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Original Article

Surgical treatment of posterior fracture-dislocation of the acetabulum: Five-year follow-up

Chi-Sheng Lee*, Chien-Lung Chen, Pu-Wiu Han, Ping-Chung Shiuan, Chiu-Meng Wang, Wai-Hee Lo

Department of Orthopedic Surgery, Lo Tung Pohai Hospital, Lotung, Yilan, Taiwan

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ABSTRACT

Background/Purpose: Acetabular fractures are a relatively uncommon fracture type. Among patients with acetabular fractures, posterior wall fractures are the most common. Open reduction and internal fixation is the treatment of choice for this type of injury. Anatomical reduction with rigid fixation as early as possible is the immediate goal of surgical treatment. This study retrospectively evaluated the clinical outcomes and radiographic findings of our clinical practices.

Materials and methods: This study analyzed the short-term clinical results of 16 cases of acetabular posterior fracture-dislocations with 2 to 6 years of postoperative follow-up. The first study group included 13 patients who underwent open reduction and internal fixation with plates and screws. The second study group included 3 patients who underwent open reduction and internal fixation with screws only.

Results: The second group who underwent fixation with small AO screws alone failed to provide enough rigidity and led to premature failure in three cases. Otherwise, there was only one case of implant failure in fixation with plates and screws, because of nonunion of the fracture site 8 months after surgery.

Conclusions: We recommend using buttress plates with screws for the fixation of the fractures in this relatively uncommon injury, especially in younger patients. Total hip arthroplasty, using femoral head autografting to augment acetabular deficiency, is a reliable salvage procedure for failed open reduction and internal fixation of acetabular posterior fracture-dislocations.

1. Introduction

Posterior wall fractures, with or without dislocations, are the most common type of acetabular fractures, accounting for a quarter to a third of all cases.[1,2] Posterior wall fractures of the acetabulum have been classified as an elementary fracture by Letournel.[13] Studies have shown that despite the relative simplicity of these fractures, they have a very high incidence of unsatisfactory results, in approximately 30% of cases.[1,3,4] Possible complications include osteonecrosis of the femoral head, post-traumatic osteoarthrosis, resorption of wall fragments, neurological injury, and loss of fixation.[2,4–6] Performing open reduction on the fractures of bone and cartilage and restoring stability by means of internal fixation offer the best prognosis. Risk factor variables associated with poor results include: a delay in dislocation reduction, age $\geq$ 55 years, intra-articular comminution, osteonecrosis, and substandard reduction quality.[2,4–7]

Fixation failure of the fracture site or inadequate reduction of the intra-articular fragments can cause serious complications and lead to devastating degenerative changes. In younger, more active patients who experience loss of fixation of their acetabular fracture, the best possible outcome that can be obtained is reoperation and arthrodesis of the hip.[2,4,6,8]

Secure fixation of a posterior wall fracture is crucial. In this retrospective study, we evaluated and analyzed the risk factors of early failure of fixation involving acetabular posterior wall fracture-dislocations treated by open reduction and internal fixation (ORIF).

2. Materials and methods

From October 2000 to October 2004, 16 patients with acute posterior wall fracture-dislocation of the acetabulum received surgical treatment with ORIF from surgeons on duty in our hospital. There were 14 male and two female patients with a mean age of

* Corresponding author. Department of Orthopedic Surgery, Lo Tung Pohai Hospital, 83 Nan Chang Street, Lotung, Yilan 265, Taiwan, ROC. Tel.: +886 3 9543131x1762; fax: +886 3 9543131x1514.
E-mail address: v4638@yahoo.com.tw (C.-S. Lee).

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54.9 years (range: 16–77 years). Fourteen of the patients were injured in motorcycle accidents. One patient was involved in a motor vehicle–pedestrian accident, and the remaining one was a victim of a crushing accident. Seven of the patients sustained multiple injuries, including extremity and other organ injuries. One patient presented with a concomitant injury to the ipsilateral sciatic nerve.

All patients were evaluated preoperatively using plain radiographs with two standard views: an anteroposterior radiograph of the pelvis and a lateral radiograph of the involved hip. Computed tomography scans were not performed on all patients.

The indication for surgery was hip instability, which was immediately identified after closed reduction of hip dislocation. The hip was assessed by a post-reduction test with the hip flexed to 90°.[9] Using this dynamic fluoroscopic stress test under general anesthesia, fracture instabilities were identified and the necessity of operative intervention was determined. Surgical treatment was performed as soon as the patients' general medical conditions allowed them to undergo ORIF. There were five patients who had delays (range: 12 hours to 5 days; average: 23 hours) from the time of injury to surgical intervention due to unstable medical conditions. These five underwent closed reduction of the dislocated hip within 6 hours after arriving at our hospital.

The Kocher–Langenbeck approach was used in all patients. Transtrochanteric osteotomy[10] was used for six hips. Somatosensory evoked potentials were not available in our hospital. During surgery, we first identified the sciatic nerve, which was then protected with surgical gauzes between the nerve and the retractors. The operated extremity was always kept in the position where the hip was extended and the knee was flexed. In our patients, there was only one postoperative case of iatrogenic sciatic nerve palsy and that patient completely recovered 1 year after surgery.

The operative findings revealed comminuted fragments (more than two pieces) in all patients. In our series, there were no gross injuries to the cartilage or bone of the femoral head. There was only one case of acetabular articular impact injury.

Prophylactic antibiotic treatment with cefazolin (1 g every 6 hours) was used perioperatively. Closed suction surgical drains were routinely used for 2–3 days. Antibiotics were continued postoperatively until drains were removed.

Postoperative immobilization with traction was routinely used for all patients. Skin traction or tibial skeletal traction was used on all patients for 2–3 weeks. The mean traction time was 2.5 weeks (range: 1–4 weeks). Patients were ordered to perform no weight-bearing activities for 2 weeks after external traction was stopped. Walking with partial weight-bearing (about 12 kg) on the ipsilateral extremity with use of crutches or a walker usually commenced during the second month after surgery. Full weight-bearing was individualized and was allowed 8 weeks after the operation.

There were five patients with delays from initial injury to ORIF because of their unstable medical conditions, but they all underwent closed reduction of the dislocated hip within 6 hours after they arrived at our hospital. After receiving closed reduction of the hip with dynamic fluoroscopic stress examination, they were sent to intensive care units to wait for ORIF surgery. The mean interval between their injury and surgery was 0.94 days (range: 12 hours to 5 days). No prophylaxis against heterotopic ossification and deep vein thrombosis was used in our study.

Results of reduction and fixation were determined through postoperative radiographs. Before hospital discharge, three standard radiographs of the pelvis (including one anteroposterior and two 45° oblique views) were made for evaluation. Fracture reduction was evaluated by measuring residual postoperative displacements. The maximum displacement seen at the normal radiographic lines of the acetabulum was recorded in millimeters and the highest of the three values was used to grade the reduction: anatomic (0–1 mm displacement); imperfect (1–2 mm displacement); or poor (>2 mm). After discharge from the hospital, routine evaluations were scheduled at 2 weeks, 6 weeks, 3 months, 6 months, 1 year and then annually thereafter.

Table 1
Clinical grading system, modified by Matta 1996.

Pain
6 = none
5 = slight or intermittent
4 = after walking but resolves
3 = moderately severe but patient is able to walk
2 = severe, prevents walking
Walking
6 = normal
5 = no cane but slight limp
4 = long distance with cane or crutch
3 = limited even with support
2 = very limited
1 = unable to walk
Range of motion[a]
6 = 95–100%
5 = 80–94%
4 = 70–79%
3 = 60–69%
2 = 50–59%
1 = <50%

The clinical score was determined by adding the points from pain, walking (gait), and range of motion. A clinical grade of excellent was a score of 18 points; good, a score of 15–17 points; fair, 13–14 points; and poor, <13 points.
[a] Range of motion is expressed as a percentage of the value for a normal hip.

At the final follow-up examination, functional outcomes were evaluated according to the clinical grading system developed by Merle d'Aubigné and Postel as modified by Matta (Table 1).[4,11] In this grading scale, pain, gait and range of motion of the hip are each assigned a maximum score of six points per category. The three individual scores are then summed to derive the final clinical score. According to the final scores, the clinical results were classified as excellent (18 points), good (15–17 points), fair (13–14 points), or poor (<13 points).

The radiographs were then graded according to the criteria described by Matta (Table 2).[4,11] A grade of excellent was given to a normal-appearing hip joint; good was defined as mild changes with minimal sclerosis and joint narrowing (≤1 mm); fair denoted intermediate changes with moderate sclerosis and joint narrowing (<50%); and poor indicated advanced changes.

The 16 patients were grouped according to the fixation implant system used on the fractures: Group I method of fixation utilized small AO plates and screws; and Group II used small AO screws only. The 13 patients (11 male and 2 female) in group I had a mean age of 57 years (range: 21–77 years) at primary surgery and a mean follow-up duration of 4 years and 3 months (range: 2 years and 3 months to 5 years and 6 months). The three male patients in group II had a mean age of 46 years (range: 16–62 years) at primary surgery and a mean follow-up duration of 3 years and 9 months (range: 2 years and 1 month to 6 years and 7 months).

Table 2
Radiographic grading system, modified by Matta 1996.

Grade	Description
Excellent	Normal-appearing hip joint
Good	Mild changes, small osteophytes, moderate joint narrowing (≤1 mm), and minimal sclerosis
Fair	Intermediate changes, moderate osteophytes, moderate joint narrowing (<50%), and moderate sclerosis
Poor	Advanced changes, large osteophytes, severe joint narrowing (>50%), collapse or wear of the femoral head, and acetabular wear

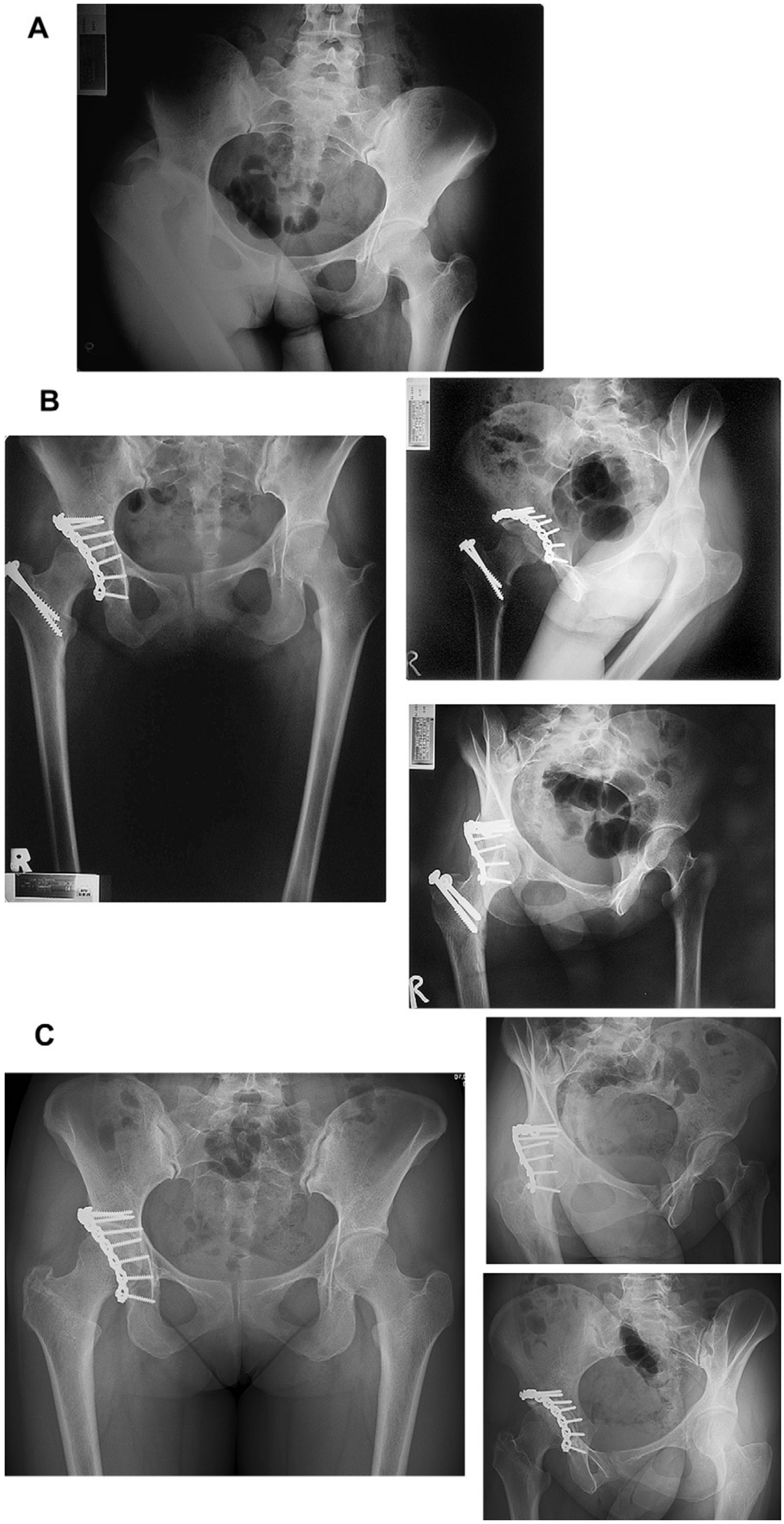

Fig. 1. (A) Radiographs of a 25-year-old woman who had posterior wall fracture-dislocation of the right acetabulum after she was involved in a motor-vehicle accident. (B) Postoperative anteroposterior and 45° oblique radiographs. One attempt at closed reduction of the hip dislocation with the patient under general anesthesia was made. Instability of the hip joint was verified prior to ORIF. ORIF was performed with the Kocher–Langenbeck approach with transtrochanteric osteotomy. This approach was chosen because of a broader exposure necessary for the fracture site to reduce and precisely fix the fracture. (C) Anteroposterior and 45° oblique radiographs taken 4.5 years after injury. Screws for the fixation of the osteotomy were removed about 6 months after surgery because of screw impingement on the right hip when lying in the right decubitus position. The result was excellent both clinically and radiographically at final follow-up. ORIF = open reduction and internal fixation.

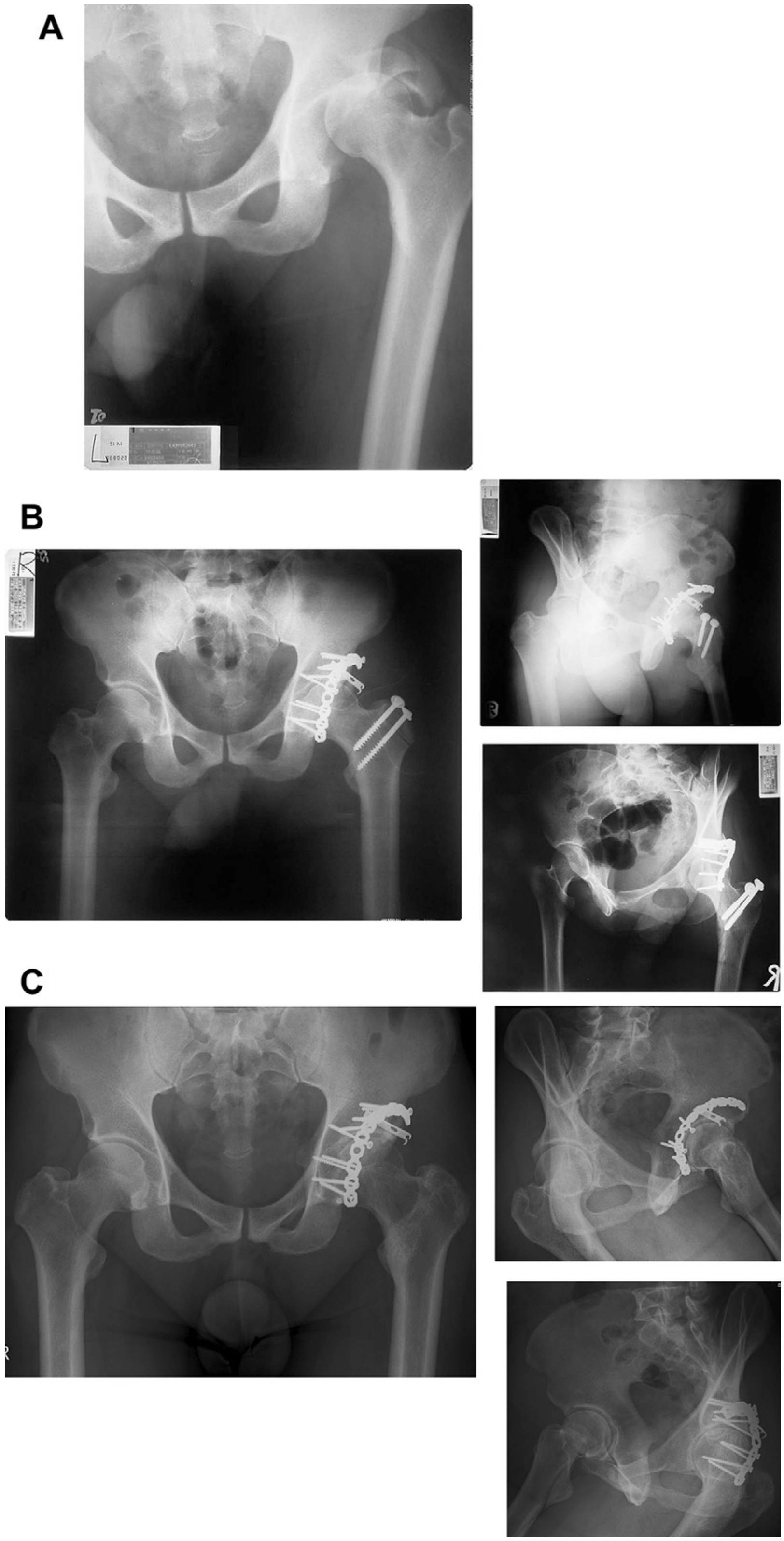

Fig. 2. (A) Anteroposterior radiographs of a 48-year-old man who had a comminuted posterior wall fracture-dislocation of the left acetabulum. He sustained an ipsilateral sciatic nerve injury and presented with drop foot. (B) Anteroposterior and 45° oblique radiographs made after ORIF, performed with the Kocher–Langenbeck approach with trans-trochanteric osteotomy. Decompression and inspection of the sciatic nerve was performed to check the integrity of the nerve on the involved segment. Marginal impaction of the cartilage was reduced with a bone graft from the femoral osteotomic site and was fixed with a hook plate. The reduction was graded as anatomic. (C) Anteroposterior and 45° oblique radiographs taken 4 years and 7 months after injury. The radiographs were graded as good because of a slight marginal osteophyte. The clinical result was also graded as good because the injured deep peroneal nerve was only partially recovered. ORIF = open reduction and internal fixation.

In group II, the average time between initial ORIF and conversion to a total hip replacement was 3 months (range: 1–5 months). Furthermore, all patients in group II underwent ORIF within 6 hours.

3. Results

The postoperative reductions of nine out of the 13 patients in group I were graded as anatomical (Fig. 1A). According to clinical and

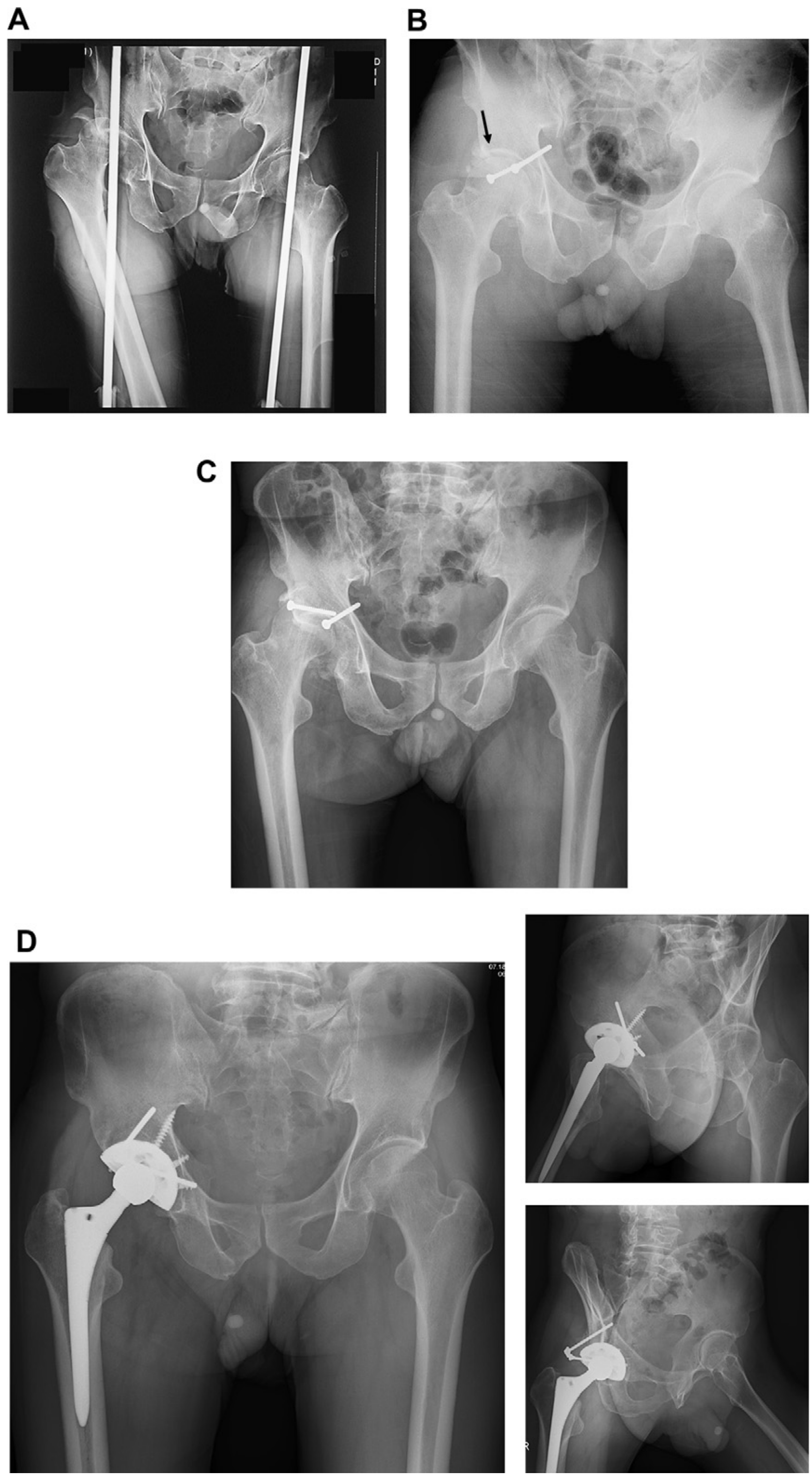

Fig. 3. (A) Radiographs of a 62-year-old man who had a posterior wall fracture-dislocation of the right acetabulum. (B) Anteroposterior radiograph taken after ORIF with the Kocher–Langenbeck approach was performed on the day of injury. Reduction was graded as imperfect (red arrow indicates the 2-mm residual fracture gap). (C) Anteroposterior radiographs taken 1 month after injury. Loss of reduction with loosening of the screws resulted in femoral head dislocation. (D) Anteroposterior and 45° oblique radiographs taken 1 year after injury showing total hip arthroplasty with union of the autogenous bone graft for the previous failed surgery. ORIF = open reduction and internal fixation.

radiographic grading systems, these nine cases led to eight excellent results (Fig. 1A–C), and one good result (Fig. 2A–C). Two group I patients out of the 13 had imperfect postoperative reductions: one had a good clinical and radiographic result, and the other was converted to a total hip joint replacement because of nonunion of the fracture site and broken implants noted 8 months after initial surgery. The remaining two patients' reductions were graded as poor, and they both led to poor radiographic results (Table 2), in that they progressed to hip arthritis. In these two cases, the clinical result of one patient was graded as poor and the other as good.

In group II, the postoperative reductions were graded as imperfect according to the grading system after ORIF failed in all three cases. As a result of loss of reduction after an average of 3 months postoperatively, all three patients underwent total hip replacement with bulk femoral head autografts (Fig. 3A–C).[12] This salvage procedure for treating the cases after the failed ORIFs achieved good clinical results during our final follow-up (Table 1 and Fig. 4).

There was one iatrogenic sciatic-nerve injury that happened in group I. However, that patient spontaneously recovered 1 year after surgery. There were neither superficial nor deep wound infections in either group. In group I, there was one case that required total hip arthroplasty (THA) with autogenous femoral head graft because of nonunion of the fracture site and failure of the implants 8 months after initial ORIF (Fig. 4).

There were six patients who underwent a trochanteric osteotomy followed by fixation with large AO screws. Five of the six patients underwent removal of trochanteric screws after bony union due to screw irritation to the tensor fascia lata, especially when in a decubitus position. The remaining patient also had removal of trochanteric screws, except when it was because of nonunion of the fracture site.

4. Discussion

Isolated posterior wall fractures are the most common type of acetabular fractures, accounting for almost a quarter to a third of all cases.[1,2] There are many risk factors involved in unsatisfactory results of acetabular fracture fixation. Foremost among them include the timing of the surgery and the accuracy of a minimal surgical approach reduction. For fractures of the posterior wall, performing reduction within 12 hours is one of the most important contributors to a functional outcome,[2] however, some studies have concluded that delays of up to 15 days after injury may be acceptable for elementary fractures.[13,14] Other factors relating to poor results include complexity of fracture-dislocation, femoral-head-associated injuries, increased patient age, and other surgical complications.[9,15]

There were five patients (all in group I) who did not undergo fixation on the same day as their injury occurred, but they all had closed reduction for hip dislocation within 6 hours after they were transferred to our hospital. Once the general conditions of these patients improved sufficiently to undergo ORIF, the procedure was undertaken within 5 days. One of the five patients had a good final clinical result after undergoing THA because of nonunion of the fracture site, and the remaining four had excellent final clinical and radiographic results (Fig. 4). Therefore, it is hard to conclude that surgical timing is a major determining factor in our study.

Anatomic reduction of the displaced acetabular wall fracture has led to optimal prognosis in many studies.[2–16] In the present case series, the two poor reductions of radiographic surveys in group I led to early osteoarthritic change of the injured hip and unpredictable final clinical results. Nonetheless, nine hips with initial anatomic reduction led to eight excellent radiographic and clinical results. In group II, the relatively younger patient group, good reduction alone was not sufficient for a satisfactory outcome. The three patients in this group initially had imperfect reductions using small AO screw fixation alone and all led to early fixation failure, necessitating subsequent THA and autogenous femoral head bone grafts (Fig. 4). In the fixation of a comminuted acetabular posterior wall, a buttress plate is stronger than screw fixation alone; supplementary fixation with spring plates can help to prevent redisplacement of fracture fragments.[17] Matta et al[4] have stated that screw fixation alone is not often indicated for posterior acetabular wall fractures. To avoid early failure of fixation and anatomic reduction maintenance, anatomic reduction with rigid

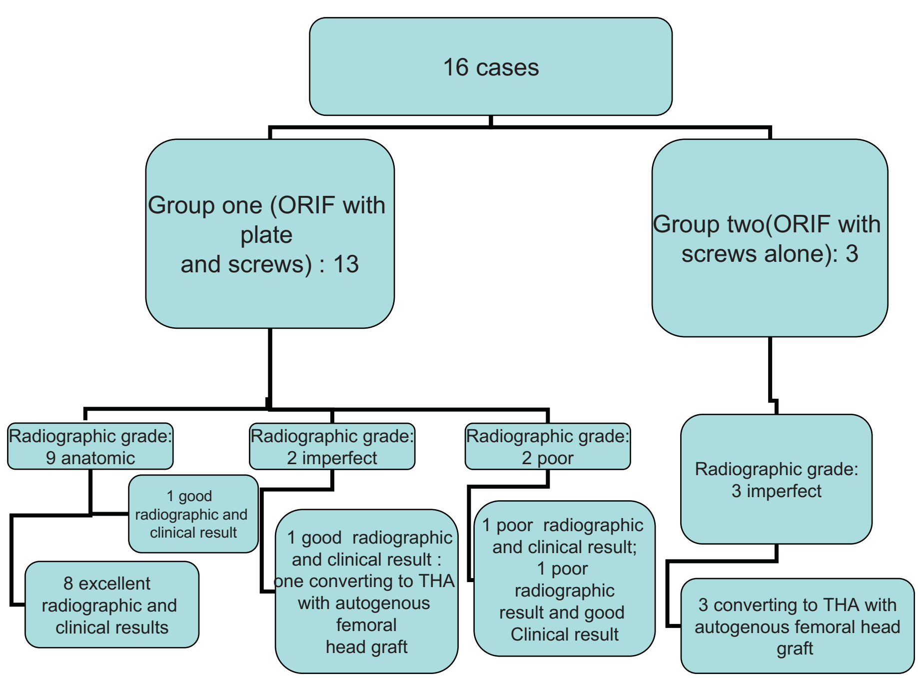

Fig. 4. Summary of patients' results.

fixation is essential for excellent final results, especially in younger patients. We recommend using a buttress plate for the stabilization of acetabular posterior wall fracture fixations.

The Kocher–Langenbeck approach is standard in surgical treatment of acetabular posterior wall fractures.[2,4] Upon osteotomy of the greater trochanter, good visual exposure was provided for the posterior column, the superior dome, and the anterior column in the Kocher–Langenbeck approach. After internal fixation of the fracture, the osteotomic site was fixed with two large AO cancellous screws.[10] There were six patients who underwent greater trochanteric osteotomy in surgical treatment. Reductions of five patients were graded as anatomic and one patient was graded as imperfect reduction in the initial radiographic study. The one hip graded as an imperfect reduction underwent THA and autogenous femoral head autograft because of nonunion of the fracture site 8 months after initial surgery. The other five patients who fixed with trochanteric screws all underwent further surgery for removal of the screws because of screw heads irritation to the ipsilateral tensor facia lata and iliotibial band when lying down. The trochanteric osteotomy in the Kocher–Langenbeck approach can be done without difficulty and can provide better exposure for successful reduction and fixation surgery. Patients should be informed of the high probability of another operation for the removal of the screws used for trochanteric osteotomy.

The necessity of intraoperative sciatic nerve monitoring during operative fixation of acetabular fractures is still controversial.[18,19] There are no intraoperative somatosensory evoked potentials available in our hospital. We maintained hip extension with knee flexion while performing the Kocher–Langenbeck approach. Palpation of the sciatic nerve was meticulously performed intraoperatively on occasion with the use of retractors and gauzes to avoid overstressing the nerve. There was only one case of iatrogenic sciatic nerve palsy, and that patient recovered spontaneously 1 year after surgery.

A failed ORIF of acetabular posterior wall fracture causes pain and incapacity to walk, which requires further surgery to restore function of the injured hip.[2,6,8,11] In one study, an autogenous femoral head graft to restore bony congruity of the posterior acetabular wall, THA for treatment of failed surgery led to good functional results in all four patients.[12] We believe that THA with an autogenous femoral head graft is a good procedure to salvage failed surgery.

Traction was routinely used postoperatively after ORIF. In group II, fixation failed within 5 months in all patients. Skeletal and skin tractions seem unnecessary in the treatment of acetabular posterior wall fractures.[1,4]

Despite the relatively small number of patients and short period of follow-up, we made some useful conclusions. First, anatomic reduction and rigid fixation lead to good clinical and radiographic results. Second, ORIF utilizing buttress plating via the Kocher–Langenbach procedure is a reliable approach for an acetabular posterior wall fracture-dislocation. Moreover, an ORIF with small AO screws alone is not adequate for comminuted fractures, especially in younger, more active patients. Finally, THA with a femoral head autograft can be a good treatment to salvage failed ORIF surgery.

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