Open Reduction Internal Fixation and Primary Total Hip Arthroplasty of Selected Acetabular Fractures

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Objective: The purpose of our study was to analyze the outcomes of patients treated with combined open reduction internal fixation (ORIF) and primary total hip arthroplasty (THA) for selected cases of acetabular fractures.

Design: Retrospective case series.

Setting: University Medical Center.

Patients and Participants: Four hundred twenty patients underwent ORIF for displaced acetabular fractures at our institution. Twenty-one of these patients underwent ORIF and primary THA. All surgeries were performed under the direct supervision of a fellowship-trained orthopaedic trauma surgeon and a fellowship trained adult reconstructive surgeon who acted as a cosurgeon. At the time of review, 18 patients met the 1-year follow-up requirement and formed the study cohort. Mean patient age was 71 years (range 55–86 years). There was 1 transverse fracture, 1 anterior column posterior hemitransverse and 1 both-column fracture. There were 15 posterior wall fractures. Of the 15 posterior wall fractures, 1 was associated with posterior column fracture, 1 with dome fracture, 2 with transverse fractures, and 9 with femoral head impaction fracture. There were 2 patients with isolated posterior wall fractures. Clinical outcomes were analyzed using Harris hip score. Radiographs were analyzed for implant migration and loosening around the implant.

Results: Of the 18 patients in the study, 14 patients were followed for more than 2 years (average 3.9 years, range 1–10.1 years). All but 1 patient healed successfully. One patient required revision and placement of a constrained prosthesis due to failure of acetabular component, 3 weeks post-index procedure. Harris hip score ranged from 78 to 99 with a mean of 88. The radiographs showed an average medial displacement of 1.2 mm (range 0–3 mm) and an average vertical displacement of 1.3 mm (range 0–4 mm). There was no radiographic evidence of acetabular component loosening, but loosening was evident on 1 uncemented femoral stem.

Conclusions: Treatment of acetabular fractures remains challenging particularly in the presence of severe osteopenia, comminution, or associated femoral head fracture. In appropriately selected patients, ORIF and primary THA provide an acceptable treatment option.

Key Words: elderly, acetabular fractures, total hip arthroplasty, outcomes, femoral head fracture, osteopenia

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INTRODUCTION

Surgical treatment of acetabular fractures is a challenge requiring surgical skill and mature judgment. When these fractures occur in elderly patients with osteopenic bone, the complexity increases. Although open reduction internal fixation (ORIF) is the preferred treatment, prognosis is notably poor in osteopenic bone.[1–3] Maintaining acetabular bone stock and achieving accurate reduction is vital for better long-term results.[4–8] When these fractures are associated with osteopenia, articular surface comminution, femoral head impaction, and acetabular surface impaction that involves significant joint surface in the weight-bearing region, achieving accurate reduction and maintaining joint congruity until healing may not be possible. Outcome after early fixation and late hip arthroplasty is predictably poor in these groups of patients.[9] Acute ORIF and total hip arthroplasty (THA) is an option in these cases.

Few studies address acetabular fractures in the elderly,[7,9,10] and the treatment algorithm for these complex fractures is not well described. Various treatment options exist for managing these fractures including operative and nonoperative management. The reluctance to operate on the acetabular fractures in the elderly is due to several factors including problems with operative exposure, osteopenic bone, and the medical risks of such a procedure. When acute fracture fixation and delayed THA is considered, outcomes have been shown to be inferior to the outcomes after THA performed for nontraumatic arthritis.[11–14]

The primary goal of acetabular fracture care is preservation of the hip joint. Reconstruction of the bone stock to facilitate a more stable subsequent total hip replacement may not be the ideal solution in elderly population. Acetabular ORIF and THA may be a more appropriate treatment option in this group of patients. The purpose of this study was to report the 1 to 10-year results of a selected group of patients with

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displaced acetabular fractures who underwent ORIF of the acetabulum and acute THA.

PATIENTS AND METHODS

From 1997 through 2007, a consecutive series of 420 patients with displaced acetabular fractures were operatively managed by a single surgeon at our institution. Twenty-one patients underwent ORIF and acute THA. Eighteen patients were followed up for at least 1 year and formed the study cohort. The average duration of follow-up was 3.9 years (range 1–10 years), and 14 patients were followed up for at least 2 years. Average age of the patients was 72 years (range 55–86 years), and 12 patients were older than 60 years. There were 10 males and 8 females in the study. The combined procedure was undertaken 2–29 days (average 9 days) after the injury. Each fracture in the study group was displaced by at least 5 mm.

Ten of the 18 injuries (44%) were classified as major trauma and 6 (66%) were classified as minor trauma based on guidelines provided by Lonner and Koval.[15] Six of the 10 patients in the major trauma group sustained additional injuries to other long bones, and 1 patient in the minor trauma group sustained additional bony injury. The initial evaluation included a plain anteroposterior radiograph, 2 plain 45-degree radiographs (iliac and obturator oblique), and a computed tomographic scan. Fractures were classified with the method of Judet et al.[8] There was 1 transverse fracture, 1 anterior column posterior hemitransverse, 1 both-column fracture, and 15 posterior wall fractures. Of the 15 posterior wall fractures, 1 was associated with posterior column fracture, 1 with dome fracture, 2 with transverse fractures, and 10 with femoral head impaction fracture. There were 2 patients with isolated posterior wall fractures (Table 1).

The main indications for acute THA included severe intraarticular comminution, impaction of the femoral head including femoral head fracture, and impaction of the acetabulum involving significant portion of the weight-bearing area. Radiographic evidence of osteopenia was weighed against a primary ORIF. In elderly patients with significant medical risk, a second anesthesia and a surgical procedure for a delayed THA may increase the overall risk to the patient. When fracture comminution is associated with osteopenia, achieving adequate bone stock for a subsequent arthroplasty with optimal outcomes may be difficult. In the above circumstances, consideration was given for acute arthroplasty.

Operative Technique

In all our case, we used the lateral decubitus position and a Kocher-Langenbeck approach. No patients had extensile approach. The senior author (D.E.A.), fellowship trained in orthopaedic trauma, performed the ORIF. The displaced column fractures were reduced and stabilized with plate and screws. Osteotomy of the femoral neck was performed, and femoral head excised before plate fixation of the acetabulum was attempted. In posterior wall fractures, a sleeve of periosteal tissue was preserved. The fracture fragments were provisionally stabilized using Kirschner (K) wires. With K wires in place plate was applied on the posterior wall. K wires were removed subsequent to acetabular reaming. Femoral head autograft was used to reconstruct the posterior wall when needed. Plates and screw osteosynthesis was then performed before implanting the acetabular component. In all cases, the acetabular subchondral bone was preserved. A single experienced adult reconstruction specialist (S.Z.) performed the arthroplasty. The acetabulum was prepared with acetabular reamers and a cup size greater by 1 mm than the outside diameter of the acetabular reamer was placed in a press fit. In

TABLE 1. Patient Profile, Injury Pattern, Complications, and Outcome

No.	Age (yrs)	Fracture Pattern	HO Prophylaxis	Complications	HHS
1	78	Hip dislocation + transverse fracture			90
2	68	Hip dislocation + PC/PW			90
3	86	Femoral head subluxation + AC/PH	Indocin/RT	Wound infection	78
4	63	Femoral head impaction fracture + PW/dome			98
5	64	Both column	Indocin		95
6	68	Femoral head fracture + PW			90
7	70	Femoral head impaction fracture + PW	Indocin		N/A
8	55	Femoral head fracture+ impaction fracture PW	Indocin		99
9	72	Hip dislocation and femoral head fracture + PW	Indocin		91
10	76	Comminuted osteopenia + PW			85
11	74	Hip dislocation and femoral head osteopenia + PW	Indocin		99
12	84	Hip dislocation with marginal impaction + PW		Revision of THA	N/A
13	55	Hip dislocation with femoral head fracture + PW	Indocin		88
14	82	Femoral head fracture + PW	Indocin	Bilateral parasthesia	80
15	63	Transverse and posterior wall + PW			76
16	70	Hip dislocation and transverse + PW		HO stage II–III	76
17	88	Femoral head impaction + PW	Indocin		83
18	78	Femoral head fracture + PW	Indocin		90

AC, Anterior column; HHS, Harris hip score; HO, Heterotopic ossification; N/A, not available; PC, posterior column; PH, posterior hemitransverse; PW, posterior wall.

most cases, the femoral head was morselized and used as autograft. The cup was anchored using 2, 3, or 4 screws. Larger head size was preferred in all cases to provide increased joint stability. Constrained liners were avoided. We used constrained liner in 1 case, which required revision of THA. An uncemented femoral stem was used in younger patients with better bone, and a cemented femoral component was used in osteopenic bone.

Postoperative Management

Patients were touchdown weight bearing for 8 weeks and partial weight bearing over the next 4 weeks. Twelve weeks after the surgery, the patients were allowed to bear weight as tolerated. The patients were evaluated at 6 weeks, 3 months, 6 months, 1 year, and yearly thereafter. Because callus formation in this area is limited, maintenance of surgical fixation and lack of clinical symptomatology were used to assess fracture healing. Clinical examination included a Harris hip score[16] measurement and gait assessment. When Harris hip score was not recorded during the examination, a telephone interview was conducted to complete the data. Harris hip score was categorized as excellent (90–100), good (80–89), fair (70–79), or poor ($\leq$69).

Radiographs were assessed for various parameters including fracture healing, vertical and medial cup subsidence, changes in the version and abduction angles, and osteolysis around the implant. Magnification standardized true anteroposterior radiographs of the pelvis were used. When the radiographs were not deemed as true anteroposterior views, different sets of radiographs were chosen. Immediate and late postoperative radiographs were used for comparisons. Migration of the cup by more than 4 mm or change in the abduction angle by more than 4 degrees was deemed as an indicator of loosening of the acetabular component. Bone around acetabular component was assessed for osteolysis and loosening as described by DeLee and Charnley.[17] Bone stock around the femoral stem was also assessed for resorption and osteolysis in the zones described by Gruen et al.[18] A radiolucent line of $\geq$2 mm in width around the circumferential area of 50%–99% around the femoral stem was considered loosening according to the criteria of Harris and McGann.[19] The stems were also evaluated for settling.

RESULTS

Clinical Results

The average Harris hip score was 88 (range 78–99). Nine patients (56%) had an excellent score, 4 patients (25%) had a good score, and 3 patients (18%) had a fair score. Scores were not available for 2 patients. At the latest follow-up, all the patients were ambulating except 1 patient who had developed rapidly progressive dementia. A single patient reported pain at the time of the latest follow-up. The pain in this patient was attributable to lumbar disc disease–related problems. One patient who developed superficial wound infection was successfully treated with antibiotics. One patient required revision of the THA 3 weeks after the index surgery. Recurrent hip dislocation necessitated the revision surgery. This patient suffered from dementia and failed to follow hip precautions after arthroplasty.

Radiographic Results

All patients were healed at 12 weeks after surgery. There was no incidence of delayed union or nonunion. One patient (6%) had Brooker grade 3 heterotopic ossification. The acetabular cup showed an average medial displacement of 1.2 mm (range 0–3 mm) and an average vertical displacement was 1.3 mm (range 0–4 mm). There was no radiographic evidence loosening of the acetabular component. (Figs. 1, 2) One uncemented femoral stem showed osteolysis in zones 3, 4, and 5. There was no subsidence of any of the stems.

DISCUSSION

Various treatment options for acetabular fractures in elderly have been described. Some studies describe conservative treatment as the preferred treatment in osteoporotic bone.[1,10,20] However, current treatment trends are now swaying more toward operative intervention including ORIF and either primary or delayed THA.

The indications for primary THA in acetabular fractures are still evolving. When an osteoporotic acetabular fracture is associated with a femoral head impaction fracture, the likelihood of preserving joint congruity and achieving good long-term results can be bleak.[21] There is a paucity of literature that describes the outcomes in these situations. Of the 18 patients in our study, 10 patients had femoral head impaction

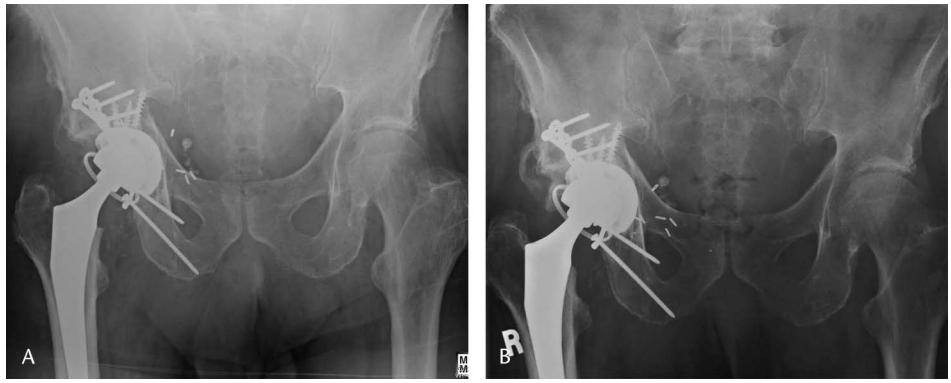

FIGURE 1. A, Anteroposterior radiograph showing immediate post operative fixation. B, Anteroposterior radiograph showing late post-operative fixation.

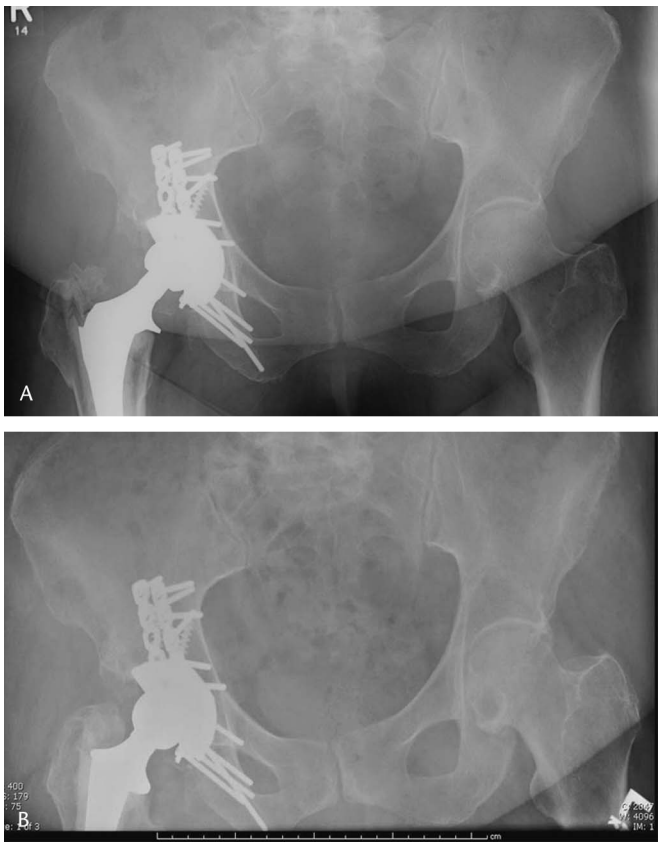

FIGURE 2. A, Anteroposterior radiograph showing immediate post operative fixation. B, Anteroposterior radiograph showing late post-operative fixation.

factures. Due to the poor quality of the acetabular subchondral bone, achieving and maintaining the reduction can be very challenging (Fig. 3). With primary fixation of the acetabular fragment and acute THA, we achieved good clinical outcomes in these patients. When the fracture involves only the osteoporotic acetabulum in a patient with significant medical morbidity, it is controversial whether the surgery for these high anesthesia–risk patients should be acute or delayed THA after ORIF.[21]

ORIF is considered less successful in the treatment of displaced acetabular fractures. Matta[4] reported significantly worse results regarding reduction and clinical outcome in elderly patients. Inferior results for ORIF in elderly patients have also been reported by others.[3] However, Helfet et al[7] evaluated 18 elderly patients with mean age of 67 years (range 60–81 years) and a mean follow-up of 31 months treated with ORIF for a displacement >5 mm. They concluded that ORIF can yield good results and may be an alternative to acute or late THA. The fracture type included anterior column plus posterior hemitransverse or both column versions. The mean Harris hip score was 90, which is comparable to our results. In another study by Helfet et al that includes 45 patients who are older than 55 years who underwent ORIF for acetabular fractures describes a low complication rate of 4%–7% and a satisfactory outcome. When the fracture is extensive, achieving stable fixation through a single incision may be challenging. Extensile approaches such as triradiate, extended iliofemoral, or 2 simultaneous approaches may be needed. These approaches are not without complications.[7] Helfet and Schmeling[22] studied the outcome of 124 surgically treated acetabular fractures of which 84 had complex fracture pattern. They reported excellent results. Extrapolating this principle

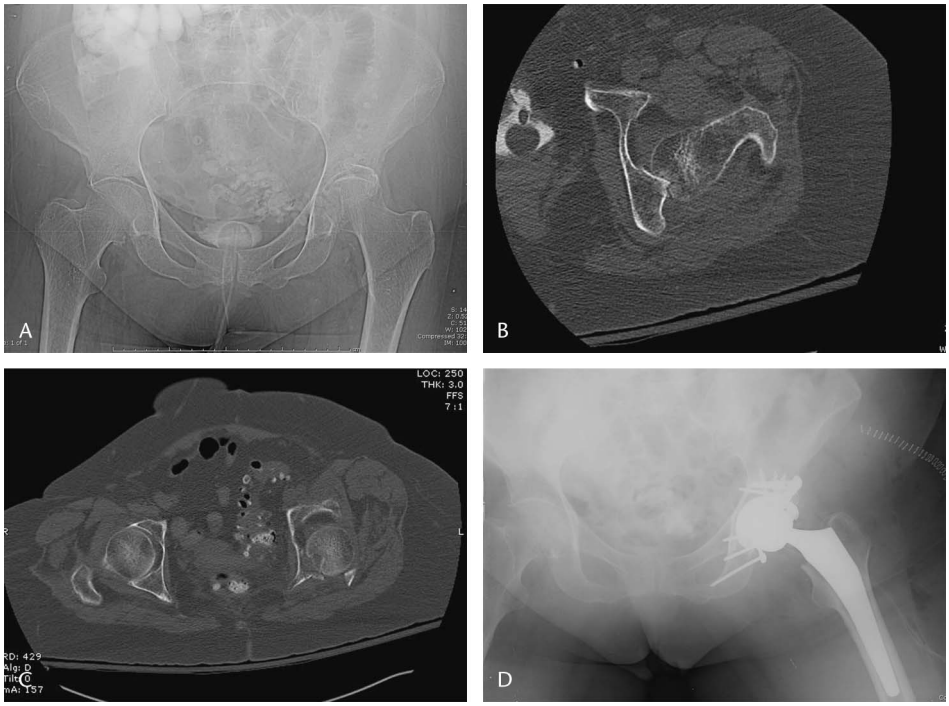

FIGURE 3. A, Anteroposterior radiograph showing posterior wall fracture and femoral head fracture in osteopenic bone. B, C, Axial section of computed tomography scan showing impacted femoral head fracture and posterior wall fracture. D, Anteroposterior radiograph showing after fracture fixation and THA.

and technique, we managed our cases with single Kocher Langenbeck incisions. In elderly patients with associated medical morbidities, an extensive procedure to preserve the bone stock for a late THA may not be ideal. A less extensile approach and single surgery with ORIF and acute THA can have good outcomes.

THA as a treatment option for posttraumatic arthritis and pain after acetabular fracture has also been studied. Sixty-six primary THAs were performed to treat posttraumatic osteoarthrosis that had developed after an acetabular fracture and subsequent ORIF. The mean follow-up was 9.6 years.[13] Twenty-seven patients underwent a revision of THA at the time of the review. Failure rate of the acetabular component was noted to be 4–5 times higher than in cases performed for routine osteoarthritis. They concluded that the restoration of acetabular bone stock was the major prognostic factor that may improve the outcome.

The value of ORIF in restoring bone stock and minimizing pelvic deformity has been described.[6–8,23] Series ranging in size from 60 to 456 patients have shown that even when accurate anatomic reduction is achieved, posttraumatic arthritis occurs in up to 30% of the patients.[4,20,24,25] Once posttraumatic arthritis develops, salvage options are generally limited to THA and arthrodesis. THA however remains a favorable alternative to arthrodesis.[26] The reported results of patients undergoing THA for posttraumatic arthritis after acetabular fracture have results inferior to those of patients undergoing the procedure for nontraumatic arthritis. More extensive studies comparing the outcomes of patients undergoing THA either at a primary stage or at a delayed stage will be beneficial. Mears recently reported an 8-year outcome of 57 patients treated with ORIF of the acetabulum and primary THA using uncemented acetabular component.[27] The average Harris hip score was 89. He concluded that the primary THA to be a promising option in selected cases of acetabular fractures.

FIGURE 4. Anteroposterior radiograph showing the fracture fixation and arthroplasty in a patient with isolated posterior wall fracture.

There are several limitations to this study aside from the small cohort of patients. There is heterogenity in the fracture pattern, and the indications of surgery are multiple (Fig. 4). Our radiographic follow-up analysis was limited to a maximum of 2 years. This is a relatively short-term follow-up to assess the longevity of the implants and also to assess osteolysis around the implant. Because the primary objective of the study was to report the outcome related to fracture, cup medialization and subsidence related to healing of acute fracture may be expected to occur in this period. The long-term stability and osteolysis around the implant may not vary significantly than those performed for osteoarthritis. A more extensive study after controlling the variables like fracture pattern and bone quality is needed to overcome this limitation.

With a mean Harris hip score of 88 points and no radiographic evidence of implant migration in this elderly population, the authors believe that acetabular ORIF and acute THA seems to be a promising option in selected cases.

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