Necessity of fixing both columns in the operative treatment of transverse combined with posterior wall acetabular fractures

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Objective

We evaluated clinical and radiographic outcomes in patients with displaced combined acetabular fractures, with or without lag-screw fixation, managed over a period of 3 years using a posterolateral single approach, direct posterior wall and posterior column reduction and plating, and indirect reduction of the anterior column controlled using fluoroscopic imaging. The aim of this study was to identify whether the Matta radiographic roof-arc angles obtained immediately after fracture reduction and fixation change in the postoperative period when comparing posterior plating alone with posterior plate and anterior column lag-screw fixation.

Patients and methods

A total of 35 skeletally mature patients (31 men and four women, with a mean age of 39.9 years, range 23.3–.7 years) with combined transverse–posterior wall acetabular fractures surgically treated using a posterolateral single approach were enrolled in this study. The first part of the acetabular fracture management consisted of anatomical reduction and fixation of the transverse posterior component, followed by anatomical reduction and fixation of the posterior wall component. The transverse anterior component reduction was controlled using fluoroscopic imaging (anteroposterior, iliac-oblique, and obturator-oblique views) and digital palpation through the greater sciatic notch. Of the 35 patients, 15 underwent an additional lag-screw fixation from the posterior to the anterior columns using an extra-long small-fragment cortical screw. Anteroposterior and Judet oblique radiographic views were imaged at the end of the procedure, and roof-arc angles were measured. Clinical results were assigned according to the grading system of Merle D'Aubigné and Postel as modified by Matta and colleagues. Radiographic roof-arc angles were measured and compared between the two groups of patients at the time of the surgical procedure and at 3 months postoperatively.

Results

During the final follow-up examination 18–60 months postoperatively (mean, 36.8 months), the clinical results were considered satisfactory in 31 (88.6%), excellent in nine (25.7%), and good in 22 (62.9%) patients. There was no difference between patients with ($n=15$) and without ($n=20$) fixation of the transverse anterior component of the acetabular fracture. Radiographic roof-arc angles measured during discharge, at 3 months postoperatively, and at the last follow-up consultation did not change significantly.

Conclusion

Associated transverse–posterior wall acetabular fractures can be managed using a single posterior approach. If there is adequate indirect reduction of the anterior column, as checked by digital palpation and fluoroscopy, it is not necessary to fix the anterior column component of the transverse acetabular fracture.

Keywords:

acetabulum, fracture, posterior wall, roof-arc angle, transverse

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Introduction

The combined transverse–posterior wall type is one of the most common patterns of acetabular fractures, accounting for 24–32% of those lesions [1–3]. Generally, the main fracture line of the transverse component crosses the acetabular dome and displaces the weight-bearing area, ultimately altering the mechanical forces of the hip [2,3].

Conventional treatment techniques related to the combined double or extensile approach and posterior and anterior column plating are considered extremely aggressive. Many authors have demonstrated significant intraoperative and postoperative complications, including massive hemorrhage, deep wound infection, and functional heterotopic ossification [4,5].

Recently, some authors have proposed the use of a single posterior approach for the management of combined transverse–posterior wall acetabular fractures [1,6–8].

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Normally the approach selected is determined by the amount of column displacement; however, the associated presence of the posterior wall component makes the use of a posterior approach mandatory.

Clinical and biomechanical investigations have shown the combination of the transverse component with the posterior column plate using an anterior column lag-screw to be the most stable construction [9,10], but prolonged operative time, higher risk of articular penetration, and loss of or inadequate reduction remain limiting factors [11].

Matta *et al.* [12] have demonstrated that measuring the radiographic roof-arc angle is a useful technique for evaluating transverse acetabular fracture reduction. Intraoperative roof-arc angles of 45° or higher represent a satisfactory reconstruction of the weight-bearing portion of the acetabulum cavity [12]. However, when there is an associated posterior wall fracture, the radiographic roof-arc measurement cannot be used during the preoperative period. Nevertheless, during the surgical procedure the wall fracture is primarily reduced and fixed, and the concept of roof-arc angle can be applied again for the transverse component.

Atchison *et al.* [13] have found no significant difference when comparing posterior plating alone with posterior plate and anterior column screw fixation for transverse acetabular fractures at both 0 and 90° of hip flexion.

In the present study, we evaluated clinical and radiographic outcomes in patients with displaced combined transverse–posterior wall acetabular fractures, with or without lag-screw fixation, managed at our Institution over a period of 3 years using a posterolateral single approach, direct posterior wall and posterior column reduction and plating, and indirect reduction of the anterior column controlled by fluoroscopic imaging. The aim of this study was to identify whether the Matta radiographic roof-arc angles obtained immediately after wall reduction and fixation change in the postoperative period when comparing posterior plating alone with posterior plate and anterior column lag-screw fixation.

Patients and methods

Over a 3-year period from January 2006 to March 2009, a series of 35 skeletally mature patients surgically treated at the Royal Commission Hospital, KSA, using a posterolateral single approach were enrolled in this study.

There were 31 male and four female patients with a mean age of 39.9 years (range 23.3–56.7 years). No patient had trauma to other internal organs. Nineteen patients had 21 associated orthopedic injuries, including posterior dislocation of the hip ($n = 8$), ipsilateral femoral shaft fracture ($n = 6$), ipsilateral femoral and tibial shaft fractures ($n = 2$), and contralateral pelvic fractures ($n = 3$). Three patients had traumatic sciatic nerve dysfunction. Fracture dislocations of the femoral head were promptly reduced after hospital admission using the closed technique (Allis maneuver). The two patients with floating knee injuries were managed primarily by transarticular external fixation.

Patients were operated on during the first 2 weeks after admission (mean, 10 days; range 5–15 days) using the posterolateral Kocher–Langenbeck approach. All orthopedic injuries were treated during the same surgical procedure. For treatment of the acetabular lesions, patients were positioned in a fixed lateral position. Femoral shaft fractures were managed by antegrade nailing using the same approach as that used during the acetabular fixation procedure. For treatment of the pelvic and tibial lesions, patients were positioned supine. Pelvic fractures were fixed either using plates and screws or percutaneous sacroiliac screws alone. Tibial shaft fractures were managed using the interlocking nailing technique. Associated orthopedic lesions and respective treatments are listed in Table 1.

The first part of the acetabular fracture management consisted of anatomical reduction and temporary fixation of the transverse posterior component, followed by anatomical reduction of the wall component and definitive fixation using plates and screws. Transverse anterior component reduction was controlled using fluoroscopic imaging (anteroposterior, iliac-oblique, and obturator-oblique views) and manual palpation through the greater sciatic notch.

Fifteen patients underwent an additional lag-screw fixation from the posterior to the anterior column using an extra-long small-fragment cortical screw. There was no significant difference between the groups with respect to age, sex, fracture side and complexity, and number of associated lesions. None of the patients required a trochanteric osteotomy.

Anteroposterior and Judet oblique radiographic views were imaged at the end of the procedure, and roof-arc angles were measured. Postoperatively, patients were instructed to use crutches; full weight-bearing was permitted after all the fractures had healed (mean 12.8 weeks, range 12.0–16.3 weeks).

After discharge from the hospital, patients were followed-up at the outpatient clinic on days 21, 45, 90, and 180 and 1 year after the surgery. Thereafter, patients were examined once a year. Standard radiographs were taken at all outpatient clinic consultations. Clinical results were assigned according to the grading system of Merle

Table 1 Associated orthopedic lesions and respective treatments

Orthopedic lesion	Patients ($n = 19$)	Treatment
Posterior dislocation of the hip	8	Closed reduction
Femoral shaft fractures	8	Antegrade reamed nailing
Tibia shaft fractures	2	Reamed nailing
Pelvic fractures	3	Plate and screws
Horizontal transiliac fracture	1	Percutaneous screws
Sacroiliac dislocation	2	Percutaneous screws

D'Aubigné and Postel as modified by Matta and colleagues (Table 2). Radiographic roof-arc angles were checked and compared between the two groups of patients at the time of the surgical procedure and at 3 months postoperatively.

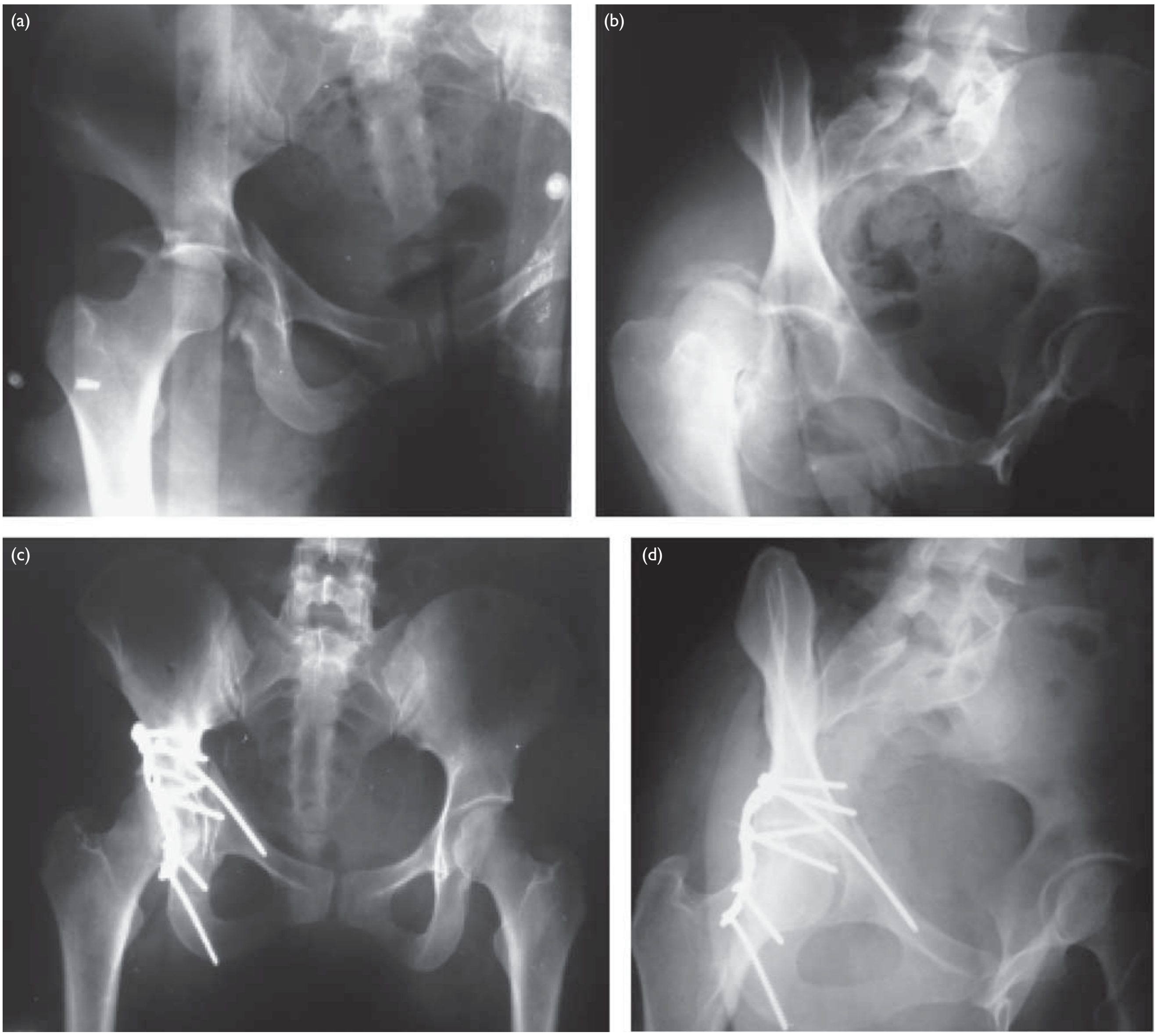
Results

In the current series, at final follow-up examination 18–60 months postoperatively (mean, 36.8 months), the clinical results were considered satisfactory in 31 (88.6%), excellent in nine (25.7%), and good in 22 (62.9%)

Table 2 Grading system of Merle D'Aubigné and Postel modified [12]

Pain	Points	Ambulation	Points	Range of motion (%)	Points	Clinical grade (final score)
No pain	6	Normal	6	100	6	Excellent (18)
Slight or intermittent	5	No cane but slight limp	5	80	5	Good (15–17)
Mild after ambulation but disappears with rest	4	Long distances with cane or crutch	4	–	–	Fair (13–14)
Moderately severe, permits ambulation	3	Limited even with support	3	60	3	Poor (≤12)
Severe, with ambulation	2	Very limited	2	–	–	
Severe, prevents ambulation	1	Bedridden	1	≤40	1	

Figure 1

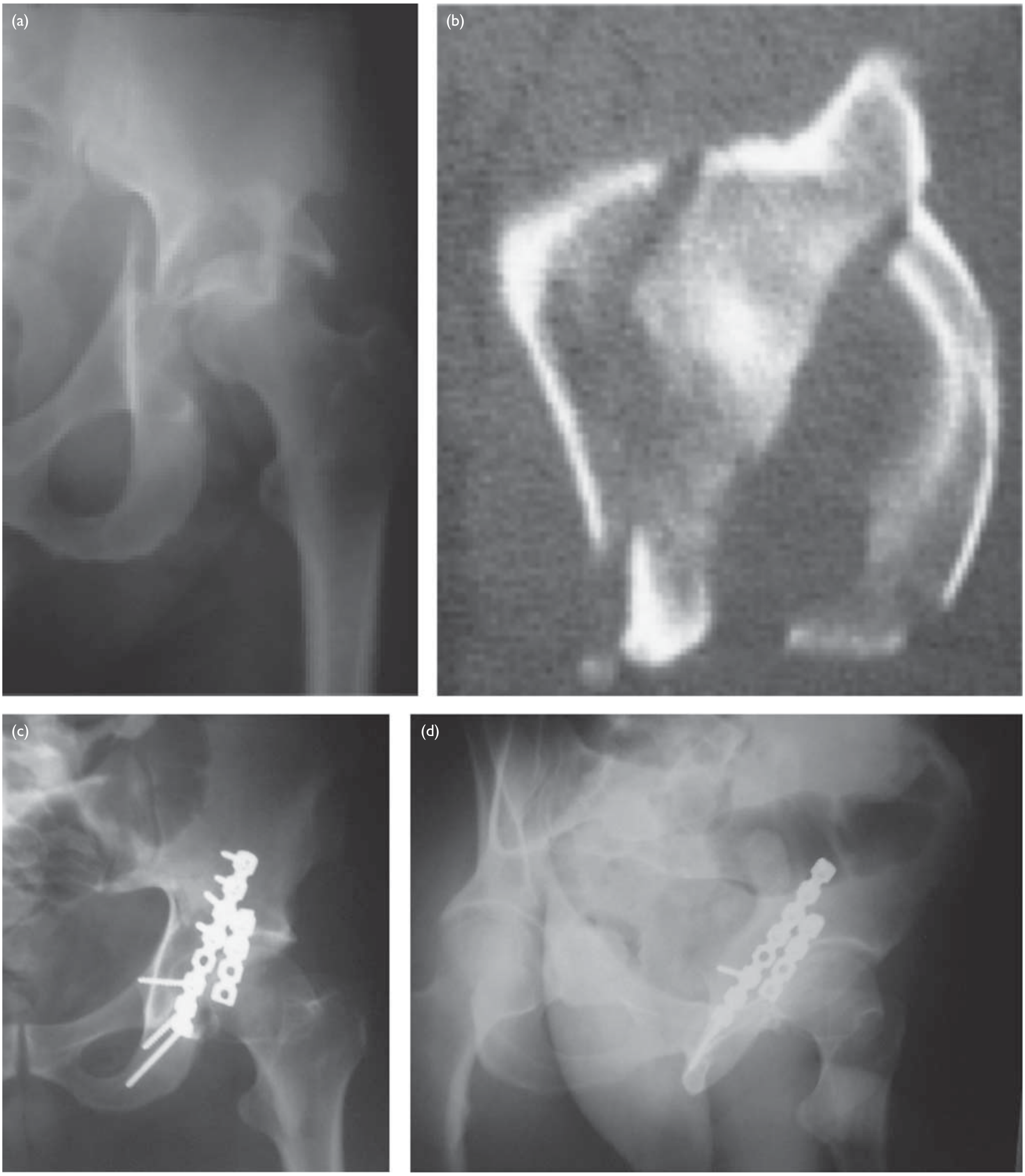


(a–d) Preoperative and postoperative radiographs of a 31-year-old patient with fixation of the anterior component of the transverse fracture.

patients. There was no significant difference between patients with (14 satisfactory results) and without (17 satisfactory results) fixation of the anterior transverse component of the acetabular fracture. Of the 14 satisfactory results observed in patients with anterior column fixation, four were excellent and 10 were good. Of the 17 satisfactory results observed in patients who had not undergone anterior column fixation, four were excellent and 13 were good.

Of the unsatisfactory clinical results ($n = 4$), three (8.6%) were observed in patients without fixation of the anterior

Figure 2



(a–d) Preoperative and postoperative radiographs of a 57-year-old patient without fixation of the anterior component of the transverse fracture. Observe the anatomic reduction.

column of the acetabulum. One (2.8%) patient had avascular necrosis of the femoral head. One (2.8%) patient had a loss of articular reduction 45 days after discharge.

The patient who had a loss of articular reduction was a morbidly obese patient and refused a second operation at our hospital. She underwent joint replacement at another hospital.

Post-traumatic osteoarthritis of the hip was seen in another patient, and he underwent total hip replacement 24 months after the fracture fixation procedure.

The last unsatisfactory outcome was observed in a patient who had undergone lag-screw fixation of the anterior column of the acetabulum. He developed osteonecrosis of the femoral head 12 months after the trauma and underwent total hip replacement during this time.

Partial sciatic nerve palsy was seen in three patients at the time of hospital admission, but they recovered completely after a mean period of 12 months.

Two (18.2%) patients with associated femoral shaft fractures developed complications during the postoperative period.

One of them developed a persistent drainage through the stab incisions used to distally lock the intramedullary nail.

Screws were removed just after the femoral fracture healed, and the drainage resolved.

The other patient developed a hypertrophic nonunion and was managed by exchange nailing. The fracture finally healed 20 weeks after the second operation.

In the two patients treated by tibial nailing, consolidation of the fracture occurred without any disturbance during healing. Finally, all patients with an associated pelvic lesion showed satisfactory results during the last outpatient clinic consultation. Figures 1–3 illustrate cases from the series, showing immediate postoperative and last follow-up radiographs. Except for the patient who had loss of articular reduction, all patients (34) showed acetabular fracture healing at 12 weeks.

Postoperative reduction checked before patient discharge showed a radiographic Matta angle greater than 45° in all cases. Radiographic roof-arc angles measured at 3 months postoperatively and at the last follow-up consultation did not change significantly.

There was no significant difference between patients treated with and those treated without fixation of the anterior component of the transverse acetabular fracture in terms of medial displacement of the femoral head (because of inadequate quadrilateral plate buttressing).

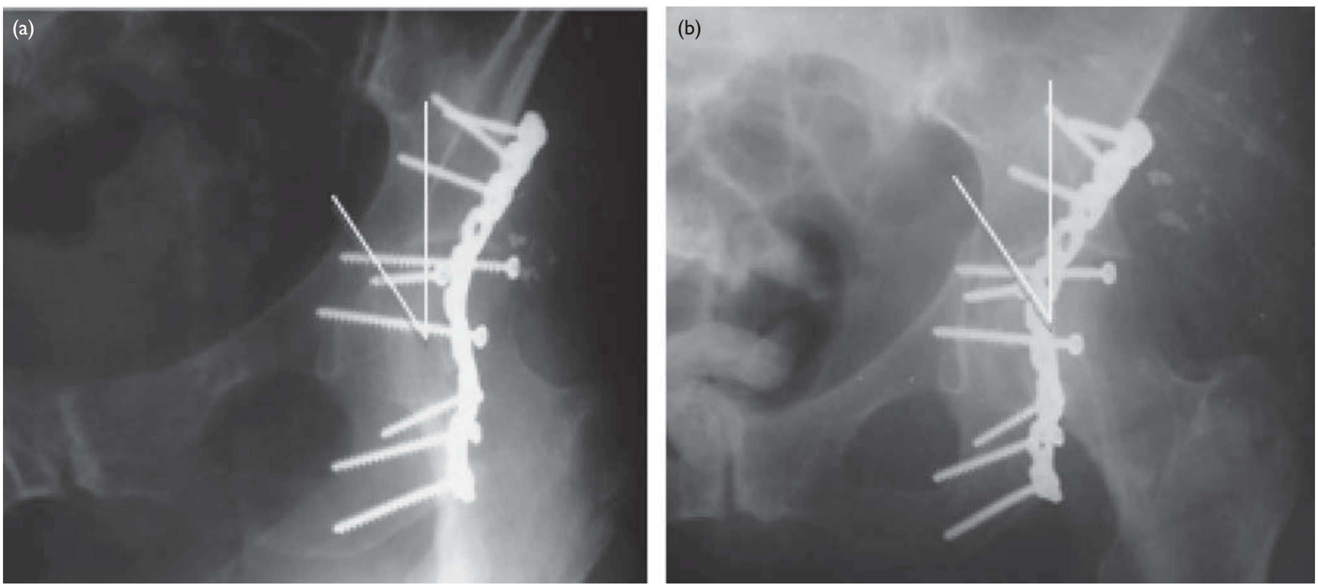
Discussion

The combined transverse–posterior wall type is one of the most common patterns of acetabular fractures [2,3]. Abnormal loads applied to the hip joint ultimately lead to cartilage degeneration and early post-traumatic arthritis. For this reason, treatment methods comprise anatomical restoration of joint congruity, stable fixation of the fracture components, and early hip motion.

Until recently, transverse–posterior wall acetabular fractures were treated by direct reduction through anterior and posterior approaches and by internal fixation using plates and screws. There was extensive intraoperative bleeding and a higher risk of neurovascular damage.

According to many authors, currently, transverse–posterior wall acetabular fractures are preferably treated using a single posterior approach. Reduction and fixation of the displaced posterior wall and column components

Figure 3



(a, b) Postoperative and follow-up radiographs of a 66-year-old patient with fixation of the anterior component of the transverse acetabular fracture; roof-arc angle measurements did not change.

are carried out through direct visualization, and the anterior component is stabilized using one lag-screw passed from the posterior to the anterior column of the acetabulum. Although this construct reduces extensile dissection-related complications and provides adequate strength and stiffness, some potential problems are still pointed out, such as a higher risk of implant joint penetration, inadequate or loss of fracture reduction, and consequent high risk of arthritis [7,11,14].

Atchison *et al.* [13] observed no significant difference when comparing posterior plating alone with posterior plate and anterior column screw fixation at both 0 and 90° of hip flexion. In another study, Chang *et al.* [15] demonstrated a significantly greater yield and maximum strength of fixation on using a posterior column plate and screw construct when compared with both the two lag-screws and screw and wire techniques. On using roof-arc measurements as described by Matta *et al.* [12], we found no significant difference between patients with and without anterior column fixation. Operative time, radiation exposure, and bleeding tend to be reduced if the surgeon does not fix the anterior column component of the fracture. Moreover, iatrogenic neurovascular trauma could also be prevented by avoiding the anterior quadrants of the acetabulum [11].

Finally, transverse acetabular fractures are characterized by a unique distal bone block, with no separation into ischial and pubic fragments (as occurs in the 'T'-type pattern), and a perfect reduction of the posterior column implies a perfect reduction of the anterior column, without rotation [2,3]. It is necessary to have adequate intraoperative fluoroscopic images to verify correct alignment and continuity of the ilioischial line (using the obturator-oblique view of Judet). Another important and definitive step for the success of the procedure is the palpation of the anterior column through the greater sciatic notch. In case of indirect reduction failure, if there is uncertainty about a perfect reduction of the anterior column, trochanteric osteotomy may help in reducing the anterior column component of the fracture.

In terms of mechanical stability of the construction, Chang *et al*. [15] and Shazar *et al*. [16] have shown sufficient stability with a posterior column plate with two screws on each side of the fracture.

On the basis of our observations, it is reasonable to suggest that associated transverse–posterior wall acetabular fractures can be managed using a single posterior approach. Direct reduction and fixation of the posterior wall and column components is an adequate option in these injuries. It is not necessary to fix the anterior column component of the transverse fracture.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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