Posterior pelvic plating in the treatment of tile type C unstable pelvic injuries: a prospective study

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Introduction
Unstable pelvic ring disruptions result from high-energy trauma and are often associated with multiple concomitant injuries. Internal fixation has become the preferred treatment for unstable posterior pelvic ring injuries. Several methods of fixation of posterior pelvic injuries have been described, including anterior pelvic plating, posterior sacroiliac plating, lumbopelvic fixation, and percutaneous fixation with iliosacral screws.

Aim
The aim of this study was to report on the clinical and radiological results of plate osteosynthesis for fixing posterior pelvic injuries in Tile's C completely unstable pelvic ring injuries.

Patients and methods
This study involved 21 patients with Tile type C pelvic injuries who had their posterior injuries fixed by plate osteosynthesis. The mean duration of postoperative follow-up was 25.29±9.93 (13–48) months. The clinical outcome was assessed with postoperative Majeed's score and the rate of postoperative complications. The radiological outcome was assessed through the measurement of posterior displacement as per the method of Matta and Tornetta.

Results
The mean±SD postoperative Majeed score was 76.57±11.21. There was a statistically significant improvement in the postoperative vertical displacement of the posterior injury ($P<0.001$). The incidence of postoperative complications was 38.1%.

Conclusion
Pelvic plating is an effective procedure in the management of completely unstable posterior pelvic ring injuries. The treatment of these complex injuries is associated with a relatively high incidence of postoperative complications.

Keywords:
completely unstable, pelvic injury, pelvic plating, tile c

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Introduction

Unstable pelvic ring disruptions result from high-energy trauma and are often associated with multiple concomitant injuries [1–3]. Bleeding, head injury, pelvic soft-tissue trauma (open fractures), and primary system complications are responsible for the high mortality associated with unstable pelvic injuries [4–6]. Internal fixation has become the preferred treatment for unstable posterior pelvic ring injuries [3,7–9]. Several methods of fixation of posterior pelvic injuries have been described, including anterior pelvic plating, posterior sacroiliac plating, lumbopelvic fixation, and percutaneous fixation with iliosacral screws [10–14].

The aim of this study was to report the clinical and radiological results of plate osteosynthesis for fixing posterior pelvic injuries in Tile's C completely unstable pelvic ring injuries.

Patients and methods

During the period from October 2011 to January 2014, 21 patients with completely unstable pelvic injuries have had their posterior pelvic injuries fixed with plate osteosynthesis at our institution. This study was carried out at El-Hadara University Hospital, Alexandria, Egypt. All patients fulfilled the following inclusion criteria: (a) aged 18 years or older and (b) diagnosed with completely unstable pelvic ring injuries (Tile C) in which the pelvic ring is both rotationally and vertically unstable.

The mean age of our patients was 30.71±12.23 (18–60) years. Fourteen patients were males, and seven patients

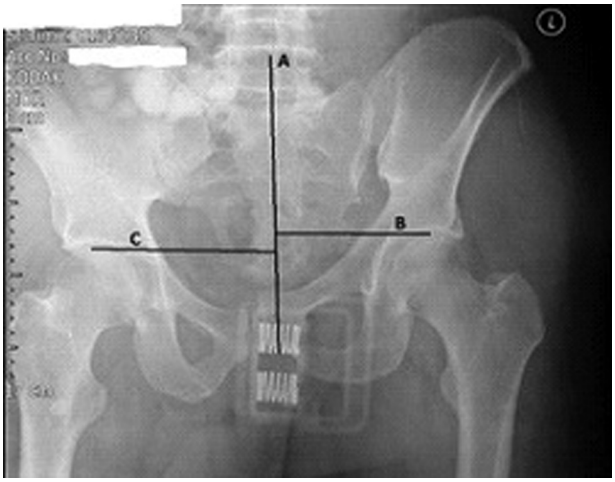
were females. The mean duration of postoperative follow-up was 25.29±9.93 (13–48) months. Four (19%) patients had associated medical comorbidities in the form of type II diabetes mellitus, hypertension, and bronchial asthma.

The patients' clinical data were collected prospectively. Pelvic injury was classified according to Tile's classification [15]. The preoperative vertical displacement of the posterior pelvic injury was measured according to the method of Matta and Tornetta [8]. This was carried out by measuring the difference between the heights of the femoral heads on the anteroposterior pelvic radiographs (Fig. 1).

Surgical technique

The supine or the prone position was used depending on the planned surgical approach and the presence of an associated injury that needed to be addressed. Either the anterior or the posterior approach to the sacroiliac region was used according to the location of the posterior pelvic ring injury. For plating of sacral fractures, the posterior approach was used, whereas for sacroiliac dislocations either the anterior or the posterior approach was used. After exposure of the site of the pelvic injury, reduction was performed by a combination of traction applied to the ipsilateral leg to correct the vertical displacement and a direct reduction of the pelvic injury using different clamps designed for pelvic fractures. After reduction was achieved, the posterior injury was then fixed with a plate. For posterior iliac fractures, fixation was performed by anterior iliac plating through the lateral window of the ilioinguinal approach, which was also used to approach the sacroiliac dislocations that were fixed using anterior sacroiliac plates. For sacral fractures, we used ilioiliac plates through the posterior pelvic approach.

Figure 1



Preoperative anteroposterior radiographs showing a C1 pelvic injury. Line A represents a line passing through the axis of the sacrum. Lines B and C are drawn from the highest points of the femoral heads perpendicular to line A. The difference between the height of both femoral heads represents the vertical displacement of the affected hemipelvis.

Postoperative outcome

All patients were prescribed low-molecular-weight heparin for 28 days if they showed no contraindications (e.g. high bleeding risk). Patients were mobilized from bed as early as possible. All patients, if their general condition allowed, were advised to start toe-touch weight bearing for 6 weeks and then partial weight bearing for another 6 weeks. Patients started complete weight bearing at 12 weeks postoperatively.

Follow-up

All patients have been followed-up for at least 1 year postoperatively. The clinical outcome was assessed with the Majeed pelvic outcome score [16]. Clinical grade was based on a score out of 100 points for working and out of 80 points for nonworking patients (Table 1).

Postoperative anteroposterior radiographs were assessed for fracture healing, residual vertical displacement (as per preoperative radiographic assessment), and the quality of reduction. The posterior reduction was graded according to Matta and Tornetta [8] (Table 2).

Statistical analysis

Data were analyzed using IBM Corp., Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Qualitative data were described using numbers and percentages. Quantitative data were described using ranges (minimum and maximum), means, SDs, and medians. Significance of the obtained results was judged at the 5% level.

Table 1 Clinical outcomes according to the Majeed score [16]

Working before injury	Not working before injury	Grade
>85	>70	Excellent
70–84	55–69	Good
55–69	45–54	Fair
<55	<45	Poor

Table 2 Radiological grading of the posterior reduction according to Matta and Tornetta [8]

Excellent	Residual vertical displacement < 5 mm
Good	Residual vertical displacement of 5–10 mm
Fair	Residual vertical displacement of 11–20 mm
Poor	Residual vertical displacement >20 mm

Results

According to Tile's classification, 16 (76%) pelvic injuries were classified as C1 injuries, five (24%) were classified as C2 injuries, and none of the patients had C3 injuries. All patients had either APC3, vertical shear, or a combined mechanism of injury as per Young and Burgess classification. On assessing the anterior pelvic injury, seven (33.3%) patients had symphyseal diastasis, whereas 14 (66.7%) patients had pubic rami fractures with no diastasis through the symphysis pubis. In terms of posterior pelvic injury, eight (38%) patients had posterior iliac fractures, which were fixed with anterior iliac plates, eight (38%) patients had sacroiliac joint injury (dislocation or fracture dislocation), which were stabilized by anterior sacroiliac plating, and five (24%) patients had sacral fractures, which were fixed with ilioiliac plates through the posterior approach.

Tile's classification	*N* (%)
C1–1	9 (42.9)
C1–2	5 (23.8)
C1–3	2 (9.5)
C2–1	3 (14.3)
C2–2	0 (0.0)
C2–3	2 (9.5)

The duration between injury and definitive fixation ranged from 2 to 11 days with a median of 6 days. Eight (38.1%) patients were managed with anterior symphyseal plating for symphyseal diastasis. Only one patient with disruption of the symphysis pubis did not have anterior fixation. The rest of our cohort (52.4%) had anterior pelvic ring injury in the form of pubic rami fractures, which were not addressed surgically.

The mean±SD preoperative vertical displacement was 16.95±2.75 mm. This showed improvement postoperatively to 4.43±1.69 mm, and the difference was statistically significant ($P<0.001$). All fractures were fully united at 6 months postoperatively. One (5%) patient was lost to follow-up at 4 months, with her 3-month postoperative radiographs showing callus formation at the pubic rami fracture. According to the Matta and Tornetta [8] method of assessment of the quality of reduction of posterior pelvic injury, eight (38.1%) patients had good radiological outcome, and 13 (61.9%) patients had excellent outcome. There were no patients with poor or fair radiological outcome.

The mean±SD postoperative Majeed score was 76.57±11.21. The overall grading of the clinical outcome showed that seven (33.3%) patients had excellent, 12 (57.1%) patients had good, and two (9.5%) patients had fair clinical outcome. The mean ±SD postoperative pain score was 22.86±2.54. The mean±SD score for sitting ability was 8.48±1.08. The mean±SD postoperative standing score was 29.05±3.83. Fourteen (66.7%) patients continued with their previous jobs, while four (19%) patients had to change their jobs postoperatively. Three (14.3%) of our patients were not working before the injury.

Complications

The incidence of postoperative complications was 38.1%. We had two (4%) patients with symptomatic DVT, which was discovered 7 to 10 days after injury (3 and 4 days postoperatively).

Three (3/21, 14%) patients had superficial wound infection. Two of them had pelvic fixation through the posterior approach and one through the anterior approach. The infection was successfully treated by oral antibiotics in all of them. Two (2/21, 9.5%) patients had postoperative deep infection and were treated with surgical debridement and intravenous antibiotics.

One (4.7%) patient had redisplacement of posterior pelvic injury after the initial surgical fixation. This patient had two posterior sacroiliac plates for fixing C2–3 posterior pelvic injury and an anterior symphyseal plate. No revision surgery was performed for this patient, and she had a good clinical outcome at the end of follow-up.

One (4.7%) patient with a sacroiliac joint injury had symptomatic sacroiliac osteoarthritis that responded well to repeated computed tomography (CT)-guided steroid injection of the sacroiliac joint and had a good clinical outcome.

Discussion

Historically, nonoperative treatment was considered the treatment of choice for many pelvic ring injuries. It is now established that patients with unstable pelvic ring injuries benefit from surgical stabilization due to less residual pain and decreased incidence of malunion and nonunion [8,17–19]. There are several methods of fixation described in the orthopedic literature to manage unstable pelvic injuries [10–14,20]. Among these methods, pelvic plating is used for the stabilization of posterior pelvic ring injuries.

In this study, the overall Majeed score was 76.57± 11.21. We achieved satisfactory clinical (excellent or good) outcome in 90.4% of our cohort. This was similar to the results reported by Lindahl and

Hirvensalo [21] who published 101 consecutive Tile classification type C pelvic fractures. All their patients were treated surgically, with 78 patients receiving both anterior and posterior ring fixations. Their Majeed functional score results were excellent in 68 (67.3%) patients, good in 16 (15.8%), fair in 16 (15.8%), and poor in one (0.99%), with 84 (83.2%) patients obtaining satisfactory results.

Persistent pain is one of the main contributors to long-term disability and poor functional outcome [22]. About one-third of our patients had a degree of persistent postoperative pain. Out of these, only four (8.3%) patients had severe pain that limited their activity. This was similar to the study by Putnis *et al.* [23], who reported that among 49 patients with pelvis fractures 15 (37%) patients were pain free, 12 (29%) had either mild or very mild pain, 11 (27%) had moderate pain, and three (7%) had severe pain after 1-year of follow-up. In their series, Lindahl and Hirvensalo [21] also obtained similar results, with 34 (34%) patients reporting persistent pain after an average final follow-up of 23 months (range: 1–84 months). Of these 34 patients, 33 described the pain location as 'posterior'. Similarly, in Kabak *et al.*'s [24] series of 36 type C fractures, 25% experienced pain of pelvic origin beyond 1 year. Although relatively high, these numbers are an improvement over previously published data [3,25] where 70 and 85% of patients, respectively, with type C pelvic fractures complained about long-term pelvic pain. This difference may be related to the improved surgical and rehabilitation protocols over the past few decades.

The importance of obtaining good reduction of posterior pelvic injury has been stated in different studies. Tornetta and Matta [26] concluded that 'reduction to within 10 mm seems to be adequate for functional results'. In addition, Pohlemann *et al.* [3] noted that there is a correlation between good reduction and good clinical outcome. In this study, we achieved a satisfactory reduction (<10 mm) in all patients, which has been reflected on our patients' clinical outcome.

In terms of postoperative complications, our cohort showed a relatively high rate of postoperative complications. This increased rate of complications was mainly due to a higher postoperative wound infection associated with pelvic plating. Pelvic plating, which required either an anterior or a posterior pelvic approach, is known to be associated with postoperative wound complications [7,27,28].

The incidence of post-traumatic sacroiliac arthritis is common after pelvic injuries extending to this joint. In their series, Gänsslen *et al.* [29] have assessed the radiographic long-term results of 16 patients with type C1–2 injury. Their patients had anterior pelvic plating with a mean of 63.2 months (range: 1–14 years). Although they achieved an anatomical reduction in 81% of their patients, follow-up CT scans showed a normal sacroiliac joint in only one patient. All other patients had sacroiliac joint changes (e.g. periarticular osteophytes, degenerative changes, and ankylosis). In this study, we report a lower incidence of sacroiliac arthritis (1/8 patients, 12.5%), possibly because of our shorter follow-up and the low sensitivity of the plain radiographs compared with CT scan in detecting early degenerative changes.

Conclusion

Pelvic plating is considered an effective procedure in the management of completely unstable posterior pelvic ring injuries by which satisfactory reduction could be achieved and maintained. There was a trend for higher incidence of postoperative complications associated with pelvic plating; however, it was not statistically significant.

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Conflicts of interest

There are no conflicts of interest.

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