



One sacroiliac screw for posterior ring fixation in unstable pelvic fractures

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Unstable pelvic injuries are considered uncommon and they are usually associated with high rate of morbidity and mortality. High energy blunt trauma and falling from height are usually the main mechanism of injury.

It is a retrospective study that was performed in academic level I trauma center. From September 2015 to December 2019, a consecutive series of 26 patients (7 females), with average age of 32 years with unstable pelvic fracture were included in this study. All patients underwent reduction and percutaneous fixation with one sacroiliac screw posteriorly for each sacroiliac joint and anterior arch fixation of the pelvic ring with either plating or external fixator. The average duration of follow up was 36 months.

Clinical results: at the final follow-up, all patients had complete radiological healing of the fractures. The subjective functional assessment yielded excellent for twenty-two patients, good for two patients and fair for two patients.

Posterior arch fixation of the pelvic ring with one sacroiliac screw beside anterior arch fixation in unstable fracture pelvis is a sufficient fixation method to maintain the requiring stability to allow complete union of the fracture.

Level of Evidence: Therapeutic Level III.

Key words : unstable pelvic fracture ; percutaneous ilio-sacral screws ; pelvis fractures ; sacroiliac joint ; single iliosacral screw.

INTRODUCTION

Unstable pelvic injuries are considered uncommon injuries and they are usually associated with high rate of morbidity and mortality. They accounts for 16.7% of all pelvic injuries (1,2). High energy blunt trauma and falling from heights are usually the main mechanism of injury.

Failure of the anterior arch of the pelvic ring is represented in multiple forms as symphyseal diastasis, fracture of the superior and inferior pubic ramus whether on one side or both sides , while failure of the posterior arch is represented as sacral fractures, dislocation of the sacroiliac joint, fracture dislocation of the sacroiliac joint and trans iliac crescent fracture (3,4).

Unstable pelvic fractures are a major cause of disability. It is associated with high rate of mortality and morbidity. Neurological deficit and pelvic instability are major consequences especially in cases with comminuted sacral fractures (5, 6).

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Stabilization of both anterior and posterior components of the pelvic ring is necessary to have a stable fixation to allow early fracture healing. It is mandatory rather than optional choice. Fixation of one component rather than the other is a primary cause of fixation failure and high complication rate (7).

Fixation of the anterior component of the pelvic ring can be achieved through symphyseal plating or external fixator in case of symphyseal disruption or in pubic rami fractures respectively or more recently percutaneous screws.

The posterior component of the pelvic ring can be approached through both anterior and posterior approaches. Methods of fixation of posterior pelvic ring include anterior plating, posterior plating, sacral plating, lateral compression screw, triangular fixation (8). Posterior plating carries the risk of hardware prominence and wound healing complications.

Percutaneous iliosacral screw fixation overcomes the previous complications moreover it had many advantages as minimal soft tissue disruption, low infection rates and less blood loss (9-11). The main goal of surgical treatment of unstable pelvic fractures is to restore pelvic stability through accurate reduction and stable pelvic fixation. Stable fixation will reduce the pain and allow early ambulation of the patients. Else it will decrease patient mortality and morbidity (10,11).

The aim of this study was to retrospectively evaluate the efficiency of fixation of the posterior arch of the pelvic ring with one sacroiliac screw beside the anterior arch fixation.

MATERIALS AND METHODS

It is a retrospective study of all patients with unstable pelvic fracture who fulfilled our inclusion criteria. From September 2015 to December 2019, a consecutive series of 26 patients who had unstable pelvic fracture were included in this study.

This study was conducted in academic level I trauma center. The study was approved by our institutional review board.

The inclusion criteria included all cases with combined complete anterior and posterior arch dis-

ruption of the pelvic ring according to OTA/AO classification :

- 61-C1.2
- 61-C1.3
- 61-C3.3

Exclusion criteria included any of the following :

Any evidence of a lateral compression component injury defined as a sacral impaction fracture or internal rotation of the affected hemipelvis on CT scan.

A treatment delay of more than 2 weeks.

Patients whose initial posterior stabilization used a method other than iliosacral screws.

Patient with other fracture in the lower limb that interfere with weight bearing.

All patients were evaluated by x-ray antero-posterior view, outlet, inlet, right oblique, left oblique views and a multislice CT scan was performed (Figures 1a, 1b (1,2)).

Initial evaluation was done by a trained orthopedic surgeon, all patients had traction, a pelvic binder once they had diagnosed having unstable pelvic fracture. These measures were temporary until the patient was hemodynamically stable and prepared for surgery.

All patients (hemodynamically stable) underwent reduction and percutaneous fixation with one sacroiliac screw posteriorly for each sacroiliac joint. The sacroiliac screw is a partially threaded cancellous screw with a diameter of 7.3mm. A



Figure 1a. — Preoperative X-ray of Female patient thirteen years old with fracture pelvis type C.



Figure 1b (1,2). — Immediate postoperative X-ray, stabilization of the posterior ring with one sacroiliac screw and stabilization of the anterior ring with external fixator.

washer was used with all screws to permit more compression and prevent screw penetration within the iliac bone. Anterior component of the pelvic ring fixation was fixed using either symphyseal plating or external fixator (Supra-acetabular pin placement on both sides) Figures (1c, 2a).

The posterior component of the pelvic ring was fixed first. To achieve reduction in displaced fractures, traction of the lower limb of the affected side was enough in most cases to have accurate reduction. We had used a schantz pin as a joystick to achieve reduction in one case

All surgeries were done by the senior author (A fellowship trained orthopaedic traumatologist with experience of more than ten years in treatment of pelvic fractures).

Postoperatively all patients were mobilized the day after surgery and restricted to touch-toe weight



Figure 1c. — X-ray at four years follow up.



Figure 2a. — Pre-operative X ray anteroposterior view of patient 40 years with bilateral fracture pelvis..

bearing using crutches for the first 6 weeks then full weight bearing is allowed.

All patients were subjected to clinical and radiological evaluation which was done at six weeks, three months, six months, one year and then every year. The external fixator was removed at one month postoperatively.

Radiological evaluation was done using plain radiographs (Anteroposterior, Inlet and Outlet views)

The average duration of follow up was 36 month.

Visual analogue scale (VAS) was used for clinical evaluation to describe pain at the sacroiliac joint

while the functional evaluation was done by using Majeed scoring system (12).

The vertical displacement of fracture before and after surgery was measured by constructing horizontal reference lines through the bony landmarks according to Henderson (13).

Residual post-operative displacement was measured by comparing the pre-operative plain radiographs to the immediate post-operative plain radiographs while late displacement was measured by comparing the pre-operative plain radiographs to the last follow up plain radiographs.

Failure was defined as at least 1 cm displacement. Early postoperative and late complications were reported when present. Diagnosis of non-union was made after 6 months of surgery using CT scan with 2 criteria :

- 1 – Radiological evidence of non-union.
- 2 – Persistent pain.

RESULTS

Twenty-six patients with unstable pelvic fractures have been treated by one sacroiliac screw. There were seven females and nineteen males. The average age was 32 years. Road traffic accident was the main cause of injury in twenty-one patients while falling from height was the cause of injury in five patients.

The average operating time was 70 minutes (range 50 to 120 minute), the average follow-up was 36 months. All operations had been done within the first 5 days after trauma insult.

All screws had been inserted through percutaneous technique. The posterior arch disruption of the pelvic ring was fixed in all patients using sacroiliac screw for each sacroiliac joint. All cases required only one

Table 1. — Table showing fracture types of operated cases

Type of fractures (AO Classification)	Number of patients	Sex
61-C1.2	14	Nine males Five females
61-C1.3	11	Nine males Two females
61-C3.3	1	One male



Figure 2b. — CT Axial view showing bilateral sacral fracture (61C3.3).



Figure 2c. — Immediate post-operative x ray

screw except one case who had two screws (one in each sacroiliac joint) as this patient had failure of the posterior arch of the pelvic ring at both sides (61C3.3 injury).

The anterior component of the pelvic ring was fixed by symphyseal plate in ten patients while the external fixator was used in sixteen patients. Classification of our operated cases according to AO classification is shown in Table (1).

No wound complications or neurological complications exist in our series. None of the patients had a non-union of fractures or loss of reduction at the final follow-up Figures (2b, 2c, 2d (1,2)).

Table 2.

Case	Sex	Age	Fracture type (OTA/AO classification)	Postoperative Majeed Score
1	Male	18 years old	61-C1.2	78
2	Male	19 years old	61-C1.2	78
3	Female	13 years old	61-C1.2	78
4	Male	25 years old	61-C1.2	80
5	Male	40 years old	61-C1.2	79
6	Male	30 years old	61-C1.2	78
7	Female	30 years old	61-C1.2	80
8	Male	22 years old	61-C1.2	78
9	Male	33 years old	61-C1.2	79
10	Male	25 years old	61-C1.2	75
11	Female	32 years old	61-C1.2	80
12	Male	28 years old	61-C1.2	78
13	Male	26 years old	61-C1.2	79
14	Female	45 years old	61-C1.2	80
15	Male	22 years old	61-C1.2	80
16	Male	60 years old	61-C1.2	76
17	Female	60 years old	61-C1.2	67
18	Female	55 years old	61-C1.3	78
19	Male	34 years old	61-C1.2	80
20	Male	50 years old	61-C1.2	65
21	Male	25 years old	61-C1.2	79
22	Male	38 years old	61-C1.2	80
23	Female	33 years old	61-C1.3	80
24	Male	28 years old	61-C1.2	78
25	Male	25 years old	61-C1.2	79
26	Male	40 years old	61-C3.3	80



Figure 2d (1, 2). — Follow up x ray at three years.

The mean pre-operative VAS score was 9 ± 1 while the immediate mean post-operative VAS

score was 4.5 ± 1 . The mean post-operative VAS score at minimum 2 years follow up was 1.3 ± 2 .

The functional classification according to Majeed Score was excellent for twenty-two patients, good for two patients and fair for two patients Table (2).

By constructing Henderson horizontal reference lines through bony landmarks, all cases had no residual post-operative displacement. There was only one case of late displacement more than 1 cm at the last follows up. The patient did not deny early full weight bearing down at one week post-operative.

DISCUSSION

Surgical treatment of unstable pelvic fractures aims to restore pelvic stability through accurate anatomic reduction and stable pelvic fixation. Stable pelvic fixation will reduce the pain and allow patient early ambulation and early return to work. It will decrease the patient mortality and morbidity.

The severity of pelvic ring disruption depends on many factors as high or low energy trauma, direct or indirect trauma, blunt or perforating trauma and the direction of resulting vector of the impacting forces (14).

Evaluation of the stability of the disrupted pelvic ring depends on (1) radiological appearances (2) physical findings (3) the knowledge of the mechanism of injury (14). There is no role for conservative treatment in unstable pelvic fractures. Conservative treatment is associated with inaccurate reduction and long hospital stay that associated with high mortality and morbidity rates (15).

There are various options for internal fixation have been proposed, including percutaneous sacroiliac screws (8), trans iliac bars (4,16), sacral rods (15), posterior small plates (17), or vertical stabilization alone (18). and triangular osteosynthesis (19).

There is still controversy for the best method for fixation of unstable pelvic fractures.

Lehmann et al in 1943 were the first to report open iliosacral screw and it was associated with high infection rate (20). Matta introduced the percutaneous technique for inserting iliosacral screw while the patient in prone position with the assist of intraoperative fluoroscopic inlet and outlet views (11). Supine position with using lateral view to accurately introduce the iliosacral screw was used by

Rout in 1993 (21). Despite it is a simple technique, the proximity of neurovascular structures necessitate a high experienced skilled surgeon and a high-quality image intensifier to avoid neurovascular injury (22).

Iliosacral screw insertion in the first sacral vertebra S1 is the recommended method for fixation of unstable pelvic fractures. However, S2 sacral screw insertion can provide more biomechanical stability (23) than single sacral screw. There are many limitations for S2 screw fixation as (1) small size S2 vertebrae with narrow pedicles that difficult to visualize (2) increase incidence of screw misdirection with a greater potential risk for nerve root injury or spinal canal compromise (3) questionable purchase (24).

Moed et al in their study reported the use of S2 iliosacral screw fixation in unstable pelvic fractures in 49 cases but they recommended it uses with caution in patients with suspected pelvic osteopenia or poor screw purchase (25).

Lumbopelvic fixation was first introduced by Kach et al 1994 (18) then modified by Schildhauer et al. 1998 (19) to achieve adequate rotational stability. Schildhauer showed that triangular osteosynthesis is an effective method for fixation of unstable sacral fractures to allow early progressive weight-bearing with an acceptable complication rate.

However, long term results were not satisfied. Sagi et al in their study of long term results of using triangular fixation in unstable pelvic fractures, they observed the incidence of potential technical problems and complications as asymmetric L5 tilting with L5-S1 facet joint distraction, non-union due to lack of compression and residual fracture gaps, painful hardware that needed a second operation for removal therefore they recommended selective use of triangular fixation in comminuted transforaminal sacral fractures. Else they recommended hardware removal in all patients at 6 months after healing demonstrated using pelvic CT scan (26).

Therefore, triangular fixation should be limited only to cases with comminuted transforaminal sacral fractures. It will be associated with excellent results. Otherwise single sacroiliac screw is enough to treat unstable pelvic fracture with acceptable results according to our study. However triangular fixation has the advantage of simultaneous decompression

of the nerve roots in patients with pre-operatively neurological deficit (27).

Trans iliac- Tran sacral screw fixation is a new and recent technique for posterior arch fixation of the pelvic ring. It is best used in patients with bilateral posterior pelvic injury. It is suitable in cases with osteoporosis, pelvic instability (spinopelvic dissociation) and non-union procedures (28). However trans iliac- trans sacral screw does not adversely affect or improve patient outcomes or subjective pain scores when used in cases with unilateral pelvic injury compared to treatment with unilateral iliosacral screw (29).

The purpose of management of unstable pelvic fractures is to fix the anterior component and posterior component of the pelvic ring. Despite triangular fixation is biomechanical superior than iliosacral screw in posterior ring fixation (30). The long-term complications and long operation time is a disadvantage. Iliosacral screw fixation is a percutaneous, simple and reliable for fixation of unstable pelvic fractures.

The literature is still deficient regarding high evidence clinical studies comparing all techniques of posterior arch fixation of the pelvic ring.

CONCLUSION

Posterior arch fixation of the pelvic ring with one sacroiliac screw beside anterior arch fixation in unstable pelvic fracture is a sufficient fixation method to maintain the requiring stability to allow complete union of the fracture.

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