

Unstable pelvic ring injuries

Outcome and timing of surgical treatment by internal fixation

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ABSTRACT

Objectives: To evaluate the radiological and functional results of surgical treatment of unstable pelvic injuries and to study the factors affecting the final outcome.

Methods: Thirty-eight patients with unstable type C pelvic injuries from King Khalid University Hospital, Riyadh and North West Armed Forces Hospital, Tabuk, Kingdom of Saudi Arabia during the period January 1996 through to January 2001 were reviewed. There were 31 males and 7 females. The mean age was 37-years. Thirty-two patients had 76 associated skeletal fractures. A percutaneous iliosacral screw was carried out for all patients in the study. Anterior stabilization was needed for 23 patients.

Results: There were 2 complications of fixation, an iatrogenic S1 root injury and dismantled symphyseal plate. The average hospital stay was 29 days and the average time to start mobilization was 15 days. The radiological result was satisfactory in 32 patients (84%) while functional result was satisfactory in 27 patients (71%).

Conclusion: Unstable pelvic ring injuries should be managed surgically and must be carried out as soon as the general condition of the patient allows, even up to 4-weeks.

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Pelvic ring disruptions are uncommon injuries occurring in 3-8.2% of all trauma patients.¹⁻⁴ Of all pelvic injuries, 46% are unstable which result from high energy trauma and occur almost only in severely injured patients usually with associated other skeletal injuries.⁵⁻⁹ It is well established now that isolated posterior or combined posterior, and anterior surgical fixation are required to achieve anatomical reduction and early ambulation in most, if not all, of unstable pelvic injuries.¹⁰⁻¹³ Different techniques of open reduction and internal fixation were introduced. The choice of a particular technique of internal fixation is influenced by the general condition, the concomitant injuries and the

nursing requirements of the patient, as well as by the experience and personal bias of the surgeon. Each technique has inherent advantages as well as potential problems.^{9,10,12-15} Only very recently has the evaluation of pelvic ring injuries and its management moved from radiologic and early clinical results to functional results and quality of life-related issues.^{15,16} The more popular scoring system now in use are functional grading scale devised by Majeed¹⁷ and the short form-36 medical outcome score (SF-36) used by Olivers et al¹⁸ and the functional grading scale devised by Majeed.¹⁷ However, associated skeletal injuries may overshadow impairment caused by the pelvic

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fracture. Other considerations in the evaluation of pelvic fracture management are the type of pelvic injury, the age of the patient, the time of surgery, the expertise of the treating surgeon and the presence of other system injuries. Therefore, quantitative functional outcomes are determined by variables other than pelvic fracture itself and the best method of deleting these variables has not been established.¹⁹ This retrospective study was conducted to evaluate the radiological and functional results of surgical treatment of unstable pelvic injuries by internal fixation. The effects of associated skeletal injuries, age of the patients, types of pelvic injuries and timing of internal fixation on the final outcomes were also studied separately.

Methods. Patients with unstable pelvic ring injuries that were treated by iliosacral screws alone, or with anterior plate fixation in King Khalid University Hospital, Riyadh and North West Armed Forces Hospital, Tabuk, Kingdom of Saudi Arabia (KSA) during the period January 1996 through to January 2001 were reviewed. Patients who were lost during follow up or died due to cause not related to their skeletal injuries were excluded from the study. There were 31 males and 7 females. The mean age (\pm SD) was 37 ± 10 years (range, 18-61). The cause of injury was a road traffic accident in 35 patients, and a fall from height in 3 patients. Internal fixation was performed during the first 2 weeks of admission for 23 patients; 7 of them had surgery within 48 hours after injury. Surgery was delayed after 2 weeks, average 19 days (range 15-27) due to unstable general condition in 15 patients. In cases where combined anterior and posterior stabilizations were required, the anterior stabilization was carried out first. Anterior stabilization was carried out by a 4-hole plate placed on the superior surface of the reduced symphysis and fixed by fully threaded cancellous screws. Posterior stabilization was performed using one, or 2 cannulated screws applied percutaneously while the patient was in the supine position under image guidance. In cases with fractures through sacral neural foramina, fully threaded screws were used to avoid compression and injury of sacral nerve roots. The position of the screws was adjusted using anteroposterior, lateral, inlet and outlet views consecutively. Post operative mobilization was based on the stability of the fixation and the associated lower extremity injuries. We allowed patients with stable fixation to mobilize immediately after surgery with progressive weight-bearing as tolerated. Patients were followed for at least 2-years after discharge from the hospital. At the last visit each patient was studied radiologically and functionally. The radiological result was graded by the maximum residual displacement in the posterior or anterior pelvic ring

injuries as; excellent for 0-5mm, good for 6-10mm, fair for 11-15mm and poor for more than 15mm of displacement or established non union.¹³ The functional result was measured using the functional grading scale described by Majeed.¹⁷ The advantage of this outcome scoring system is that it is short, simple and can be used more practically in a clinical setting. Also it includes sitting, which is a function often limited after pelvic injuries. Majeed¹⁷ functional scoring system consists of several questions in 7 items. These items include pain, work, sitting, sexual intercourse, walking aids, gait and walking distance. They each score a number of points, which make up the total score ranging from 0-100. According to the total score patients were graded as excellent for >95, good for 85-94, fair for 70-84 and poor for less than 70 points.^{5,13}

Data were subjected to one way analysis of variance, where $P<0.05$ was considered significant.

Results. Thirty-eight patients were included in the study. According to Tile's classification of pelvic injuries,²⁰ there were 25 patients with type C1 (66%), 6 with type C2 (16%) and 7 with type C3 injuries (18%). Thirty-two patients had 76 associated skeletal fractures (45 lower limb, 23 upper limb and 8 spinal fractures) and 29 patients had 63 extra skeletal injuries (18 chest, 17 head, 15 abdominal, 11 bladder and urethral, and 2 lumbosacral plexus injuries). All patients in the study had percutaneous iliosacral screws fixation for their posterior lesions. In 23 patients, anterior plate fixation for symphyseal disruption was also needed. All patients were discharged from ICU one or 2 days after surgery except one who developed pulmonary embolism, in spite of receiving anticoagulant as a routine prophylactic measure. This patient (**Figure 1**) also complained of hypoesthesia along the S1 distribution and inability to move his big toe of the affected side. A computerized scan tomography revealed one screw encroaching the sacral foramen therefore, it was removed. The affection of S1 root stayed till the end of his follow up. Other post operative complications included bed sores in 3 patients, chest infection in 5 patients, superficial wound infection in 2 patients and one patient had plate failure that necessitated plate removal before healing of anterior pelvic disruption. The average total hospital stay was 29 days (range 14-75). The average time to start mobilization after surgical stabilization was 15 days (range 2-47) for all patients, 4.2 days (range 2-9) for patients who do not have other skeletal injuries affecting walking (20 patients) and 26.9 days (range 14-47) for patients who have other skeletal injuries affecting walking (18 patients). The difference in the time of mobilization in these 2 groups was found

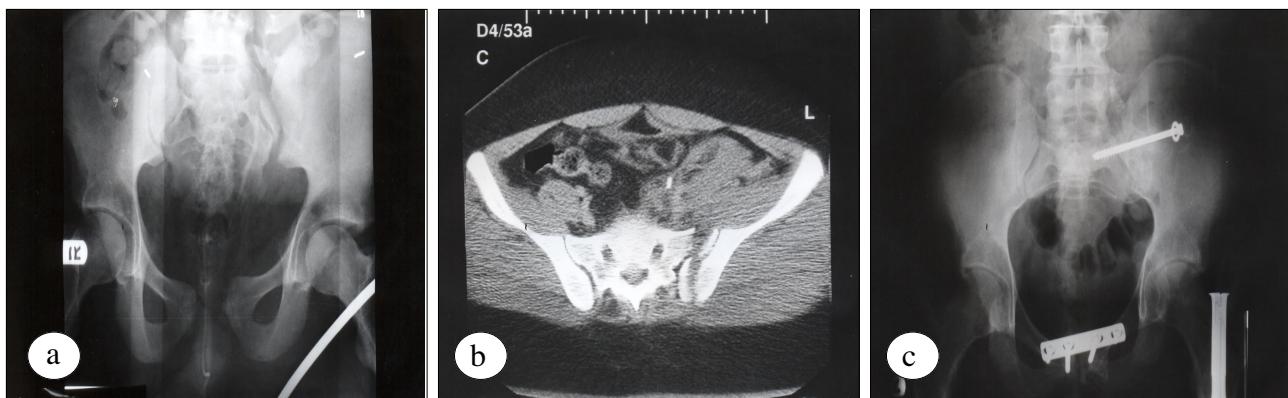


Figure 1 - Radiograph (a) and (b) computerized tomography scan of a male patient with type C1 pelvic injury (fracture) left ala of the sacrum and fracture shaft left femur. (c) Anteroposterior radiograph of the pelvis for the same patient after internal fixation of his pelvic and femoral fractures. One sacroiliac screw was removed due to incorrect placement.

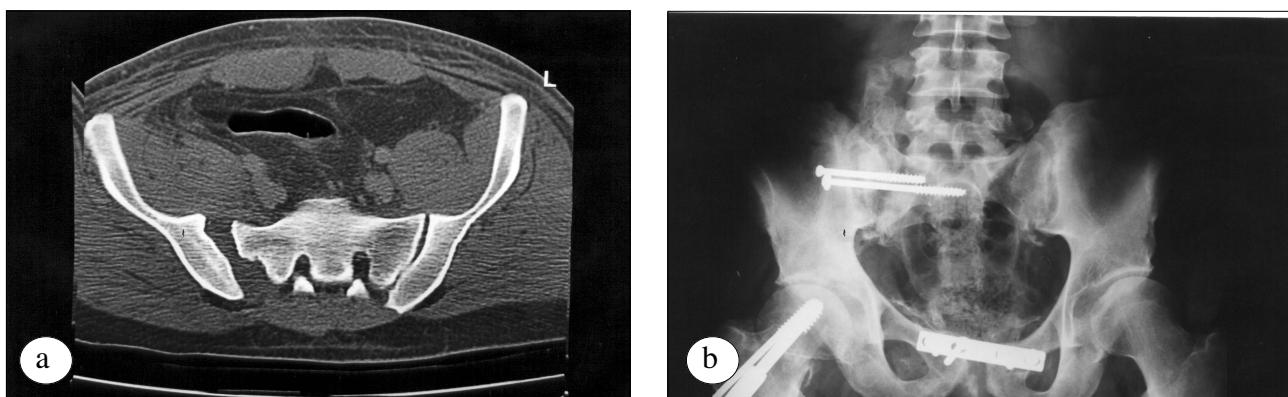


Figure 2 - A computerized scan (a) for a male patient with type C1 pelvic injury (right sacroiliac joint disruption). (b) Anteroposterior radiograph of the pelvis for the same patient after internal fixation of his pelvic and right femoral neck fractures.

Table 1 - Radiological and functional results according to the types of pelvic injuries.

Type of pelvic injury (Tile's classification)	N of patients	Radiological results				Functional results			
		Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor
C1	25	10	12	2	1	10	13	1	1
C2	6	1	3	1	1	-	2	3	1
C3	7	3	3	1	-	1	1	3	2
Total	38	14	18	4	2	11	16	7	4

Table 2 - Radiological and functional results according to timing of internal fixation.

Time	N of patients	Radiological results				Functional results			
		Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor
0-14 days after injury	23	9	11	2	1	8	9	5	1
15-27 days after injury	15	5	7	2	1	3	7	2	3
Total	38	14	18	4	2	11	16	7	4

significant statistically ($P<0.05$). The average follow up time for all patients was 39.2 months (range 24-52). At the end of their follow-up all patients had union of their bony fractures except one. The radiological assessment revealed 14 excellent (37%), 18 good (47%), 4 fair (11%) and 2 poor (5%) results, while the functional assessment revealed 11 excellent (29%), 16 good (42%), 7 fair (18%) and 4 poor (11%) results (Table 1). The difference between radiological and functional outcomes was found insignificant statistically ($P>0.05$). The radiological and functional outcomes in relation to the time of surgical stabilization were shown in Table 2. The effects of the differences in age of the patients, types of pelvic injuries and timing of internal fixation on final outcomes were all found statistically insignificant ($P>0.05$).

Discussion. Historically, pelvic ring injuries, depending on their severity had been treated by a variety of closed methods. Unstable pelvic injuries treated by these conventional measures often result in significant disability, moreover the mortality can reach 21.8%.^{5,20-22} There was a growing body of evidence that the application of an external skeletal frame will reduce venous and bony bleeding and improve tamponade by reducing and maintaining the pelvic volume to the extent that other interventions are rarely required.^{9,12,20,23} Recently, biomechanical studies showed that external frame could not ensure sufficient stability to allow mobilization without the risk of re-displacement of the fragments particularly those with vertical instability. External fixators can be used temporarily in unstable injuries as part of emergency treatment to allow the patient to be placed with the trunk in the upright position to improve ventilation.^{7,11,13,22-24} Our results agree with other studies stating that anterior or posterior fixation, or both could restore excellent stability and adequate consolidation of the unstable (Type-C) pelvic injuries with subsequent decrease in morbidity and mortality.^{5,15,21,24} The patients of this study had rapid improvement of their general condition with early discharge from ICU. They were mobilized relatively earlier without significant risk of re-displacement of the fragments (average, 15 days) in spite of associated other skeletal injuries (Figures 1 & 2). In cases where there were no other skeletal injuries that can delay walking, the average time to start mobilization was significantly ($P<0.05$) decreased to 4.2-days. Early mobilization minimized the complications associated with prolonged recumbency in patients of the study.

It has been emphasized that surgical treatment should be carried out 5-7-days post trauma when the patient general status allows.^{15,24} In the current study there was no statistical difference between the

results of internal fixation of pelvic injuries carried out within 2 weeks after injury and those with delayed fixation more than 2 weeks due to unstable general condition ($P>0.05$). It is the author's opinion to perform internal fixation for unstable pelvic injuries as soon as the general condition stabilized even up to 4-weeks after the injury. In our experience, fixation of the anterior ring disruption with 4 holes plate is a simple procedure and provides satisfactory stabilization. Percutaneous iliosacral screws fixation has recently become popular as it is minimally invasive and provides stable fixation using reasonably small implants. Biomechanically it is equal or superior to other techniques of internal fixation.^{6,10,12,21,25} This technique was used for all cases required posterior stabilization in this study, and the results were satisfactory in 84% radiologically and in 71% functionally. The technique was very demanding, even in expert hands. Misdirected screws into the sacral foramina although a rare occurrence can result in significant morbidity. Thorough understanding of the anatomy of posterior pelvis and their fluoroscopic correlations is always necessary to reduce the complication rate.^{10,12,25} Although there is no statistical difference between radiological and functional results in the current study, the clinical figures agreed with the hypothesis that radiological outcome is usually better than the functional outcome. The functional results are often affected by the associated skeletal or extra skeletal injuries as well as other variables.^{1,5,22,24} Simultaneous effects of these variables on the final outcome make it impossible to study each effect separately. A huge number of cases are needed to accomplish this task by choosing patients with only one variable at a time.

In conclusion, unstable type C pelvic ring disruptions are almost always require surgical stabilization. Surgery should be carried out whenever the general condition of the patient allows even up to 4-weeks. Surgically demanding minimal invasive internal fixation is preferable over other surgical stabilization techniques. It offers satisfactory stabilization with consequent improvement of the outcome. All efforts must be directed to correct screw placement during sacroiliac joint stabilization to avoid neurological damage which can be permanent.

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