

# Is it necessary to plate all posterior wall fractures of the acetabulum?

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## Background

Posterior wall injuries represent the commonest type of acetabular fractures. It could be isolated fractures or – more commonly – associated with hip dislocation with varying degrees of displacement and comminution. Being intra-articular injuries affecting the congruency and stability of the hip joint, 30% of patients with such injuries have poor outcomes. Accurate fracture reduction with stable fixation is the standard way for achieving satisfactory results. This study aims to evaluate the suitability and efficacy – in light of the clinical and radiological results – of using only screws for fixation of certain posterior wall fractures through a limited exposure using the Kocher-Langenbeck approach.

## Patients and methods

This study included 16 cases of displaced posterior wall fractures with single, sizable fragment or multiple, noncomminuted fragments treated with open reduction and internal fixation using only screws through a limited exposure using the Kocher-Langenbeck approach. In 14 cases, fractures were associated with hip dislocation whereas the last 2 cases had isolated posterior wall injuries. Radiological assessment according to Matta and Heeg criteria and clinical evaluation according to Postel score were done postoperatively and throughout the follow-up period that extended for a mean duration of 18.9±6.7 months.

## Results

Clinically satisfactory results (excellent and good) were reported in 14 cases, representing 87.5% of the studied cases. One case was rated fair and one case was rated poor, so unsatisfactory results (fair and poor) were reported in two cases, representing 12.5% of the studied cases. According to the modified criteria of Matta, 12 cases had excellent reduction and four cases had good reduction, and according to the radiographic grading criteria by Heeg, 14 cases were excellent with a normal-appearing hip joint compared with the healthy side; one case was fair with joint narrowing less than 50% compared with the other healthy side with no osteophytes and viable head; and one case was rated as poor with advanced degenerative changes, head subluxation, and severe avascular necrosis. No cases developed heterotopic ossification or implant failure.

## Conclusion

Fixation by only screws through a limited exposure could be a simple and reliable fixation method for certain posterior wall fractures with less soft tissue dissection and intraoperative and postoperative complications, with comparable clinical and radiological results to the more complex fixation methods using conventional reconstruction plates or locked plates.

## Keywords:

fixation using only screws, limited exposure through Kocher-Langenbeck approach, posterior wall fractures, satisfactory results

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## Introduction

Acetabular fractures are of great clinical importance and represent a challenge for orthopedic surgeons with high complication rates and poor outcome in 25–30% of patients [1]. Fracture pattern, associated osteochondral damage to the femoral head and/or the acetabulum, associated neurovascular injury, and hip dislocation at the time of injury are the factors that influence the final functional outcome [2,3].

Basically, displaced sizable acetabular fractures or fractures affecting stability of the hip joint should be

treated surgically [4]. Anatomical reduction along with rigid internal fixation has become the standard method of treatment [5]. Although various modalities of operative fixation have been evolved and refined, there are still controversies concerning the type of osteosynthesis [6].

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Standard conventional internal fixation entails the use of an interfragmentary lag screws combined with a posterior buttress plate; however, primary plate osteosynthesis can lead to slight incongruity of the joint surface by fragment displacement owing to eccentric loading while tightening the screws, so locked plates were recently used to avoid such possible displacement [6,7]. Reconstruction of the joint surface is better achieved with only screws inserted using the lag screws' principles and techniques allowing anatomical reduction with good interfragmentary compression of the various fragments [6], but it is used in less than 30% of cases, and there are few authors who have discussed only screw fixation in acetabular fracture treatment [8].

### Patients and methods

The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 and 2008. All patients gave informed consent before inclusion in the study.

#### Clinical data

This prospective, case-series study included 16 cases of posterior wall fractures of the acetabulum with no preoperative neurological insult (Table 1); all cases were caused by high-energy trauma resulted from car accidents (dash board injuries). The injury/surgery interval ranged from 2 to 21 days, with a mean of  $5.5 \pm 4.5$  days. All cases were young active males, with a mean age of  $29 \pm 6.5$  years. Two cases representing 12.5% of the studied cases had isolated posterior wall fractures whereas 14 cases representing 87.5% of the studied cases had associated hip dislocation, which was emergently reduced at time of presentation in 12 of the 14 cases, whereas the remaining two cases had neglected fracture dislocation of their hips at the time of surgery.

The inclusion criteria of the cases for this study were either displaced or nondisplaced posterior wall acetabular fractures affecting stability of the hip joint after closed reduction of a previously dislocated joint when examined under general anesthesia in  $90^\circ$  of flexion,  $20^\circ$  internal rotation, and  $20^\circ$  adduction. Fractures with displaced, single, sizable fragment or multiple, noncomminuted fragments with an articular step or fracture gap of more than 3mm were also included in this study. Cases with marginal impaction, highly comminuted posterior wall fractures, posterior wall fractures associated with

other displaced complex acetabular injuries, and cases associated with other ipsilateral or contralateral lower limb injuries were excluded from this study.

#### Clinical evaluation

The participants of the study underwent complete and detailed history of the injury, its nature, initial management, and duration till presentation for surgery, with paramount importance given to the neurological condition of the patient (sciatic and femoral nerves). Postoperatively, clinical results were assessed according to D'aubigne and Postel [9] score that includes pain, gait, and range of motion with a maximum of six points for each, and the total is classified as excellent (18 points), very good (17 points), good (15 or 16 points), fair (13 or 14 points), or poor (<13 points).

#### Radiological evaluation

Meticulous assessment of plain radiographies, anteroposterior view of the pelvis and both hip joints, and a computed tomographic (CT) scan performed with 3 mm sagittal, axial, and coronal cuts and three-dimensional reconstruction of the involved hip joint was of paramount importance. CT could tell about postreduction congruency of the previously dislocated joint and comminution of the posterior wall and incarcerated fragments. In this study, fractures were categorized based on radiological appearance in both plain radiography and the CT scan into either of the following (Fig. 1):

- (1) Fractures with single, noncomminuted, sizable fragment affecting either the posterior or the postero-superior wall of the acetabulum with or without hip dislocation.
- (2) Fractures with more than one, noncomminuted, separated or nonseparated fragments affecting the posterior or the postero-superior wall with or without hip dislocation.
- (3) Fractures with more than one separated fragment with a small comminuted part affecting either the posterior or the postero-superior wall with or without hip dislocation.

For postoperative assessment, iliac and obturator oblique views were also done in addition to the plain radiography anteroposterior view of the pelvis and both hip joints and a CT scan.

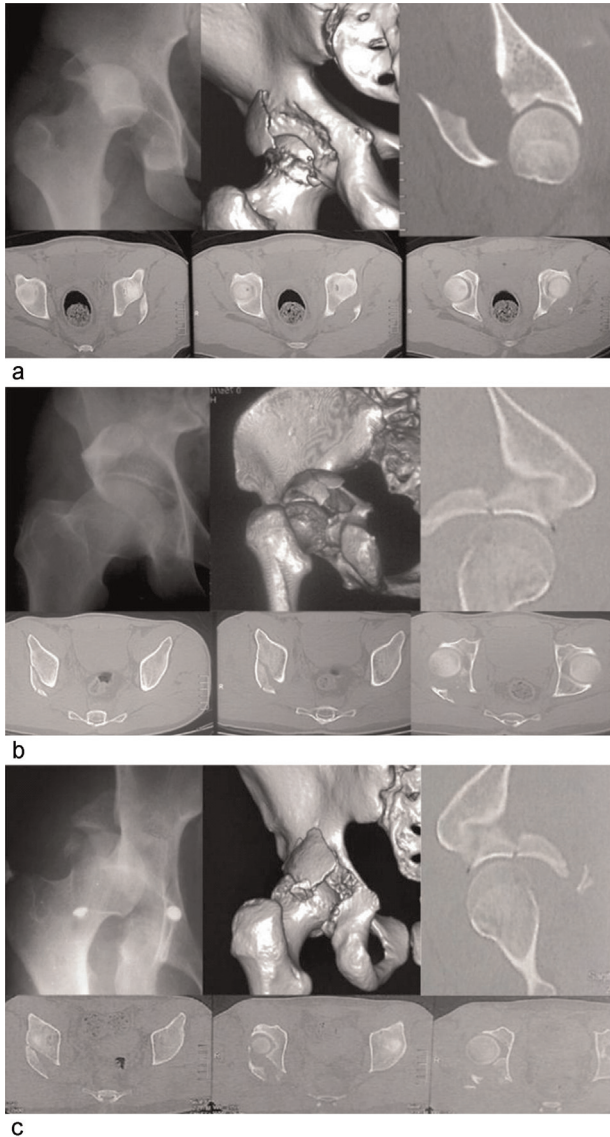
#### Operative technique

All cases were operated through a limited exposure using the Kocher-Langenbeck approach in the lateral position under spinal anesthesia. Image intensifier

**Table 1 Characteristics of the studied cases**

Cases	Age (year)	Sex	Fracture characteristics	Associated dislocation	Injury/surgery interval (day)	Number of fixation screws	Reduction quality according to the criteria by Matta <i>et al.</i> [10]	Union time (week)	Follow-up period (month)	Final radiological results according to criteria of Heeg <i>et al.</i> [4]	Final Postel score
1	23	Male	Single, postero-superior large fragment	Yes	5	3	Excellent	14	32	Excellent	18
2	28	Male	Two, postero-superior large fragments	No	4	3	Excellent	13	17	Excellent	17
3	32	Male	Single, postero-superior large fragment	Yes	3	2	Good	11	22	Excellent	17
4	35	Male	Single, posterior large fragment	Yes	3	3	Excellent	17	9	Excellent	18
5	20	Male	Two, postero-superior large fragments with a small comminuted piece	Yes	6	2	Excellent	13	12	Excellent	17
6	30	Male	Single, postero-superior large fragment	Yes	4	3	Excellent	17	22	Excellent	18
7	22	Male	Single, posterior large fragment	Yes	8	3	Good	16	18	Excellent	17
8	40	Male	Single, postero-superior large fragment	Yes (still dislocated)	21	2	Good	13	11	Poor	12
9	21	Male	Single, posterior large fragment	No	5	3	Excellent	15	23	Excellent	17
10	28	Male	Two, postero-superior large fragments with a small comminuted piece	Yes	7	3	Excellent	15	29	Excellent	17
11	32	Male	Two, postero-superior large fragments	Yes (still dislocated)	3	3	Good	16	19	Excellent	17
12	27	Male	Two, postero-superior large fragments	Yes	2	3	Excellent	14	26	Excellent	18
13	30	Male	Two, postero-superior large fragments	Yes	4	3	Excellent	13	11	Excellent	18
14	32	Male	Single, postero-superior large fragment	Yes	2	3	Excellent	14	15	Fair	14
15	42	Male	Single, posterior large fragment	Yes	7	3	Excellent	16	22	Excellent	18
16	22	Male	Single, posterior large fragment	Yes	4	2	Excellent	17	15	Excellent	17
Mean	29±6.5				5.5±4.5			14.6±1.8	18.9±6.7		

Figure 1



Different varieties of posterior or postero-superior wall fractures based on plain radiography and computed tomographic scan. (a) Posterior wall injuries with a single, noncomminuted sizable fragment. (b) Posterior wall injuries with multiple, non-separated, non-comminuted fragments. (c) Posterior wall injuries with multiple, separated fragments with a small comminuted part.

and complete set of pelvic and acetabular fixation instruments in addition to the basic sets were mandatory. Most of the studied cases (14/16 cases) were fracture dislocations with marked injury to the posterior stabilizing structures of the hip joint – mainly the posterior capsule and the lateral rotators except the quadratus femoris muscle – to the extent that the femoral head was directly under the splitted gluteus maximus muscle in cases with neglected, unreduced dislocation (Fig. 2a) or the reduced femoral head was completely visible, palpable, and exposed through the injured capsule and the short rotators of the hip joint (Fig. 2b).

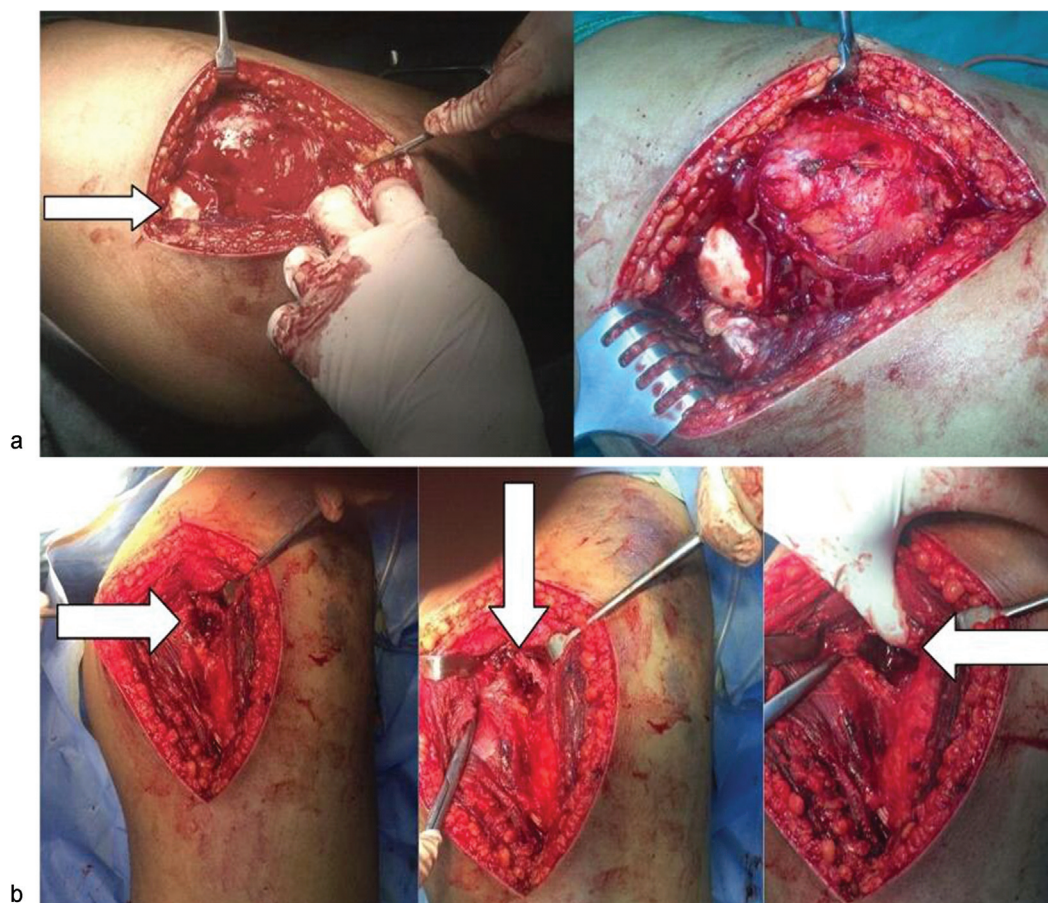
Copious irrigation of the empty socket was done in the still-dislocated joint to remove debris or comminuted incarcerated fragments before reducing the head back into the acetabulum, and the same was done while rotating the hip joint into internal and external rotation without dislocating the stable or previously reduced hips. Now, the displaced fragment could be easily approached for reduction and fixation through the soft tissue window in the upper part of the surgical wound without the need for any muscle cutting or massive dissection for exposing the entire length of the posterior column usually needed for conventional plating for posterior wall fractures. The displaced fragment with its remaining soft tissue attachments was everted – as much as possible – exposing its under surface and allowing better exposure of its cancellous bed with any debris or clotted hematomas finely curetted from both rough surfaces.

Through the soft tissue window, manipulation and directing of the displaced fragment was done from above downward to its bed using the spiked-ball pusher closing the fracture gap, and then the fragment was provisionally secured in place using Kirschner wires (Fig. 3a). Accuracy of reduction was assessed manually by palpating the coaptation of the displaced fragment to its bed with proper closure of the fracture line, and then confirmed radiologically using image intensifier in different views with different arcs of the C-arm (Fig. 3b).

After provisional fixation was achieved, the definitive fixation was done with at least two cancellous 4-mm fully threaded screws with washers inserted using the lag technique or by using partially threaded cancellous screws (Fig. 3c). An optional, fully threaded additional screw without over drilling the near cortex was used as a holding screw (Fig. 3d) when fixing a sizable wall fragment. Screws were inserted tangentially in relation to the posterior rim ensure that screws were not endangering the articular surface of the acetabulum or the femoral head. Stability of the fixation was assessed by moving the hip in all direction, and then meticulous repair of the remnants of the posterior capsule and rotators to the greater trochanter in the area of the piriformis fossa or to the posterior border of the gluteus medius muscle with nonabsorbable sutures was done. Finally, closure of the wound in layers over a suction drain was done after careful hemostasis.

Now, a stable fixation was achieved using this minimally invasive technique, with all the surgical steps done through the defect in the already injured posterior capsule and the upper lateral rotators without the need for cutting through – the usually intact – quadratus femoris (Fig. 3e), with a

Figure 2



Extensively injured soft tissues (posterior capsule and lateral rotators) in fracture dislocations. (a) The femoral head (marked by the white arrow) was directly seen just under the splitted gluteus maximus muscle in a 21-day neglected fracture dislocation hip with extensive injury to the posterior capsule and rotators except the quadratus femoris muscle. (b) The classic picture of soft tissue injury in cases with fracture dislocations after reduction of the hip joint with a large defect (marked by the white arrows) that could be used as a window for manipulation, reduction, and fixation of the displaced posterior wall fragment.

theoretical advantage of more preservation of the blood supply to the precious femoral head with less chances for development of avascular necrosis.

#### Postoperative protocol and follow-up

Neurological evaluation immediately after recovery from anesthesia was vital. For postoperative radiological evaluation, plain radiography and CT, which is more reliable for assessing reduction and detection of any articular incongruity, intra-articular hardware, or incarcerated fragments, were done in the first postoperative day. Suction drains were removed the day after surgery, and intravenous third-generation cephalosporins were given for 7 days. Patients were kept on skin traction – with thromboembolic prophylaxis – in slight abduction and external rotation to protect the fixation and relax the repaired capsule and lateral rotators for 2 weeks, and then removed. The patients started active and passive range of motion of the operated hip joint for another 2 weeks.

Patients started mobilization with absolute non-weight bearing in the fifth week for another 4 weeks and then partial weight bearing – as tolerated – for another 4 weeks, and then unprotected, full weight bearing was allowed from the 12th postoperative week. Clinical and radiological assessment was recorded at 1, 3, and 6 months and 1 year after surgery throughout the follow-up period.

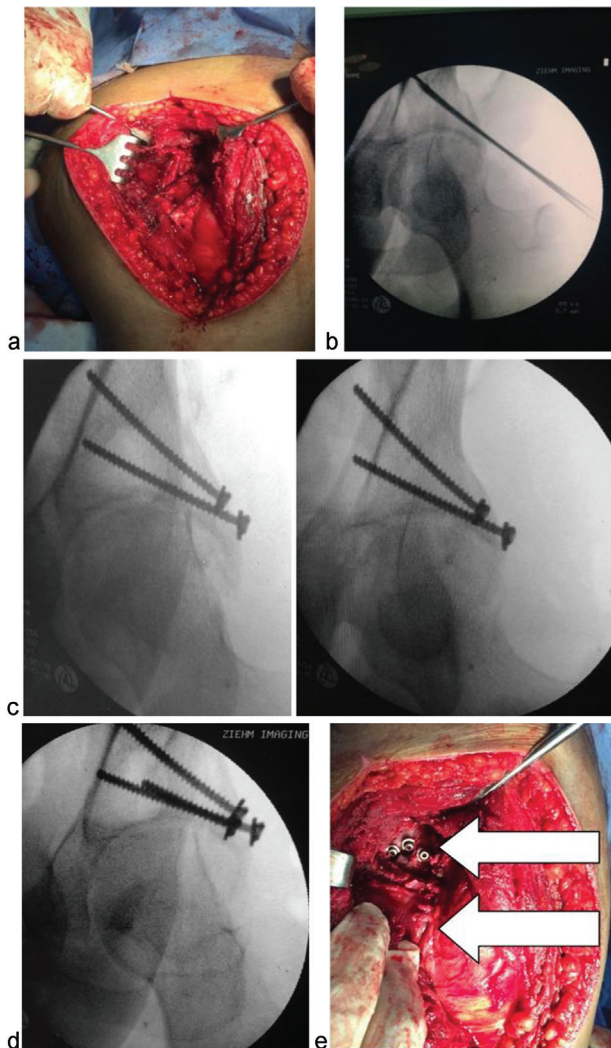
#### Statistical analysis

Statistical analysis was performed using SPSS, version 19.0 (SPSS Inc., Chicago, Illinois, USA). Statistical analysis was done using a two-tailed Student *t*-test, and *P*-value less than 0.05 was considered statistically significant.

#### Results

Immediate postoperative plain radiography (Fig. 4) was done to document the orientation and length of the screws and confirm the concentric, congruent

Figure 3



Surgical technique. (a) Provisional fixation by Kirschner wires was done through the soft tissue defect in the upper part of the wound without the need for cutting through the quadratus femoris muscle. (b) Reduction and orientation of provisional Kirschner wires were assessed using image intensifier. (c) The definitive fixation with 2 cancellous lag screws over washers with anatomical reduction of the fracture. (d) A third, fully threaded, cancellous holding screw was added for better fixation. (e) Stable fixation with 3 screws (marked by the upper white arrow) was completely done through a small window in the defective muscles with complete preservation of the quadratus femoris muscle (marked by the lower white arrow).

reduction of the hip joint. Serial radiography could detect any loss of fixation or secondary displacement, subluxation or redislocation of the hip, bending or actual failure of the screws or avascular necrosis (AVN) of the head or degenerative changes in the next visits throughout the follow-up period that extended for a mean duration of  $18.9 \pm 6.7$  months.

Compared with plain radiography, CT scan was more informative and reliable for assessing reduction. According to Matta *et al.* [10], a fracture gap or articular step was considered the same, a perfect or anatomical reduction was present when articular step or

Figure 4

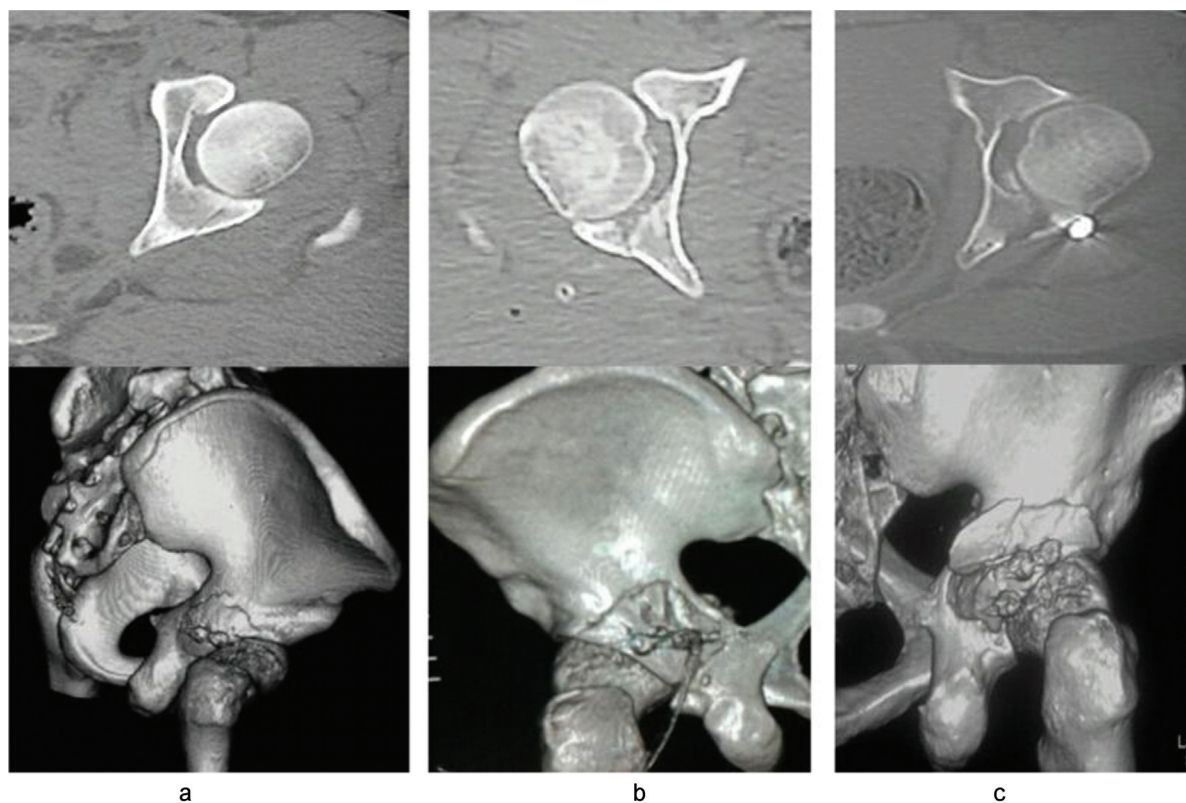


Immediate postoperative plain radiography of different cases with at least two screws for fixation.

fracture displacement was 1 mm or less, a good or satisfactory reduction was present when articular step or fracture gap was 2–3 mm, and poor or unsatisfactory reduction was present when articular step or fracture displacement was more than 3 mm. Other important points were added to these parameters including the concentric, congruent reduction of the head with absence of incarcerated fragments or hardware and intact inner and outer borders of the reduced posterior wall fragment denoting no loss of either cortico-cancellous (outer border) or osteochondral (inner border) fragments (Fig. 5).

According to the criteria of Matta *et al.* [10] for assessing the reduction, 13 cases – representing 81.25% of the studied cases – showed excellent results (Figs. 6a), three cases – representing 18.75% of the studied cases – showed good results (Fig. 6b), and no cases showed fair or poor results. Meanwhile, according to the added criteria for evaluation, one case was rated fair as there was a nonanatomical reduction with a lost osteochondral fragment with an incarcerated fragment and a lost cortico-cancellous part from the reduced posterior wall (Fig. 5c).

Figure 5



Computed tomography (CT) criteria for assessment of reduction. (a) Postoperative CT images corresponding to (Fig. 1a) anatomically reduced fracture with no gap or articular step, no incarcerated fragments, no bone loss from the outer (cortico-cancellous) surface or the inner (osteochondral) surface of the reduced and fixed posterior wall. (b) Postoperative CT images corresponding to (Fig. 1c) anatomically reduced fracture with a lost osteochondral fragment affecting the articular surface with a gap, no bone loss from outer (cortico-cancellous) surface of the reduced and fixed posterior wall. (c) Postoperative CT images corresponding to (Fig. 1b) nonanatomical reduction with a lost osteochondral fragment affecting the articular surface and a lost cortico-cancellous part of the reduced and fixed posterior wall with an incarcerated fragment.

During the next follow-up visits that extended for a mean duration of  $18.9 \pm 6.7$  months, plain radiography was used for evaluation (Fig. 7). The operated hip joint was compared with the healthy side in the last follow-up, and graded according to criteria of Heeg *et al.* [4] as follows: 14 cases – representing 87.5% of the studied cases – were excellent with a normally appearing hip joint compared with the healthy side; one case – representing 6.25% of the studied cases – was fair with joint narrowing less than 50% compared with the other healthy side with no osteophytes and viable head; and one case (representing 6.25% of the studied cases) was rated as poor with advanced degenerative changes, head subluxation, femoral head, and posterior wall avascular necrosis. Till the last follow-up, no cases developed loss of fixation or secondary displacement, heterotopic ossification, bending of the screws, or true implant failure in the form of hardware breakage.

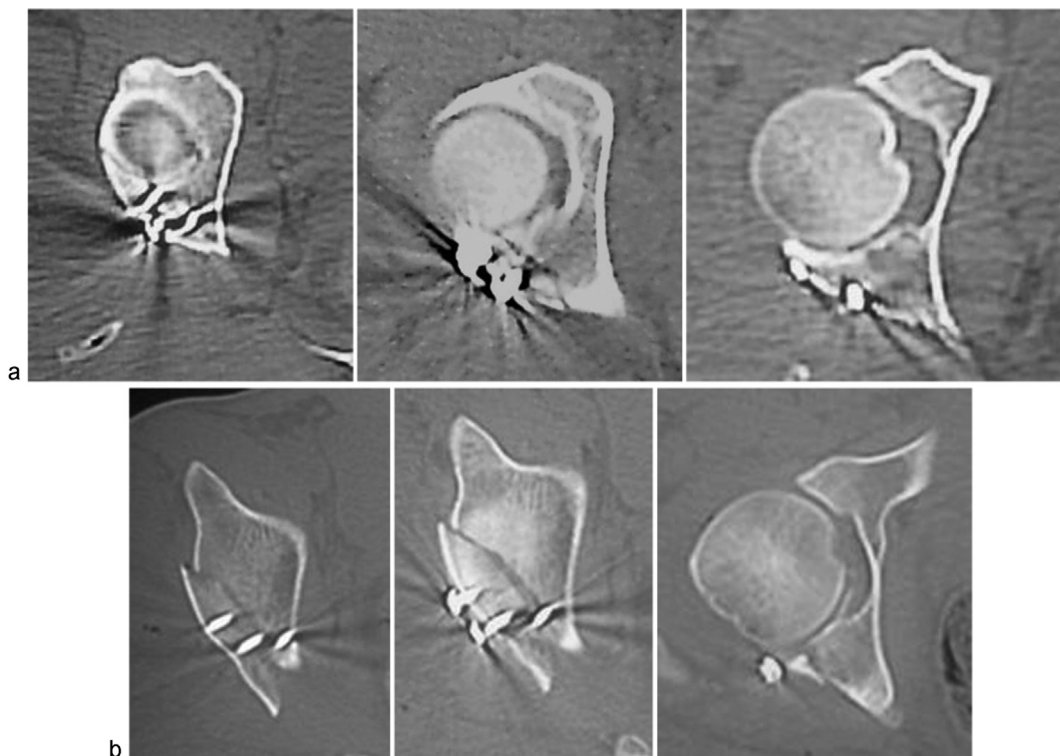
Absence of hip pain on standing and walking and disappearance of the fracture lines were sure indicators of complete healing. The mean healing time for the studied cases was  $14.6 \pm 1.8$  weeks.

The number of the screws did not affect the healing time, but the size and condition of the fractured fragment and the age of the patient were important factors affecting healing time.

One case developed deep wound infection – with infrequently discharging sinus – 3 months postoperatively. This case had a fracture dislocation and was operated 2 days after injury; there was marked injury to the posterior capsule and the short rotators, which made repair extremely difficult, creating a dead space under the gluteus maximus muscle, and a hematoma was formed in the third postoperative day that was evacuated surgically in the operating theater and then led to infection, which was treated by hardware removal and meticulous debridement once a dependable union was detected. Infection subsided completely 6 weeks later with complete clinical and laboratory quiescence. There was just narrowing of the hip joint with no osteophytes and a still viable femoral head till the last follow-up (Fig. 7d).

The worst scenario occurred in one case that was presented 21 days after injury with a neglected hip

Figure 6



Computed tomography assessment of reduction. (a) Excellent reduction with no more than 1-mm gap with nonarticular step. (b) Good reduction with less than 3-mm fracture displacement and gap.

dislocation with associated posterior wall fracture. MRI was done preoperatively to assess the viability of the head that revealed avascular necrosis of the femoral head. This case developed subluxation of the hip joint and resorption of the posterior wall fragment with the screws' heads directly eroding the proximally migrated avascular femoral head producing severe pain and restricted movements. Screws were removed and the end result was advanced arthritis with a deformed, eroded, nonviable, and sclerotic head (Fig. 7e). Apart from this case with documented preoperative AVN, no other cases developed AVN throughout the follow-up period that extended for a mean duration of  $18.9 \pm 6.7$  months.

Clinically, according to D'aubigne and Postel [9] score, six cases were rated excellent and eight cases were very good, so satisfactory results (excellent and good) were reported in 14 cases, representing 87.5% of the studied cases. One case was rated fair and one case was rated poor, so unsatisfactory results (fair and poor) were reported in two cases, representing 12.5% of the studied cases.

## Discussion

It is quite clear that many factors – other than the adequacy of reduction and mode of fixation – could

affect the clinical results in posterior wall acetabular fractures. Deep wound infection, avascular necrosis of either the femoral head or the acetabular fragment and the stability of the hip joint following repair of the soft tissues after open reduction and internal fixation were all of critical importance, and the final outcome depends on fracture healing in a near anatomical position and the presence of a stable, concentrically reduced, congruent hip joint.

Being a synovial ball and socket joint, stability of the uninjured hip depends on the integrity and congruency of the articulating surfaces and the protective stabilizing cuff formed by the capsule and overlying muscles. In the two cases with isolated posterior wall fractures, the posterior capsule was quite intact, and the displaced fragment still had a capsular attachment, meaning that these injuries were pure bony injuries. Therefore, reduction and bone-to-bone fixation could guarantee a proper repair of the posterior stabilizers of the hip joint. In the 14 cases of posterior wall fractures associated with dislocation, it was found intraoperatively that the dislocated head found its way either through the fracture site itself (in 9 cases) between the displaced fragment laterally and its bony bed medially or through a midsubstance injury of the myo-capsular cuff between the lateral edge of the displaced posterior wall fragment and the femoral



Figure 7



Follow-up plain radiography – different views – of some of the studied cases (a–c) excellent results (NB) proper length of screws in (a–b) and too long screws in (c). (d) Fair result in a case that was infected – with infrequently discharging sinus – 3 months postoperatively; sinogram was done and screws were removed with meticulous debridement once a dependable union was detected. Infection subsided completely after 6 weeks with clinical and laboratory quiescence. Although the head was healthy, viable till the last follow-up, there was narrowing of the hip joint indicating a fair result. (e) Poor result in a case with severe avascular necrosis of both the femoral head and the posterior wall fragment with subluxation of the hip joint with advanced arthritis.

attachment of the capsule and overlying muscles (in five cases), meaning that reduction and fixation of the bony fragment could not guarantee proper soft tissue repair, so soft tissue preservation and repair is mandatory.

Restoring postoperative stability to the injured hip joint depends on restoring the posterior bony support by anatomically reducing and stably fixing the posterior wall in addition to a proper repair of the injured posterior capsule and overlying short rotators of the hip. Repair was much easier and more reliable in cases operated after 7–14 days of injury than in cases operated early in the first 1–4 days after injury. This coincides with what was reported by Letournel and Judet [11] regarding the ideal time for surgery (between 12 and 16 days after injury).

Proper reduction and fixation of the fractured posterior wall with minimal dissection and proper soft tissue repair were the clues for the satisfactory clinical and radiological results in this study, which were comparable and could be superior to the results of Mitsionis *et al.* [12] and Im *et al.* [13]. Satisfactory results could also be explained by the relatively younger ages of the included cases as well as less complex patterns of fractures with minimal comminution.

Zhang *et al.* [14] reported that few biomechanical studies [15,16] have been done to identify optimum technique of fixation for posterior wall fractures and whether it is stable enough by using screws fixation alone for posterior wall fracture, or is it necessary to combine with a buttress plate?. Other studies have attempted to examine the contact area and load

distribution of intact, fractured, and repaired cadaveric posterior acetabular wall with different fixation methods [17–20].

In-vivo assessment of mechanical stability of any fixation construct could be ascertained by the ability of such fixation to keep the reduced fracture till secure healing with no secondary displacement or implant failure. In-vitro assessment – which is out of the scope of this study – depends on specialized biomechanical studies that could evaluate a selected method of fixation or compare two or more different methods of fixation by testing special models under specific conditions of loading.

This work highlighted a method of fixation for certain injuries of the acetabulum, so – logically – paramount importance was given to the mechanical stability of the fixation construct and its ability to keep the reduction and withstand stresses without secondary displacement or true implant failure – in the form of screw breakage or bending – till complete healing of these fractures occurs, as internal fixation is always viewed as a race between implant failure and fracture healing.

Posterior wall fractures were not the same in all cases. Fractures were obviously different regarding the site, size, the presence or absence of comminution, and the degree and direction of displacement. Fractures with displaced, large, noncomminuted fragment affecting the postero-superior border of the acetabulum were the commonest type between the studied cases; postero-superior fragments were characterized by a large surface area of cancellous bed allowing an easy, safe, and reliable fixation by two or more interfragmentary screws. Fixation using only screws could have been used when the fractured fragment was single, noncomminuted or mildly comminuted with a main fragment large enough to accommodate and hold at least two screws. This can go with what was reported by Zhang *et al.* [14] who reported that comminuted fractures affecting the posterior and/or the posterior-inferior aspects of the acetabulum parallel to the acetabular rim should be fixed using a reconstruction plate but noncomminuted posterior-superior fractures with a large cross-section can usually hold multiple screws [21]. More recent studies done by Marintshev *et al.* [22] and Jianyin *et al.* [23] reported that fixation of certain posterior wall acetabular fractures using only screws could significantly enhance biomechanical stability.

Fixation failure could be described as a loss of reduction or loss of fixation of a previously reduced fracture with secondary displacement or position change. It could be considered as an entity of implant failure, as this

fixation construct could not withstand stresses till union predominates the condition and protects the fixation. Actual or frank implant failure occurs with screws breakage or bending. In contrast to Stöckle *et al.* [6] who used 3.5-mm cortical screws in their cases, fixation in this study was done using 4-mm cancellous screws, and patients were strictly instructed to avoid full weight bearing for a minimum of 12 weeks.

Implant failure was not reported in any of the studied cases till the last follow-up. However, Stöckle *et al.* [6] reported two cases with screw breakages that occurred less than 3 months postoperatively, and they explained this by premature weight bearing and recommended at least 3 months of partial weight bearing for patients whose acetabular fractures are treated with screws alone [6]. Using 4-mm screws for fixation of a sizable, noncomminuted fragment in the postero-superior or the posterior wall of the acetabulum and delaying full weight bearing till the end of the third month effectively reduced the incidence of implant failure in this study and could be the key for a successful fixation of these injuries using only screws for fixation.

This study highlighted a limited exposure using the Kocher-Langenbeck approach with much more preservation of soft tissues. The use of this limited approach markedly decreased the operative time, the blood loss intraoperatively or postoperatively in the suction drain, with no need for either intraoperative or postoperative blood transfusion. Minimal dissection also ensures and guarantees proper soft tissue repair which is a critical factor in the stability of the hip especially if fracture dislocation was present. Carr *et al.* [24] have demonstrated a small-incision and gluteal-splitting approach for the treatment of selected fractures involving the posterior acetabulum. The approach essentially involves the proximal portion of the Kocher-Langenbeck incision, and it can be extended to a larger one if necessary.

Regarding the postoperative protocol for weight bearing, in the first 2 weeks, complete bed rest with skin traction was advised. In the next 2 weeks, traction was removed and active and passive range of motion (ROM) was started. From the beginning of the second postoperative month, patients were mobilized with absolute non-weight bearing for another 4 weeks. Partial weight bearing – as tolerated – started from the beginning of the third postoperative month and continued for another 4 weeks. Nonprotected, full weight bearing was allowed after the end of third postoperative month. Some authors recommended full weight bearing after 12 weeks postoperatively

whereas others recommended up to 14 weeks of bed rest following only screws fixation of posterior wall fractures of the acetabulum [21].

This study was limited by the small number of cases with a relatively short-term follow-up period. It was also limited by the absence of control groups addressing other methods of fixation and the lack of any specialized biomechanical work comparing the selected method of fixation with other different methods; however, these limitations do not undermine the results achieved by this study.

## Conclusion

- (1) Posterior wall fractures were not the same in all cases, and fractures were obviously different regarding the site, size, the presence or absence of comminution, and the degree and direction of displacement.
- (2) Fractures with sizable, noncomminuted fragments affecting the posterior or the postero-superior border of the acetabulum which have a large surface area of cancellous bed that can accommodate and hold at least two interfragmentary screws could be easily and reliably fixed using only screws for fixation without the need for posterior plating, with less intraoperative and postoperative complications.
- (3) Fixation by only screws could be a simple and effective method for treating certain patterns of posterior wall fractures of the acetabulum, with minimal soft tissue dissection ensuring more protection to the vascular supply of the femoral head, and improved functional outcome.

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## Conflicts of interest

There are no conflicts of interest.

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