Treatment of sacroiliac joint disruption with anterior stabilization

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Background
Patients with pelvic ring injuries present with fractures ranging from single pelvic fractures to those accompanied by many life-threatening injuries. Sacroiliac joint disruption from high-energy trauma is always complicated with chronic pain and long-term morbidity. Open reduction and anterior stabilization with anterior plating have biomechanical advantages.

Patients and method
Ten patients were studied at Al-Azhar University Hospital (Damietta) during the period from March 2009 to February 2011. There were eight (80%) men and two (20%) women. Their ages ranged from 20 to 50 years. All patients presented with acute pelvic pain, with a history of a road traffic accident in nine (90%) patients and falling from height in one (10%) patient. Plain radiography was the first step in the diagnosis and development of a treatment plan for patients with pelvic trauma. Computed tomography has been proven to be an effective diagnostic tool for the evaluation of pelvic fractures.

Results
The results were excellent in three (30%) patients, good in six (60%) patients, and poor in one (10%) patient. Complications included posterior pelvic pain in one (10%) patient, superficial infection in one (10%) patient, foot drop in one (10%) patient, and pelvic tilt in one (10%) patient.

Conclusion
Surgical anterior stabilization was required for type C injuries with two plates lead to excellent outcome and associated with minor complications.

Keywords:
anterior stabilization, joint disruption, sacroiliac

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Introduction

The pelvic ring is a very important part of the human skeleton and has two main functions. It protects the pelvic viscera and provides stability to support the weight of the body [1].

Pelvic injuries account from 10.5 to 29% mortality rates because of complications resulting from displacement of the pelvic ring, which is usually associated with multiple injuries and significant blood loss because of hemorrhage from iliac arteries or presacral venous plexus. The clinical examination of a critically injured patient is usually limited. Thus, diagnostic radiographs represent an efficient means to determine the appropriate plan of care [2].

Definitive stabilization of the pelvic ring disruption remains a challenge for the managing team. Anterior external fixation is useful in acute situations to reduce pelvic volume and control hemorrhage. However, definitive anatomical reduction and stabilization, particularly of the sacroiliac joint, is important to minimize chronic pain and long-term morbidity [3].

All patients suspected to have an injury to the bony pelvis are investigated by a series of plain radiographies including anteroposterior, inlet, outlet, and Judet views; these views are commonly used in most trauma centers to evaluate the presence or absence of pelvic fracture and also for the classification and management of most pelvic fractures. In general, simple fractures that do not involve the acetabulum and are stable can be evaluated adequately on plain radiography [4].

Computed tomography (CT) has been proven to be an effective diagnostic tool for the evaluation of pelvic fractures. Plain radiography fails to identify ~30% of pelvic fractures that are visualized with CT scan. In addition, plain radiography missed 29% of sacroiliac diastasis, 57% of acetabular rim fractures, and 34% of vertical shear fractures. Although the benefits of CT imaging of pelvic fractures are many, the radiation exposure received during a CT examination should be taken into account and should not be utilized routinely in all pelvic fractures [5].

When imaging pelvic fractures, the axial image obtained in CT imaging enables better visualization of anterior and posterior displacement of fractures. It

is also effective in the evaluation of minor degrees of sacroiliac joint displacement, sacral fractures, crushing or shearing injuries, and other more subtle pelvic ring fractures [6].

The orthopedic surgeon should be involved in the care when the patient is brought into the hospital. Unstable pelvic ring disruption is often associated with concomitant multiple injuries [7].

Primary system complications, bleeding, and head injuries are responsible for high mortality rates [8].

In unstable pelvic injury, the higher rates of death in comparison with stable injury are because of the severe injury of system organs other than pelvic injury in polytraumatized patients [9].

In patients who are hemodynamically unstable, the main goal of the surgeon is to control airway, to establish adequate ventilation, and to maintain circulation [10].

In the emergency room, hemodynamically unstable patients should be treated with antishock measures and an external fixator in an attempt to minimize blood loss. External fixation of the unstable pelvic injury is simple and safe and represents a definitive treatment [11].

A team work approach with coordinated care are needed to achieve best outcome [12].

Early definitive internal fixation is difficult. The contraindications for internal fixation are poor general health and severe local soft tissue injuries [13].

The aim of this study was to evaluate the results of open reduction and anterior stabilization of sacroiliac joint injuries with two dynamic compression (DC) plates with postoperative clinical and radiological follow-up.

Patients and methods

This study was carried out at Al-Azhar University Hospital (Damietta, Egypt) during the period from March 2009 to February 2011. The study included 10 patients. There were eight (80%) men and two (20%) women. Their ages ranged from 20 to 50 years. All patients presented with acute pelvic pain, with a history of road traffic accidents in nine (90%) patients and falling from height in one (10%) patient.

All patients were subjected to the following:

(1) Full assessment of clinical history.
(2) General and local examinations.
(3) First-aid treatment for all patients and antishock measures for hemodynamically unstable patients.
(4) Full laboratory investigations.
(5) Imaging that included the following:
    (a) Plain radiography including the anteroposterior view, which is considered the baseline projection for hip and general pelvic pathology, was performed for all patients; the inlet view, the outlet view, and oblige or Judet view was obtained in some patients.
    (b) Multidetector computed tomography (MDCT) was performed for all patients. Scans were obtained using a four MDCT scanner. The patient lay supine with the arms comfortable on the chest or above the head and the legs were supported; the scanning was extended from above the iliac bones down to the symphysis pubis including both hip joints and femoral neck with a total distance of 14 cm. The slice thickness for the pelvic and the acetabulum was 1 mm. This smaller slice thickness enables less partial volume averaging, visualization of the smallest of fragments, and yields better three-dimensional and reformatting images.
(6) Operation: the preoperative preparation was started by provision of an explanation of the nature of the operation and its complications to all patients and obtaining an operative consent, followed by administration of preoperative prophylactic antibiotics. The duration of surgery ranged from 7 to 15 days (mean 9 days) after trauma. Spinal anesthesia was administered for all patients. A supine position with an anterolateral approach was used for the iliac crest with subperiosteal detachment of the iliacus muscle. Reduction of the sacroiliac joint (SI) joint was performed under vision with longitudinal traction of the limb. The reduction was assessed using an image intensifier. The SI joint was fixed by two DC plates (two or three holes). The wound was closed with suction drain. The suction drain was removed after 48 h. The stitches were removed after 2 weeks. Radiography was performed immediately after the operation and after 2 weeks to assess the reduction and fixation. Weight bearing started after 8 weeks, with full weight bearing after 12 weeks.
(7) Clinical and radiological follow-up for all patients was initially performed monthly, and then after 3, 6, 9, and 12 months. Clinical assessment of union included assessment of the presence of tenderness at the fracture site, gait abnormalities, internal and external hip rotation, and the presence of pain or discomfort during walking. Radiological assessment was performed by a radiograph at the follow-up interval with evaluation of the pubic joint widening; if the widening of the symphysis pubis was less than 1 cm, the reduction was considered good.

Results

Ten patients with pelvic ring injuries with complete sacroiliac disruption were operated upon with open reduction and anterior stabilization with two plates (DC plates). No preoperative neurological deficit was found in any patient. The duration of follow-up ranged from 3 to 20 months. The duration of non weight bearing was about 6–8 weeks, followed by partial weight bearing on crutches and full weight bearing after 12 weeks. Of these patients, three showed excellent results, six patients showed good results, and one patient showed a poor result. They were assessed according to the Majeed [9] system for functional assessment after pelvic fractures.

The extrapelvic injuries in the patients studied were genitourinary injuries in two patients (one patient had a ruptured urethra and one patient had capsular hematoma at the upper pole of the left kidney) and head injuries in one patient (linear left parietal fissure fracture with underlying small left parietal epidural hematoma and overlying left parietal subgalial hematoma and cardiothoracic injuries), fracture of the left anterior sixth and seventh ribs with left hemithorax.

Union had occurred in all patients, range 6–12 weeks.

Posterior pelvic pain developed in three patients after union and was because of sacroiliac arthritis; these patients were treated with analgesics and advised rest. One patient with a poor result had limb-length discrepancy. One patient had a superficial infection and was treated by repeated dressings and antibiotics.

One patient had foot drop immediately after the operation and was treated by physiotherapy and neurotonics; complete recovery was achieved after 3 months. Pelvic tilt occurred in one patient with mild limb-length inequality (Tables 1–7 and Figs. 1 and 2).

Discussion

Patients with unstable pelvic fracture usually present with complex problems for the orthopedic surgeon. These injuries are the result of high-energy trauma, which places patients at risk of multiple life-threatening injuries [14].

Pelvic trauma patients require a rapid and accurate diagnosis to identify the correct and suitable surgical approach. Plain radiography plays an important role in the diagnosis, treatment, and follow-up [15].

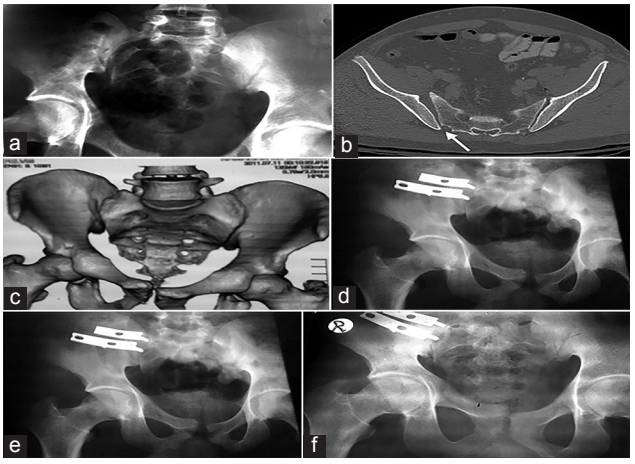
In our study, all patients were subjected to plain radiography (including an anteroposterior view for all patients, inlet view for three patients, outlet view for two patients, and Judet view for one patient) and CT in both axial and reformatting images, which were more sensitive in visualization of fractures and detection of minor degrees of sacroiliac joint displacement. As plain radiography failed to identify ~30% of pelvic fractures, CT has found to be an effective diagnostic tool in the evaluation of pelvic fractures [6].

In our study, false-negative results for plain radiography were found in two patients, accounting for 20%.

Table 1 Majeed system for functional assessment after pelvic fractures [9]

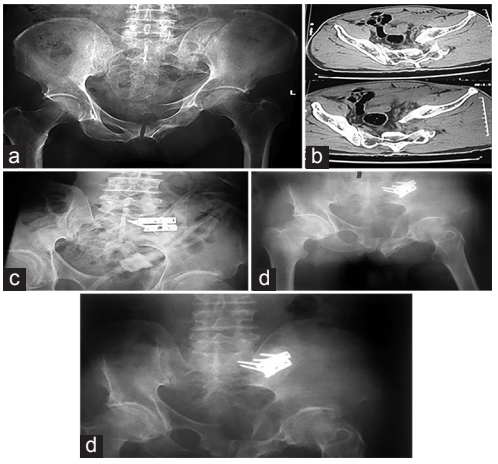
Pain (30 points)	
Intense continuous at rest	0–5
Intense with activity	10
Tolerable but limit activity	15
With moderate activity, abolished by rest	20
Mild, normal activity	25
Slight pain	30
Work (20 points)	
No regular work	0–4–8
Change of job	12
Same job, reduced performance	16
Same job, same performance	20
Sitting (10 points)	
Painful	0–4
Painful if prolonged	6
Uncomfortable	8
Free	10
Sexual intercourse (4 points)	
Painful	0–1
Painful if prolonged	2
Uncomfortable	3
Free	4
Standing (36 points)	
Walking aids (12)	
Bedridden or almost	0–2
Wheelchair	4
Two crutches	6
Two sticks	8
One stick	10
No stick	12
Gait unaided (12)	
Cannot walk or almost	0–2
Shuffling small steps	4
Gross limp	6
Moderate limp	8
Slight limp	10
Normal	12
Walking distance (12)	
Bedridden or few meters	0–2
Very limited time and distance	4
Limited with sticks	6
1 h with a stick	8
1 h without stick	10
Normal	12

Figure 1



Right SIJ disruption. (a) Anteroposterior (AP) view of the pelvis showing irregularity and diastasis at the right SIJ; no other bony abnormalities were noted. (b) Axial computed tomography scan clearly shows the location and degree of sacroiliac disruption, which is clearer than as seen on radiographs. A slight posterior displacement of the right iliac side of the sacroiliac joint suggests ligamentous disruption (arrow). (c) Three-dimensional image of the hole pelvis showing asymmetry at both SIJs. (d) Immediate postoperative AP view of the pelvis showing plate and screw stabilization for the right SIJ with good postoperative alignment. (e) Postoperative follow-up AP view for the pelvis after 6 months shows progressive union with no visible SIJ diastasis. (f) Postoperative follow-up AP view for the pelvis after 12 months showing complete union with near-symmetrical appearance of both SIJs.

Figure 2



Unstable fracture at the left pelvic ring. (a) Anteroposterior (AP) view for the pelvis showing fracture involving the left SI joint and ipsilateral ischiopubic ramus. (b) Axial computed tomography (CT) scan at two different levels of the SIJ showing complete sacroiliac joint disruption with displacement, which is better seen on CT than on radiographs. (c) Immediate postoperative AP view of the pelvis showing plate and screw stabilization for the left SIJ with acceptable postoperative alignment. Drainage tube is noted. (d) Postoperative follow-up AP view of the pelvis after 3 months showing progressive union with no visible SIJ diastasis. Pubic diastasis and irregular left superior pubic ramus can be noted. (e) Postoperative follow-up AP view of the pelvis after 12 months showing complete union with the symmetrical appearance of both SIJs, lower degree of pubic diastasis, and irregularity at the left superior pubic ramus.

Table 2 Age distribution of the ten patients included in this study

Age groups (years)	*N* (%)
>20–30	2 (20)
>30–40	5 (50)
>40–50	3 (30)
Total	10 (100)

Table 3 Mechanism of injury in the selected patients

Main clinical presentations	*N* (%)
Road traffic accidents	9 (90)
Falling from height	1 (10)

Table 4 Associated pelvic injuries other than sacroiliac joints

Pelvic injuries	*N* (%)
Vertical shear	2 (20)
Fracture pubic rami	3 (30)
Widening of symphysis pubis	3 (30)
Sacral fractures	–

Provisional stabilization of the pelvic ring either by an external fixation or by a pelvic clamp is very important to maintain hemodynamic stability [16]. Surgical management of severe pelvic ring fractures includes life-saving surgery, early total care, and delayed definitive surgery. However, the displaced pelvic ring disruption has to be reduced and stabilized to prevent a long-term disability. High-energy pelvic combination injuries, which occur in the anterior pelvic ring and the anterior column of the acetabulum with sacroiliac joint disruption, are common in high-energy trauma [17].

A pelvic external fixator alone rarely confers sufficient stability to be used as a definitive treatment in high-energy pelvic ring disruption. Lindahl *et al*. [18] found that pelvic fixation is useful in acute resuscitation, but it is of limited value in the definitive treatment of an unstable type C or even an open book injury. Unstable posterior pelvic disruption such as dislocation of the sacroiliac joint is always complicated by significant disability. Adverse effects of nonoperative treatment include leg-length discrepancy, rotational malunion, prolonged recumbency, delayed neurological compromised, and chronic pain. Numerous techniques with variable success have been described to overcome this problem. These include anterior plate stabilization and the posterior iliosacral screw. Sacroiliac plating enables direct visualization of the joint, removal of any intra-articular debris, and anatomical reduction of the disrupted unstable sacroiliac joint.

In this study, the mechanisms of injury in our patients were motor car accidents in nine (90%) patients and falling from height in one (10%) patient. In the study of Dalal *et al*. [19], motor car accidents were the cause

Table 5 Extrapelvic injuries

Affected systems	*N* (%)
Genitourinary injuries	2 (20)
Head injuries	1 (10)
Cardiothoracic	1 (10)
Total	4 (40)

Table 6 Postoperative results according to the Majeed system

Degrees of response	*N* (%)
Excellent	3 (30)
Good	6 (60)
Poor	1 (10)
Total	10 (100)

Table 7 Postoperative complications

Complications	*N* (%)
Posterior pelvic pain	1 (10)
Superficial infection	1 (10)
Foot drop	1 (10)
Pelvic tilt	1 (10)
Total	4 (40)

of injury in 58% of patients, and in 57% of patients in the series of Cryer *et al*. [20] and 54% of patients in the series of Goldstein *et al*. [21]. It is important to emphasize that the fixation of the posterior lesions in cases of vertically unstable pelvic ring disruptions is the cornerstone to restoring the stability of the pelvic ring even if the anterior lesions are left untreated. However, fixation of only the anterior lesion, with the posterior lesion left untreated, usually results in a poor outcome. This result in agreement with that of Tile [12] in that surgical stabilization is required for type C vertically unstable pelvic disruption with more than 2.5 cm symphysis diastasis.

Routt *et al*. [22] reported difficulties in achieving closed reduction in pure sacroiliac joint disruption. Open reduction of the sacroiliac joint often was necessary before percutaneous screw placement. Simpson *et al*. [23] reported excellent results with the use of an anterior retroperitoneal approach for anterior plating of the sacroiliac joint. In this study, 10 patients were operated upon by anterior plating of the sacroiliac joint. All patients presented with acute pelvic pain. The postoperative follow-up period ranged from 3 to 20 months. The results were excellent in three (30%) patients, good in six (60%), and poor in one (10%). The time of surgery ranged from 9 to 15 days after trauma to assess the hemodynamic condition.

In the series of Browner and Cole [24], delayed posterior pelvic internal fixation for an average period of almost 3 weeks (range 7–31 days) avoided infection and hemorrhage, but failed to achieve anatomic reduction of certain posterior arch disruption. Residual displacement was encountered in all cases with pain and persistent neurological deficits were common findings.

In our study, patients were kept in bed for 6–8 weeks and allowed to walk with a cane or crutches after 8 weeks, followed by full weight bearing after 12 weeks.

Tile and Heara [25] suggested at least 3–6 weeks of complete bed rest. During this period, the patients could assume the upright position. Subsequently, a patient may be allowed to ambulate with a walker, progressing to crutches and a cane when possible. For patients with vertically unstable pelvic ring disruption, he suggested that the patient required bed rest for 6 weeks, but could assume the upright position. Simpson *et al*. [23] recommended that patients with anterior stabilization of the sacroiliac joint require complete bed rest for 2 weeks before being allowed to ambulate with crutches or a walker.

In this study, union occurred in all patients. Lange and Hansen [26] reported on one patient with nonunion in their series of eight patients with vertical shear injury.

Conclusion

Most evaluations of the pelvic trauma should begin with plain radiography because of their usefulness as a screening tool and relatively low cost. As plain radiography fails to identify ~30% of pelvic fractures. CT has been proven to be more sensitive in the visualization of fractures and detection of minor degrees of sacroiliac joint displacement. The assessment of clinical background, plain radiography, and MDCT were complementary to make the correct diagnosis and choosing a suitable surgical treatment plan. The stability of the pelvic ring depended mainly on the integrity of the posterior weight-bearing sacroiliac complex. Nonoperative treatment of these unstable sacroiliac joint disruption resulted in significant disability.

Surgical anterior stabilization was required for type C injuries with two plates lead to excellent outcome and associated with minor complications. Sacroiliac fusion and stabilization of the disrupted sacroiliac joint decreased the incidence of sacroiliac arthritis.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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