeletal, neural or visceral injuries are treated by gradual closed reduction using skeletal traction through lower femur and percutaneous sacroiliac fixations using a 7 mm Cancellous partially threaded screws following the technique described by Matta and Saucedo using C-arm fluoroscopy. A data for the duration of procedure, blood loss, intra-operative and post-operative complications and post-operative rehabilitation were collected analyzed and compared to data for open reduction and internal fixation for the same injuries from other studies . pre and post-operative radiographs and CT scans of the pelvis were studied to evaluate the procedure.

RESULTS:

A total of 13 screw where inserted percutanously to a six patients . The duration of the surgical procedure was 30 minutes to 60 minutes including the preparation time. Wound size was 5mm-10mm, Blood loss was negligible, no anesthetic complications no intra or post-operative complications, no wound complications, and a very good post-operative rehabilitation. post-operative X-rays and CT scans show no complications and a very good reduction and fixation for the Sacroiliac joints and sacral fractures.

CONCLUSION:

Gradual closed reduction and Percutaneous sacroiliac fixations using cannulated screws have demonstrated a very good minimally invasive technique with no intra-operative or post-operative complications. This technique may be advantageous as it avoids using extensive approaches, bleeding, wound complications and prolonged surgeries.

KEYWORDS: sacroiliac injuries, percutaneous screw fixation.

INTRODUCTION:

Pelvic fractures represent wide spectrum of injuries that carry a lot of complications from life threatening to a crippling situations, Survivors frequently experience long term medical and socio-economic complications of fractures of the pelvis.

Senior Lecturer Orthopedics and Trauma/ College of Medicine / Baghdad University.

, Classification of pelvic fractures in to a high and a low energy injuries carries a good prognostic guideline for the management and prediction of the outcome, but it is not simply like that, pelvic injuries could involve any part of the pelvic ring including the hemipelvis, the sacrum, or acetabular fractures each injury can happen in isolation or in association with other injuries and each carries a different morbidity

High-energy pelvic fractures result most commonly from motor vehicle accidents, falls, motorcycle accidents, automobile-pedestrian encounters, and industrial crush injuries. The potential complications of high-energy pelvic fractures include injuries to the major vessels and nerves of the pelvis.[1] If there are only two sites of injury within the pelvic ring, reduction of the anterior ring may facilitate reduction of the posterior pelvis in some circumstances; however, beginning treatment with the posterior injury is still recommended.[2]

Sacroiliac joint disruption is commonly associated with high energy pelvic ring fractures when a vertical shear force, the lateral compression or anteroposterior compression force were the mechanism of injury. Disruption of the sacroiliac joint could be associated with incomplete or complete posterior ligamentous disruption, the mechanism of injury and its severity decide whether the injury is rotationally unstable or rotationally and vertically unstable.[3,4] The stability of the pelvic ring depends upon the integrity of the posterior weight-bearing sacroiliac complex, which includes the sacroiliac joint and the major sacroiliac, sacrotuberous and sacrospinous ligaments as well as the muscles and fascia of the pelvic floor, the extremely strong posterior sacroiliac ligaments maintain the normal position of the sacrum in the pelvic ring, the sacrospinous ligaments resist external rotation of the hemipelvis, where the sacrotuberous ligaments resist rotational force in the sagittal plane[5] (Fig. 1,2 &3). Fractures through the sacrum or the iliac blade are equivalent to disruption of the sacroiliac association.

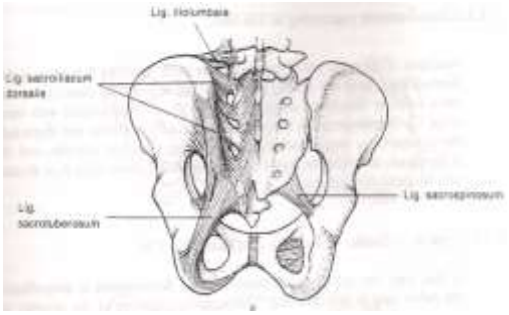

Fig. 1: Osseo-ligamentous structures essential for pelvic stability (M. E. Muller . M. Allgower/ Manual of Internal fixation/ techniques recommended by the AO-ASIF group, 1992 page 485-500).

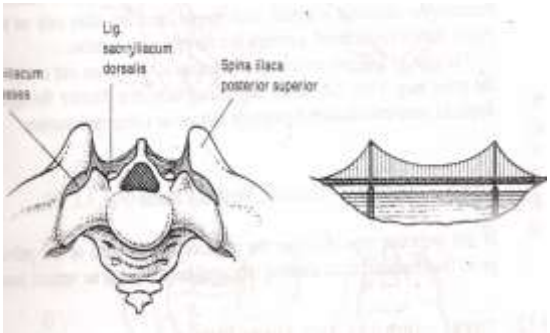

Fig. 2: Osseo-ligamentous structures essential for pelvic stability(M. E. Muller . M. Allgower/ Manual of Internal fixation/ techniques recommended by the AO-ASIF group, 1992 page 485-500).

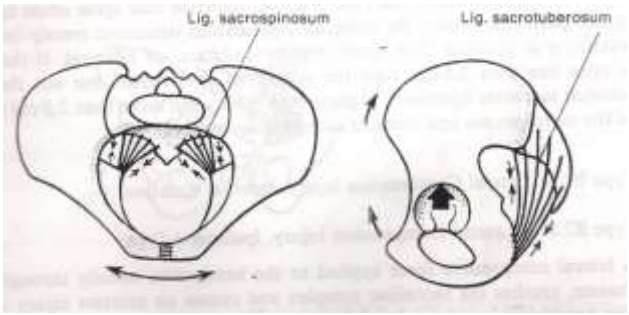

Fig. 3: Forces acting on the pelvic floor (M. E. Muller . M. Allgower/ Manual of Internal fixation/ techniques recommended by the AO-ASIF group, 1992 page 485-500).

Currently, the classification used most often for the sacral fractures is that proposed by Denis, Davis, and Comfort (Fig. 4), type I fractures occur lateral to the neural foramina through the sacral ala; type II fractures are transforaminal; type III fractures occur medial or central to the neural foramina. Transverse fractures of the sacrum are classified as type III injuries because they involve the spinal canal and often are H or U shaped (so-called jumper's fracture because of their association with falls from heights). These fractures may have significant translation noted on the lateral sacral radiograph.[1]

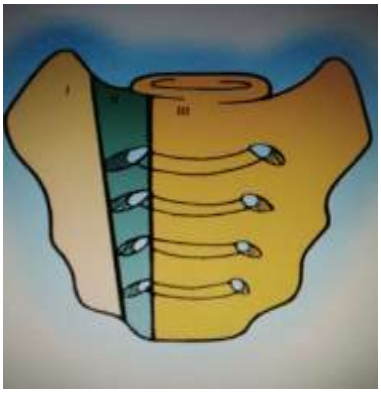

Fig 4: Denis classification of sacral fractures, in which three zones of injury are differentiated: zone I, sacral ala; zone II, foraminal region; and zone III, spinal canal. Most medial fracture extension is used to classify injury. (From Denis F, Davis S, Comfort T: Sacral fractures: an important problem retrospective analysis of 236 cases, Clin Orthop Relat Res 227:67, 1988.)

Early anatomic reduction and stable fixation of the unstable pelvis have been shown to diminish pain, allow early mobilization and improve patient outcome.[6,7,8,9,10,11] The techniques of closed reduction and percutaneous fixation of pelvic fractures evolved recently as a minimal invasive procedures that could be used safely in early pelvic fractures fixation to achieve stability and improve patients outcome with potentially less complications that associated with major surgery.[12,13,14,15,16]

PATIENTS AND METHOD:

In this study six patients have been treated in Medical City/Baghdad (during the period of Jan.2012 till July 2012), four males and two females with mean age 27 years (range 20-36 years), they had sacral fractures or disruption of the sacroiliac joint associated with unstable pelvic ring injuries. These injuries were treated by gradual closed reduction using skeletal traction through lower femur and percutaneous sacroiliac fixati9999999on following the technique described by Matta and Saucedo.[1] Description of the patients and their treatment are listed in the table below:

Patient	Age (yeas)	Sex	Cause of injury	Mechanism	Posterior injury	Reduction and fixation
1	36	female	Motor vehicle accident	Acetabular fracture +right sided vertical shear	Right sacroiliac disruption	Gradual skeletal traction +2 sacroiliac screws
2	20	Male	Motor vehicle accident	Vertical shear right side + anteroposterior compression type II	Right sacroiliac disruption+ left sacral fracture zone 1	Gradual skeletal traction right side + 1 right and 2 left sacroiliac screw
3	33	Male	Motor vehicle accident	anteroposterior compression type II, right sacroiliac disruption	Right sacroiliac disruption	Gradual skeletal traction +2 right sacroiliac screws and anterior internal fixation
4	26	male	Motor vehicle accident	anteroposterior compression type II, left sacroiliac disruption due to vertical shear force.	Left sacroiliac disruption	Gradual skeletal traction +2 left sacroiliac screws and anterior external fixation
5	24	Male	Fall from height	Acetabular fracture + lateral compression force	Right Sacral fracture zone 1	Gradual skeletal traction +2 right sacroiliac screws
6	25	Female	Motor vehicle accident	Lateral compression type II	Right sacral fracture zone 1	Gradual skeletal traction +2 right sacroiliac screws

Preoperative evaluation of the fractures is very important to decide the type of instability, whether rotational only or global. CT scan is superior to conventional X-ray in evaluation of the severity of injury. Vertical instability usually is defined as 1 cm or more of cephalad migration of one hemipelvis. In some pelvic injuries, vertical instability is apparent; but if vertical stability is questionable, stress testing can be beneficial. When pelvic stability is questioned, Bucholz recommended a push-pull test in which, under radiographic control, the examiner pushes up on one extremity while pulling down on the other. This maneuver is then reversed, again Under radiographic control, and the maximal displacement between the two films is determined. If more than 1 cm of cephalad displacement is possible with this test, the fracture is vertically unstable. Push-pull testing should not be performed in acutely injured patients with ongoing hemodynamic instability or in zone II or zone III sacral fractures in which potential neurological injury could occur. [(1)]

The closed reduction maneuver was done preoperatively by inserting a skeletal traction in the lower femur at the deformed side with gradual reduction starting with a 5 kg and increasing the weight as needed and the reduction

Was checked by serial x-rays this procedure needs closed monitoring for the patients pain and neurological status, this procedure took 24-48 hours or even less (Fig.5).

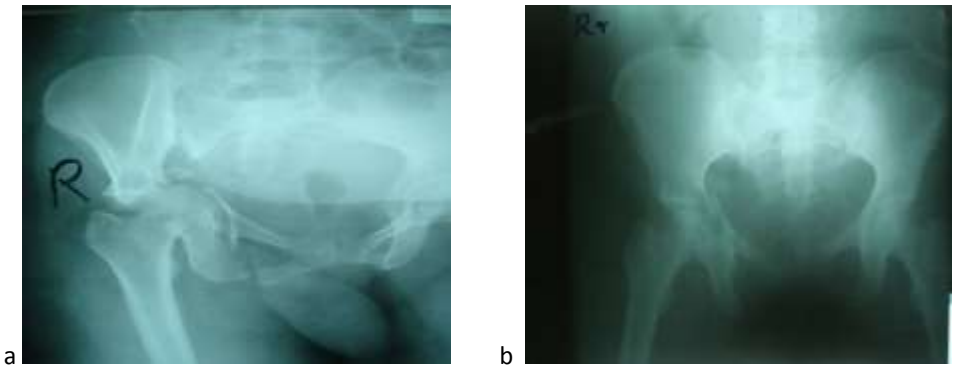

Fig. 5: a: X-ray shows disruption of the right sacroiliac joint. b: After axial skeletal traction through lower right femur, X-ray shows a very good reduction.

All the operations were performed under general anesthesia in the prone position by the same surgeon (Fig. 6). A radiolucent operating table and a fluoroscopy were used, with the guidance of the standard anteroposterior, 40 degrees cephalad and 40 degrees cauded views. We can use the skeletal traction applied previously to correct any residual deformity (Fig. 7).

Fig. 6: Intraoperative setting.

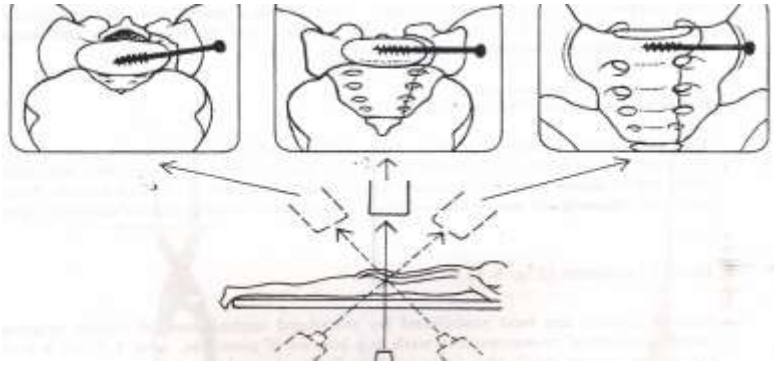

Fig. 7: X-ray control of screw position, inlet, anteroposterior, and outlet views. (M. E. Muller . M. Allgower/ Manual of Internal fixation/ techniques recommended by the AO-ASIF group, 1992 page 485-500).

Anterior to the sacral ala in this region run the L5 nerve root and the iliac vessels. The cortex of the alar slope forms the anterior boundary of the "safe zone" for passage of iliosacral screws into the body of S1. The posterior boundary of the safe zone is formed by the foramen of the S1 nerve root. (1)

Through a 1 cm incision (Fig. 8), using a 7mm partially threaded cannulated screws Following the placement of the first screw a second screw was used when needed A data for the duration of procedure, blood loss, intra-operative and post-operative complications and post-operative rehabilitation were collected analyzed and compared to data for open reduction and internal fixation for the same injuries from other studies . pre and post-operative radiographs and CT scans of the pelvis were studied to evaluate the correct placement of the screws(Fig. 9,10&11).

Fig. 8: Skin incisions, three skin incisions each less than 1cm.

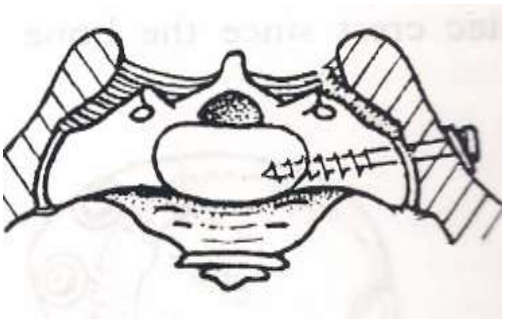

Fig. 9: Correct screw placement.(M. E. Muller . M. Allgower/ Manual of Internal fixation/ techniques recommended by the AO-ASIF group, 1992 page 485-500).

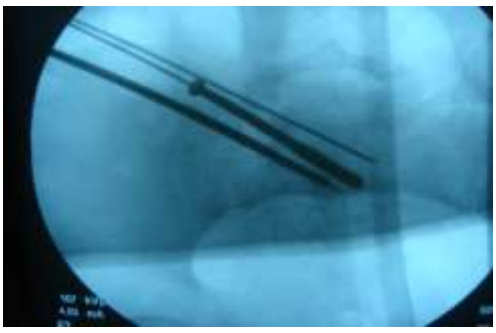

Fig. 10: Intraoperative inlet view.

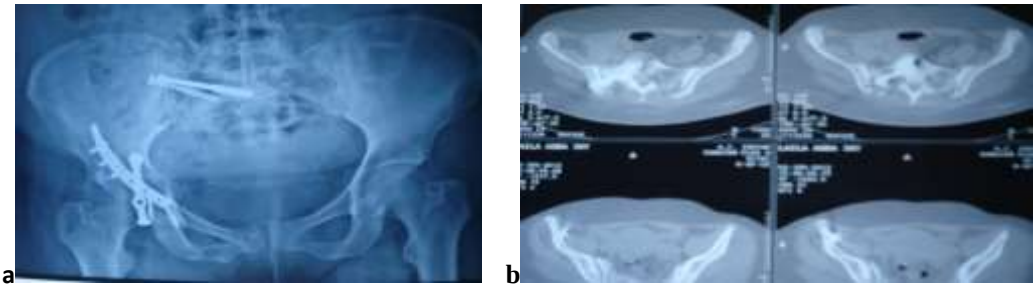

Fig. 11/ A: postoperative X-ray.
B: post-operative CT scan.

RESULTS:

A total of 13 screw where inserted percutanously to a six patients four males and two females. Five out of six patients had injury due to a motor vehicle accident and only one case had a history of a fall from height. Associated injuries were noted such as urethral injury in a male patient and S1 root injury in one patient. One patient had significant closed degloving or the Morel-Lavallee Lesion.[17] Four patients had sacroiliac disruptions and two patients had a sacral fractures through zone 1. All patients needed another fixation to an associated pelvic ring disruptions. Skeletal traction through lower femur shows a very good reduction results which assisted the intraoperative fixation too much. Pin site infection was the only complication noted which was superficial and treated by daily dressing and antibiotics with no complications. The duration of the surgical procedure was 30 minutes to 60 minutes including the preparation time. Blood loss was negligible during screw insertion, Wound size was 5mm-10mm. no anesthetic complications and no intra nor post-operative complications were noted. No wound complications, and all wounds heal satisfactorily. post-operative rehabilitation was easy and the patients were comfortable and have minimal pain treated by simple pain killers. . post-operative X-rays and CT scans show no complications, no penetration in to the spinal canal nor the anterior cortex, and a very good reduction and fixation for the Sacroiliac joint and sacral fractures. It is important to mention that for the sacral fractures fixation it is important to position the screws perpendicular to the fracture and of significant length.

DISCUSSION:

Unstable, displaced sacroiliac joint disruption should be reduced and stabilized. Internal fixations were used for those injuries that traditionally classified as vertically unstable. Posterior approach has been evaluated using plate and screws, tension band wiring, and lag screw fixation. Posterior approaches to the sacrum and sacroiliac joint have been associated with wound complications and usually the surgery delayed till the general situation of the patient becomes better to avoid disruption of the fracture hematoma and temponade effect, this delay might leads to organization of this hematoma and makes the reduction procedure very difficult or even impossible.

Sacroiliac joints can also be accessed using the anterior iliac surgical exposures. Techniques to expose the sacrum and Sacroiliac joints have been associated with injury to the fifth lumber and upper sacral nerve roots. recent data suggest that the most stable construct may be a combination of plate and Iliosacral screw fixation.[3,18]

Unstable sacral fractures or sacroiliac disruptions treated shortly after injury (within 24 72 hours) may be amenable to closed reduction performed by external manipulation of the hemipelvis and stabilization using percutaneous Iliosacral screws, and because the screws are placed percutanously, the potential problem of soft tissue infection complications are greatly diminished. [3, 19] No wound infection has been reported in our patients. A study using percutaneous fixation of the posterior pelvic structures are associated with a low incidence of infection (zero in a series of 177 patients). [3, 20]

Percutaneous techniques are demanding it require good understanding of the pelvic anatomy as well as a skilled fluoroscopic technician. Complications of percutaneous fixation after closed reductions as mentioned in some studies are poor reductions, failure of fixation, misplaced screws and neurologic injury,[3] in our patients no complications were reported and the postoperative x-ray and CT scans show very good

screw placement. In one series, 13% of the screws were either protruding out of the anterior sacral cortex or into the S1 foramen.[3,21]

Closed manipulation and percutaneous fixation of sacral fractures may increase the risk for iatrogenic nerve injury if the fracture is not aligned and is overcompressed.[2]

Misplacement caused by surgeon error occurred in 2% 0f patients.[3,20]

Another study reported on 63 patients with vertically unstable pelvic ring injuries, treated with closed reduction and Iliosacral screw fixation,[3,22] all fixation failures occurs in the presence of vertical sacral fractures. Patients noncompliance has been shown to contribute to loss of reduction in 1.7% to 13% with patients treated with percutaneous or open techniques for unstable fractures.[3,20,23,24,25]

The incidence of postoperative hematoma is 8% to 14% after open reduction and internal fixation of pelvic ring disruptions,[3,21,23,24,25] and the incidence of deep infection is 3% to 14% after open surgical procedures,[3,21,23,24] on the other side deep infections have not reported after percutaneous posterior fixation.[3,20,21]

In the presence of a degloved injury percutaneous fixation may minimize the complications associated with opening of such injuries, allows early reduction and fixation, we treated a one patient with degloved injury treated successfully with early percutaneous posterior fixation without any complications.

Although percutaneous fixation of the pelvic ring has been proposed, the most important factor in the treatment of pelvic ring fractures remains the reduction, and closed reduction of the pelvic ring is most successful when applied early in the post-injury period.[2]

Some surgeons recommend the use of electromyogram monitoring during screw insertion. If this device is used, the anode must be located at or beyond the patient's midline.[2]

CONCLUSION :

Percutaneous sacroiliac fixation after gradual closed reduction of the unstable posterior pelvic ring injuries involving the sacroiliac joint or the sacral fractures using cannulated screws have been demonstrated a very good results as it can be used as an early minimally invasive intervention and short procedure, it has a learning curve for the surgeons and need a good fluoroscopic technician and an optimal operating room settings This technique may be advantageous as it avoids using extensive approaches, much less bleeding, no wound complications and it is not a prolonged surgery. No intraoperative nor postoperative complications, minimal postoperative pain and no infections were reported in our patient.

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