Early results of iliosacral screw(s) fixation in the treatment of Tile's type C unstable pelvic injuries: a prospective study

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Background
Pelvic ring disruptions are associated with increased patients' morbidity and mortality. Several methods have been advocated for treatment of such devastating injuries. Surgical fixation is now regarded as the treatment of choice of unstable pelvic disruptions. Among different methods of surgical fixation, iliosacral screws (ISS) have shown promising results in the treatment of the disruption of the posterior pelvic ring.
Aim
The aim of this study was to report the clinical and radiological results of ISS for fixation of the posterior pelvic disruption in completely unstable pelvic ring injury (Tile's C).
Settings and design
A prospective study was held at Alexandria University.
Patients and methods
This study involved a prospective assessment of 27 patients with Tile's C pelvic disruption who had ISS fixation. The mean duration of postoperative follow up was 28.96±9.28 (12–49) months. The clinical outcome was assessed with postoperative Majeed score and the rate of the postoperative complications. The radiological outcome was evaluated by the degree of postoperative displacement on the anteroposterior plain radiographs.
Statistical analysis
SPSS version 20.0.
Results
The mean postoperative Majeed score was 79.11±13.01. There was a statistically significant improvement in the postoperative vertical displacement ($P<0.001$*). The incidence of the postoperative complications was 25.9%.
Conclusion
Fixation with ISS is an effective procedure in the management of completely unstable posterior pelvic ring injuries.

Keywords:
completely unstable, iliosacral screw (s), pelvic injury, Tile C

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Introduction

Pelvic ring disruptions are associated with increased patients' morbidity and mortality [1]. Several methods have been advocated for treatment of such devastating injuries. Pelvic ring disruptions have been classified by Tile [2] according to the degree of instability into stable, partially unstable, and completely unstable pelvic injury. Stable pelvic injuries could be treated by nonoperative measures [3]. However, surgical fixation is now regarded as the treatment of choice of unstable pelvic disruptions [4]. Among different methods of surgical fixation, iliosacral screws (ISS) have shown promising results in the treatment of the disruption of the posterior pelvic ring [5–7].

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

Patients and methods

During the period from October 2011 to January 2014, we prospectively collected the data of 27 consecutive patients of completely unstable pelvic injury who have had surgical stabilization with ISS at our institution. The study was approved by the institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Alexandria university, Egypt. All patients have fulfilled the following inclusion criteria which were as follows: first, patients were 18 years or older, second, patients were diagnosed to have a completely unstable pelvic ring injury (Tile C) in which the pelvic ring is both rotationally and vertically unstable, and third, all patients had ISS as a

definitive method of fixation of their posterior pelvic disruption.

The mean age was 38.15±12.8 (18–63). Twenty patients were males and seven were females. The mean duration of postoperative follow-up was 28.96 ±9.28 (12–49) months. Eleven patients (40.7%) had associated medical comorbidities in the form of hypertension, diabetes mellitus, bronchial asthma, and ischemic heart disease.

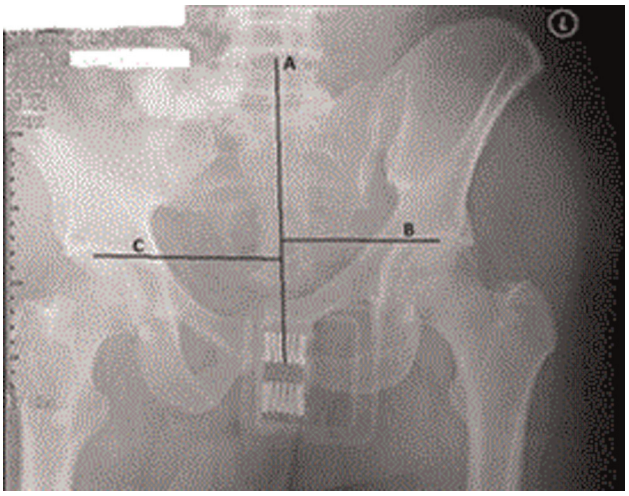
The pelvic injury was classified according to Tile's classification [8]. The preoperative vertical pelvic displacement was measured according to the method of Matta and Tornetta of measuring the difference between the height of the femoral heads on the anteroposterior pelvic radiographs [9] (Figs 1 and 2).

Surgical technique

Our preference was to insert the ISS in the supine position, which allowed us to address both the anterior and the posterior pelvic injuries without changing the patient's position. In cases with symphyseal diastasis, we always fixed the anterior injury before addressing the posterior one and that had helped the reduction of the posterior injury. Trial of closed reduction of the pelvic displacement was done by manual traction applied on the ipsilateral leg and pelvic compression. If this trial had been successful, a decision was then made to insert the ISS percutaneously. The closed reduction was also aided using Schanz pins inserted in the ipsilateral iliac crest.

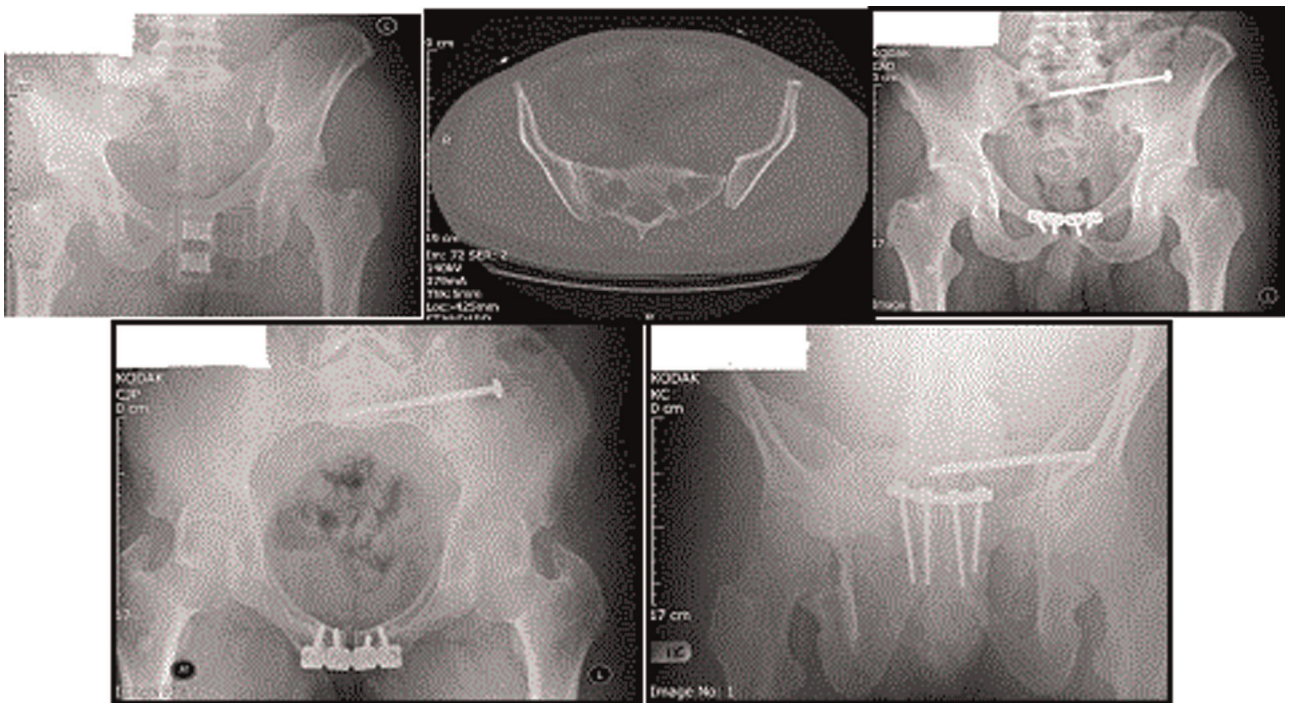
The image intensifier was positioned for a lateral view, with the C-arm placed horizontally parallel to the transverse plane to the patient's pelvis and the concavity of the C-arm under the operative table. The iliocortical density was determined on this view,

Figure 1



A preoperative anterior posterior radiographs showing type C 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.

Figure 2



Preoperative and postoperative imaging of a 43-year-old patient who was fixed with iliosacral screw and anterior pelvic plate.

Table 1 The clinical outcome according to the Majeed score [10]

Points	Grade
>85	Excellent
70–84	Good
55–69	Fair
<55	Poor

Table 2 Radiological grading of the posterior reduction according to Matta and Tornetta [9]

Excellent	Residual vertical displacement less than 5 mm
Good	Residual vertical displacement from 5 to 10 mm
Fair	Residual vertical displacement 11–20 mm
Poor	Residual vertical displacement more than 20 mm

and the entry point of the guide wire was inferior to this mark. The guide wire was then inserted at the previously determined entry point on the lateral view and advanced by a power driver through the iliac cortex, sacroiliac joint, and the sacral cortex.

Both inlet and outlet radiographs were obtained to check the planned trajectory of the guide wire. The guide wire should be above S1 foramen in the outlet, anterior to the neural canal, and not breaching the anterior sacral cortex in the inlet views. If the trajectory for the guide wire was satisfactory in the intraoperative radiographs, further advancement of the guide wire had been done across the midline of S1 vertebra. Our preference was to tap the guidewire rather than using the power driver at this stage to prevent inadvertent penetration to the sacral cortex. Measurement of the appropriate screw length was done over the guide wire. A 7.3-mm partially threaded screw was applied and was tightened to compress the sacroiliac joint in cases of sacroiliac joint dislocation. However, in cases with purely sacral fracture, excessive compression was avoided in order not to compress the fracture gap over the sacral nerve roots. A second S1 screw was inserted (if S1 pedicle allows) in the same manner.

A washer was used according to the surgeon's preference. A final check for the adequacy of the reduction and the screw position was done by intraoperative radiographies. Moreover, the pelvic stability was examined with manual compression and distraction over the pelvic ring.

Postoperative

All patients had 28 days of low-molecular-weight heparin if they had no contraindication (e.g. high bleeding risk). The 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 full 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 Majeed pelvic outcome score [10]. Clinical grade was based on a score out of 100 points for working and 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 [9] (Table 2).

Statistical analysis of the data

Data were analyzed using IBM SPSS software package version 20.0 (SPSS Inc., Chicago, Illinois, USA). Qualitative data were described using number and percentage. Quantitative data were described using range (minimum and maximum), mean, SD, and median. Significance of the obtained results was judged at the 5% level.

Results

According to Tile's classification, 20 pelvic injuries (74.1%) were classified as C1 injuries and seven patients (25.9%) were classified as C2 injury, and no 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, nine patients (33%) had symphyseal diastasis.

The duration between the injury to the definitive fixation ranged from 1 to 15 days, with a median of 5 days. A total of 14 patients (51.9%) had their anterior pelvic injury fixed. Of those patients, nine patients (33.3%) had open reduction and internal fixation, whereas five patients (18.5%) had an external fixator.

The mean±SD postoperative Majeed score was 79.11 ±13.01. The overall grading of the clinical outcome showed that 11 patients (40.7%) had excellent outcome, 14 patients (51.8%) had good outcome, and two patients (7.4%) had fair outcome. This makes patients with satisfactory clinical outcome (good or excellent) [25/27 patients (92.6%)]. The mean postoperative pain score was 23.89±6.41, with

Table 3 The radiological outcome of posterior reduction according to Matta and Tornetta

Radiological outcome of posterior reduction	*n* (%)
Fair	1 (3.7)
Good	13 (48.1)
Excellent	13 (48.1)

eight patients (29.6%) having persistent postoperative pain and four patients (14.8%) having pain that limits their daily activities. The mean score of the sitting ability was 8.67±1.57. The mean postoperative standing score was 30.67±4.04.

The mean radiologic preoperative vertical displacement of the posterior pelvic injury was 12.85 ±3.19 mm. This has improved to 4.56±2.65 mm postoperatively, which was statistically significant ($P<0.001$*). All fractures have fully united at 6 months postoperatively.

According to Matta and Tornetta method of assessment of the quality of the reduction of the posterior pelvic injury, there were no patients in this study who had a poor outcome. Only one patient (3.7%) had a fair outcome with all other patients classified as good or excellent (Table 3).

A total of 23 (85.2%) patients had well-positioned screws in the sacral pedicle without encroachment either on the spinal canal, the sacral foramina, or the anterior sacral cortex. Four patients (14.8%) had their ISS not completely contained within the sacral pedicle. Three of them (11%) had one or two screw threads breaching the anterior sacral cortex without any clinical consequences. One patient (3.7%) had an ISS breaching posteriorly into the spinal canal, which was subsequently removed.

Complications

The incidence of the postoperative complications was 25.9%. We had two patients (7.4%) with symptomatic deep venous thrombosis (DVT), which was discovered 7–10 days after injury (3 and 4 days postoperatively).

One patient (1/27, 3.7%) had postoperative deep infection who was treated with surgical debridement, washout, and intravenous antibiotics. One patient (1/27, 3.7%) had slight backing out (4 mm) of the ISS without re-displacement of their posterior pelvic injury. One patient (1/27, 3.7%) had re-displacement of the posterior pelvic injury after the initial surgical fixation. This patient had further surgical refixation with external fixator and removal of the symphyseal plate, and the original ISS was retained. The final clinical outcome of this patient was good. Two patients (7.4%) had symptomatic sacroiliac osteoarthritis, which needed further intervention. One of them responded well to repeated computed tomography-guided steroid injection of the sacroiliac joint and had a good clinical outcome. The other patient had further sacroiliac fusion through a posterior approach after 2 years of his initial surgery.

Discussion

Nonsurgical management was regarded as the mainstay treatment for most of pelvic ring injuries in the past. However, surgical fixation of unstable pelvic ring injuries has shown better outcomes in terms of reduced pain, decreased incident of malunion and nonunion, and better functional outcomes [9,11–13]. The methods of surgical stabilization of completely unstable pelvic ring injuries vary in the orthopedic literature [5,14–18]. Among these methods, the use of ISS in stabilization of the posterior pelvic ring injuries has shown encouraging results.

In this cohort, the overall Majeed score was 79.11 ±13.01. We report a slightly better clinical outcome (92.6% satisfactory results) compared with that previously reported by Lindahl and Hirvensalo [19] 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 fixation. Their Majeed functional score results were excellent in 68 patients (67.3%) good in 16 (15.8%), fair in 16 (15.8%), and poor in one patient (0.99%), with 84 patients (83.2%) obtaining satisfactory results.

Lower functional outcomes have been found previously to be associated with the presence of persistent postoperative pain [20]. Previously published data [21,22] have shown that 70–85% of patients with completely unstable pelvic injuries experienced long-term pelvic pain. In this cohort, we had eight patients (29.6%) with persistent postoperative pain. Of these, only four patients (8.3%) had severe pain that limited their activity. This was similar to more recent reports as the one published by Lindahl and Hirvensalo [19] who found that 34% of their patients had persistent pain after a mean follow-up of 23 months. In addition, Putnis *et al.* [23] have reported 29% of their cohort had moderate to severe pain after 1 year follow-up. Similarly, in the cohort of Kabak *et al.* [24], 25% had pelvic pain after 1 year. The improvement of postoperative pain levels noted in more recent

studies could be attributed to the better quality of surgical and rehabilitation protocols that developed over the past 20 years.

In this cohort, the quality of the postoperative reduction of the posterior pelvic injury was satisfactory in the majority of the patients (96.3%), and this had a significant positive implication on the clinical outcome. This was also noted by previous studies that have emphasized on the importance of the quality of reduction and its direct relation to the clinical outcome [21,25]. As someone could expect after such devastating injuries, the rate of complications was high and involved almost a quarter of our study population. This was similar to other reports which have described a complications rate ranging from 30 to 50%, which in turn highlights the morbidity associated with those high-energy traumatic events [26,27].

Conclusion

ISS have shown to be an effective and reliable method in the management of completely unstable posterior pelvic ring injuries. However, as expected, patients with Tile's C pelvic injury are associated with high rate of postoperative complications.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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