A simple reduction technique for the posterior column in acetabular fractures

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Background
Posterior acetabular column injuries can happen as an isolated fracture or can be associated with other acetabular fractures. The aim of this study was to evaluate the validity of a new technique in the reduction and fixation of fractures involving the posterior acetabular column.
Patients and methods
A prospective study which included 35 patients with displaced acetabular fractures (≥3 mm). Of the patients, 24 were men and 11 were women. The age of the patients' ranged from 25 to 50 years with a mean of 37.9 years. All patients had injuries to the posterior column, either isolated or associated with other types of acetabular fractures. The follow-up period ranged from 24 to 36 months with a mean of 28.8 months.
Results
Perfect or anatomical reduction of the posterior column was achieved and maintained in 25 (71.43%) patients. Near perfect or near-anatomical reduction of the posterior column was achieved and maintained in another six (17.14%) patients. Three (8.57%) patients had good reduction of the posterior column which was maintained till union, while one (2.86%) patient had imperfect reduction of the posterior column. According to the Harris hip score, the clinical outcome was excellent in 12 (34.29%) patients, good in 17 (48.57%) patients, fair in five (14.29%) patients, and poor in one (2.85%) patient. The operative time for reduction and fixation of the posterior column using this technique ranged from 15 to 20 min with a mean of 18 min. No permanent complications happed during this study.
Conclusion
The technique described in this study is a simple technique for open reduction without the need for such bulky instrumentations with rapid internal fixation. This method of reduction and fixation is considered useful, safe, and comparable to all the previous described reduction and fixation techniques.

Keywords:
acetabular fractures, posterior column, reduction technique

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Introduction

From the lateral aspect, the acetabulum is cradled by the arms of an inverted Y; one arm is the anterior column and the other arm is the posterior column [1–3]. Injuries of the posterior acetabulum column can happen as an isolated fracture or are associated with a posterior wall fracture or a part of transverse fracture, T-shaped fracture, anterior-type posterior hemitransverse fracture and also with both column fractures [1–5].

The Kocher Langenbeck approach is usually used to deal with this fracture [6–8]. For reduction of such fractures, many methods of open reduction were described utilizing bulky instrumentations that made the application of the internal fixation method difficult and frustrating.

A simple technique for open reduction of this fracture is described in this study without the need for such bulky instrumentations with rapid internal fixation.

The aim of this study was to evaluate the validity of this new reduction technique in dealing with posterior column fractures.

Patients and methods

This study is a prospective surgical technique case series. The material of this study included 35 patients with displaced acetabular fractures (≥3 mm). Of the patients, 24 were men and 11 were women. The

patients' age ranged from 25 to 50 years with a mean of 37.9±7.7 years.

The posterior column was fractured in all patients. According to the Letournal classification [2], seven had isolated posterior column fractures, eight had isolated transverse fracture, five had T-shaped fracture, seven had associated transverse with posterior wall fractures, five had associated posterior column with posterior wall fracture, and three had associated both column fractures. The exclusion criteria for this technique were isolated acetabular wall fractures, anterior column fractures, and anterior-type posterior hemitransverse fractures. In the later type, the posterior column is either nondisplaced or minimally displaced.

Informed consent was taken from every participant in this study after full description of the whole procedures with their benefits and hazards. All patients signed this consent without any obligation. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation.

In five patients, the operation was done on the third day after trauma, while in the remaining 30, the operation was done 4–10 days after trauma. The delay in surgical interference was related to associated injuries and unsuitable medical condition after the trauma for such interference. General anesthesia was used in 17 patients, while spinal anesthesia was used in 18 patients. The Kocher Langenbeck approach was used for open reduction and internal fixation of the posterior injury in all patients.

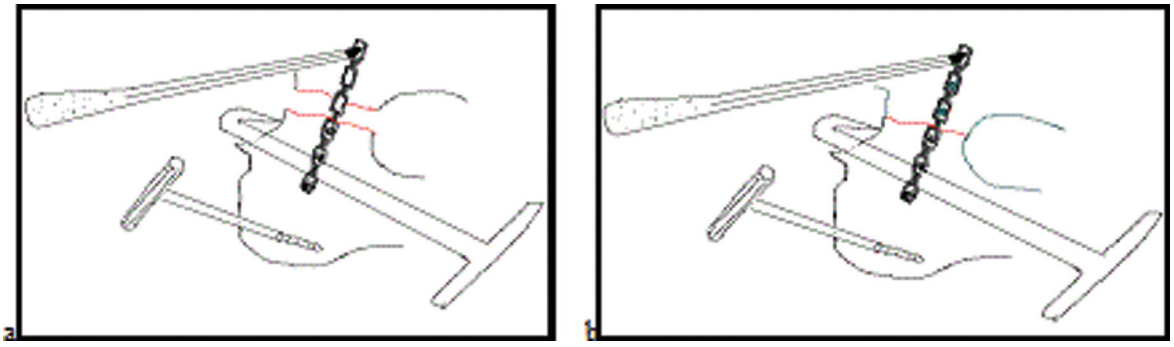
After exposure of the posterior column fracture as well as the ischial tuberosity and the outer surface of the iliac bone, the fracture surfaces were cleaned of blood clots and any necrotic debris. The femoral head was properly reduced through longitudinal traction to the whole limb with the knee flexed and the hip extended. A hook was carefully applied in the greater or lesser sciatic notch for pulling of the distal fragment to correct its posteromedial displacement. A Schanz screw was placed in the ischial tuberosity to manipulate the distal fragment and correct its rotation. These two instruments were used in the ordinary standard techniques described by Tile [1].

The idea of this technique came from the concept of plate fixation to one fragment in order to reduce such fragment to the other one. A 4–6-hole 3.5 mm reconstruction plate was carefully contoured for the posterior column. Two or three 3.5 mm cortical screws were inserted through the plate in the distal fragment. Careful application of these screws should be taken to prevent penetration of the articular surface of the acetabulum. A ball spike pusher was then inserted in the most proximal hole of the plate and the plate was then strongly pushed upwards and laterally across the outer border of the iliac bone to reduce the residual posteromedial displacement as well as the rotation of the distal fragment of the posterior column and also to do compression across the fracture site.

Once anatomical reduction was achieved, a 2.7 mm drill bit was inserted in the most distal hole in the proximal fragment to insert the first screw in this fragment. A relief feeling always happens at this point after seeing the fracture reduced anatomically or near anatomically and fixed by this screw. Another one or two screws were applied after that through the plate in the proximal fragment (Fig. 1a and b show the reduction technique described above).

In patients with isolated posterior column fractures and in patients with transverse or T-shaped fractures, another 9–11-holes 3.5 mm reconstruction plate was

Figure 1



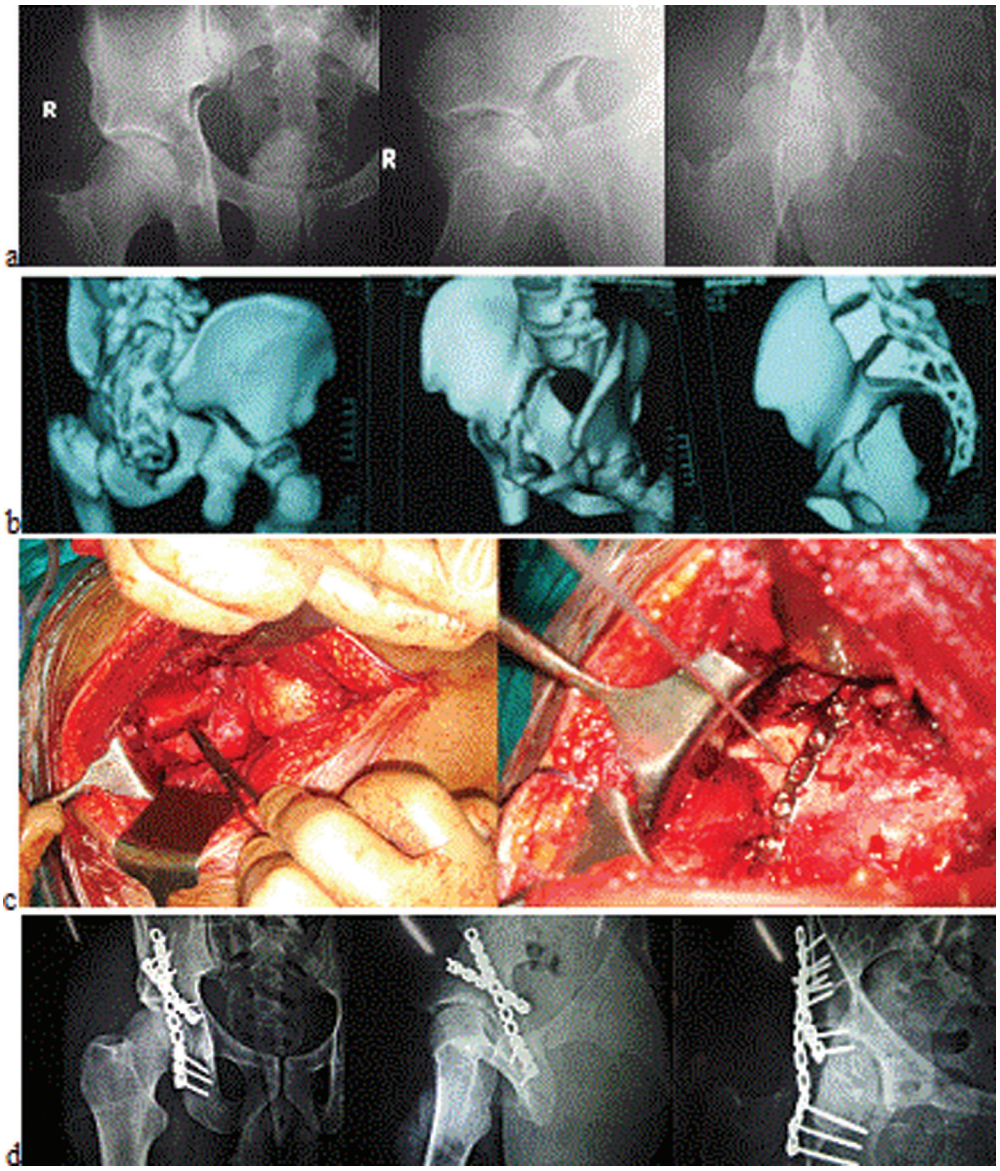
(a) The displaced posterior column fracture. (b) A diagram showing the reduced posterior column fracture after the reduction technique.

carefully contoured and applied to the posterior column.

In patients with associated transverse and posterior wall fractures, fixation of the posterior column was done first though this technique with the small reconstruction plate. This was followed by reduction of the posterior wall fragment in its ordinary manner and fixation with interfragmentary screws. Another 9–11-hole 3.5 mm reconstruction plate was applied across the posterior wall and posterior column to buttress the wall fragment and to fix the posterior column as well. Figure 2 a shows a grossly displaced posterior column before reduction, while Fig. 2b shows the posterior column after reduction and fixation with two plates. Testing the hip motion for any intra-articular hardware and for fracture stability was done at the end of fixation.

In eight patients, percutaneous anterior column lag screw was used to fix fracture of the anterior column with the help of an image intensifier. Anatomical or near-anatomical reduction of the anterior column was achieved through traction of the affected side with manipulation of the hip in different positions. In this series, percutaneous anterior lag screw was used in three cases of T-shaped acetabular fractures and in two cases of isolated transverse acetabular fractures and

Figure 2



(a) Plain radiographs of a 24-year-old man with transverse acetabular fracture. (b) Three-dimensional reconstruction computed tomography showing fracture through the posterior column and anterior column. (c) Intraoperative photographs showing the posterior column fracture before and after reduction and fixation with the first plate. (d) Postoperative radiographs show anatomical reduction of the posterior column with internal fixation with two plates.

in three cases of associated transverse with posterior wall acetabular fractures. In the remaining two cases of T-shaped acetabular fracture, the reduction of the anterior column fracture was not accepted, and therefore anterior ilioinguinal approach was used to reduce and fix this fracture.

In patients with both column fractures, the new technique was done for the posterior column fracture through the posterior approach while anterior ilioinguinal approach was used to reduce and fix the anterior column fracture. When the displacement of the anterior column is more than the displacement of the posterior column, the anterior ilioinguinal approach was done first (two patients).

Intravenous antibiotics and prophylactic subcutaneous anticoagulant were given during induction of anesthesia. Third-generation cephalosporin was used and continued for 7 days, while the prophylactic anticoagulant was continued for 14 days according to the standard postoperative treatment protocol in our center. Prophylaxis against heterotopic ossification was done using indomethacin 25 mg orally three times daily for 2 months with appropriate gastric protection medications.

Once the postoperative pain is controlled by appropriate analgesics, physiotherapy and active exercises for the hip, knee, and ankle joints were done while the patient is in bed for the first 2 weeks. Walking on the unaffected side with two crutches was allowed after 2 weeks.

Using a modified Matta [6] method of reduction evaluation, postoperative radiological evaluation of posterior column fractures reduction was done after doing the standard three acetabular views. According to the degree of fracture displacement, each view was given three points. If there is no displacement in one view it is given three points, if the displacement was from 1 to 3 mm, it was given two points, if the displacement was from more than 3 to 5 mm, it was given one point, if the displacement was more than 5 mm, and it was given zero. The reduction was graded perfect or anatomical if the sum of the three views was nine points. Near perfect if the sum was eight points, good if the sum was seven points, and failure or imperfect reduction if the sum was less than seven points.

All patients were followed up every month for 4 months and then every 2 months, clinically according to the Harris hip score [9] and radiologically to determine the stability of reduction and fixation as well as the occurrence of complications. The follow-up period ranged from 24 to 36 months with a mean of 27.75±3.75 months.

The data collected from this study were statistically analyzed using the average (mean), SD.

Results

In this study, perfect or anatomical reduction of the posterior column was achieved and maintained in 25 (71.43%) patients. Near perfect or near-anatomical reduction of the posterior column was achieved and maintained in another six (17.14%) patients. Three (8.57%) patients had good reduction of the posterior column which was maintained till union while one (2.86%) patient had imperfect reduction of the posterior column. The postoperative three acetabular views showed that all of the screws were outside the hip joints.

According to the Harris hip score, the clinical outcome was found to be excellent in 12 (34.29%) patients, good in 17 (48.57%) patients, fair in five (14.29%) patients, and poor in one (2.85%) patient. At the end of follow-up, the mean Harris hip score was 85.53±7.02 (ranged from 95 to 64). Table 1 shows the relation between the degree of posterior column fracture reduction and the final clinical results.

At the end of follow-up, all 12 patients having posterior column fractures with or without posterior wall fractures had excellent or good clinical results. Thirteen patients out of 15 of transverse acetabular fractures with or without posterior wall fractures had excellent or good clinical results, while two out of five of T-shaped acetabular fractures had fair clinical results. In both column fracture type, one patient

Table 1 Relation between the degree of posterior column fracture reduction and clinical results

Degree of reduction	Excellent [*n* (%)]	Good [*n* (%)]	Fair [*n* (%)]	Poor [*n* (%)]	Total [*n* (%)]
Perfect (anatomical)	11 (31.43)	14 (40)	0	0	25 (71.43)
Near perfect (near anatomical)	1 (2.86)	2 (5.71)	3 (8.57)	0	6 (17.14)
Good	0	1 (2.86)	2 (5.71)	0	3 (8.57)
Imperfect (failure)	0	0	0	1 (2.86)	1 (2.86)
Total	12 (34.29)	17 (48.57)	5 (14.38)	1 (2.86)	35 (100)

Table 2 The relation between fracture type and clinical results

Clinical results Fracture type	Excellent	Good	Fair	Poor	Total
Isolated posterior column	5	2	0	0	7
Posterior column with posterior wall	2	3	0	0	5
Transverse	3	4	1	0	8
Transverse with posterior wall	2	4	1	0	7
T-shaped	0	3	2	0	5
Both columns	0	1	1	1	3
Total	12	17	5	1	35

had fair clinical results and other patients had poor clinical results with imperfect reduction, while the last patient had good clinical results. Table 2 shows the relation between the fracture type and the final clinical results.

All fractures showed radiological sign of solid union at a mean of 4 months (ranged from 3 to 6 months). There was no radiological loss of reduction during and at the end of the follow-up period. At the end of the follow-up period, six patients had reduced joint space that was correlated to the fair or poor clinical result patients.

The operative time for just reduction and fixation of the posterior column using this technique ranged from 15 to 20 min with a mean of 18±1.96 min.

The complications met with in this study were superficial wound infection in one patient that resolved with appropriate antibiotic and dressing and transient sciatic nerve injury in the form of common peroneal nerve injury in one patient. Complete recovery of the nerve happened after 3 months. There were no cases of injury of the superior gluteal artery using such technique. No cases of avascular necrosis of femoral head happened till the end of the study (Fig. 3).

Discussion

Many authors [1–4,10–12] described the techniques for open reduction and internal fixation of fractures of the posterior column. These techniques usually need bulky instrumentations and take long time to achieve. The use of Farabeuf clamp over two screws is frustrating and usually slips during fixation. The use of a large pelvic reduction clamp is also frustrating and carries the risk of sciatic nerve injury due to limited access available for such bulky instrument. Also, the space available for plate application after reduction by such clamp is highly limited. The use of pointed reduction forceps in the great sciatic foramen is risky with a weak reduction power.

With the new technique described in this study, the posterior column is clearly exposed during the reduction technique with enough space for plate application. Accepted reduction of the posterior column was obtained in all patients (perfect to good reduction) except one patient with imperfect reduction. The used method of fixation maintained the reduction till sold union had occurred. The instruments used in this method of reduction are is considered to be of small size that allow easy visualization of the posterior column, fracture reduction, and rapid plate fixation.

Two plates were used to fix the posterior column in the present study. One is used for reduction and provisional fixation of the posterior column, while the other one is used for final fixation of the column. This method of fixation can be used in all types of acetabular fractures involving the posterior column except the anterior-type posterior hemitransverse where the posterior column fracture is either nondisplaced or minimally displaced.

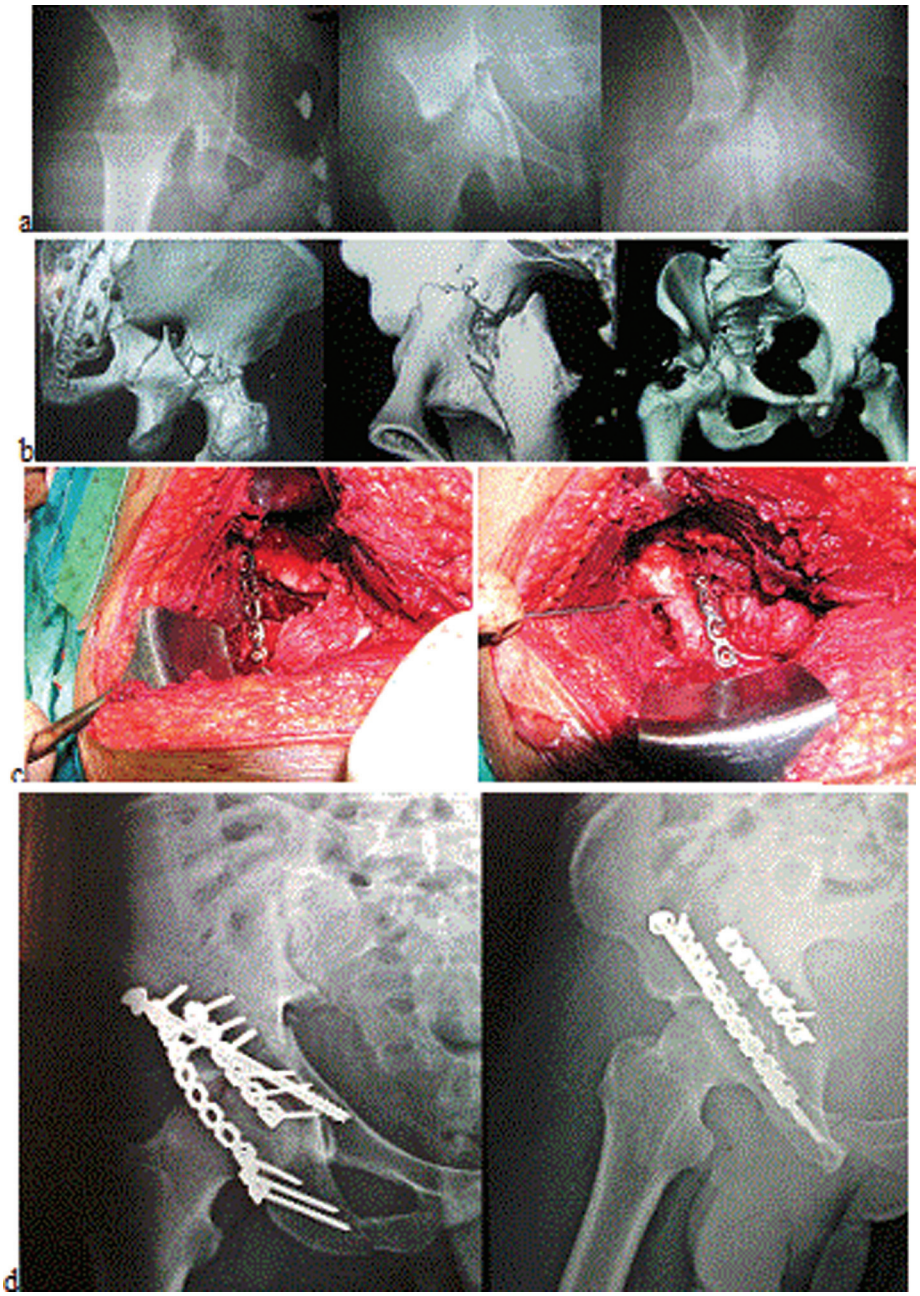
Schopfer *et al.* [13] did a biomechanical study on three methods of fixation of posterior column osteotomies. The three methods of fixation used were a single 3.5 reconstruction plate, two such plates, and a 4.5 mm lag screw with a single 3.5 reconstruction plate. They found that there are no significant differences noted in stiffness for the three procedures and all retained 80% of the intact stiffness. Chang *et al.* [14] find that fixation of the transverse acetabular fractures with plate-and-screw constructs provide good strength of fixation. The author believes that the two plates used in this study is adequate for fixation of such fractures.

The operative time for posterior column reduction and fixation is considered within the acceptable time for such surgery. The complications happened were very low and transient without any permanent disability.

In this study, the number of patients was considered relatively small (35 patients) to compare the clinical results with other authors; however, satisfactory results were obtained in 29 (82.9%) patients. Anatomical and near-anatomical reduction of fractures involving the posterior column were obtained and maintained in 31 (88.5%) patients.

The follow-up period is considered enough to determine the stability of this method of reduction and fixation. However, a longer follow-up period is

Figure 3



(a) Plain radiograph of a 20-year-old man with T-shaped acetabular fracture with central dislocation in the first radiograph. (b) Three-dimensional reconstruction computed tomography showing fracture of the anterior and posterior columns with vertical element. (c) Intraoperative photographs before and after reduction and fixation of posterior column fracture. (d) Postoperative radiographs with near-anatomical reduction of the posterior column and percutaneous screw fixation of the anterior column.

needed to evaluate the result of the surgical management of these complex acetabular fractures.

The intention of this study was not to evaluate the clinical results of acetabular fracture management rather than to evaluate the new reduction technique. This method of reduction and fixation described could be considered useful, safe, and comparable to all the previously described reduction techniques however with less instrumentation, less time and frustrations together with easy plate fixation of the posterior column.

Conclusion

The technique described in this study is a simple technique for open reduction without the need for such bulky instrumentations with rapid internal fixation. This method of reduction and fixation is considered useful, safe, and comparable to all the

previously described reduction and fixation techniques.

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Conflicts of interest
There are no conflicts of interest.

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