

# Outcome analysis of displaced acetabular fractures

## Abstract

Over a period of three and half years, twenty-eight patients with complex displaced fractures of the acetabulum were operated at our institution. Between December 2004 and June 2008 twenty-eight patients with closed displaced acetabular fractures were treated with open reduction and internal fixation. The surgical procedure consisted of open reduction and internal fixation by anterior, posterior or combined approaches during the same period of anesthesia. The cases were reviewed to determine the adequacy of the various approaches, ease of reduction and to determine the choice of approach for various fracture patterns. The patients were followed for a mean period of 20 months after surgery (Range 12 months to 36 months). Anatomical reduction and rigid internal fixation could be achieved in 71% of the cases. The clinical result was excellent for 11 hips (39 per cent), good for 10 hips (36 percent), fair for 3 hips (11 per cent), and poor for four hips (14 per cent). Osteonecrosis of the femoral head was noted in one hip (3 per cent), and progressive wear of the femoral head was seen in two hips (6 per cent). Our findings indicate that anatomical reduction can be achieved in these complex injuries in a large percentage of cases with satisfactory midterm results.

**Keywords:** Acetabulum fracture, Fixation, Approach

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## Introduction

High-energy fractures resulting in an unstable hip or incongruous weight-bearing area are best managed operatively. No displaced fractures or those not involving the weight-bearing acetabulum, especially in older patients can be managed non operatively. Anatomic reduction of the acetabulum is important for good long-term function. Residual displacement of more than one or two millimeters may lead to progressive posttraumatic osteoarthritis and a poor functional result.<sup>1</sup> However anatomic reduction does not always ensure a good result. Impacted fragments tend to worsen the prognosis. Cartilage impaction injury, comminution, and fragment avascularity may also lead to posttraumatic arthritis.

## Materials and methods

This is a retrospective study with level of evidence 3 in 28 patients which we have operated between December 2004 to June 2008. Displaced fractures were defined as fractures with minimum five millimeters of displacement in any of the three standard radiological views. All 28 patients were operated within twenty-one days after the injury. The study included twenty-six male patients and two female patients. The ages of the patients ranged from 21 to 65 years (mean, thirty-two years). Twenty patients (71 percent) were from twenty to forty years old. The most common mechanisms of injury were a motor-vehicle accident (23 patients; 82 per cent), fall from height (five patients; 17 per cent). Six patients had associated injuries. Five fractures were associated with a head injury and one fracture had an injury involving lower extremity.

All patients were initially evaluated with use of three standard plain radiographs (one anteroposterior radiograph and two 45-degree oblique radiographs of the pelvis).<sup>2</sup> Computerized tomographic scans and three-dimensional reconstructions of the scans were made for all patients. The displacement of the fracture was measured separately. The maximum displacement seen on each of the three radiographs was recorded. The fractures were classified according to the criteria of Letournel and Judet<sup>3</sup> of the 28 fractures, six fractures (21 per cent) were simple fracture types and twenty two (79 per cent) were associated

fracture types. The simple fracture types included five posterior wall fractures (18 per cent) and one anterior column fractures (4 per cent). The associated fracture types included seven posterior column-posterior wall fractures (25 per cent), four transverse-posterior wall fractures (14 per cent), one T-shaped fractures (4 per cent), and ten both-column fractures (36 per cent). Seven hips had a posterior dislocation and one had an anterior dislocation. All eight hips were reduced before the operation. Preoperative below knee skin traction was used in all patients (Figure 1).

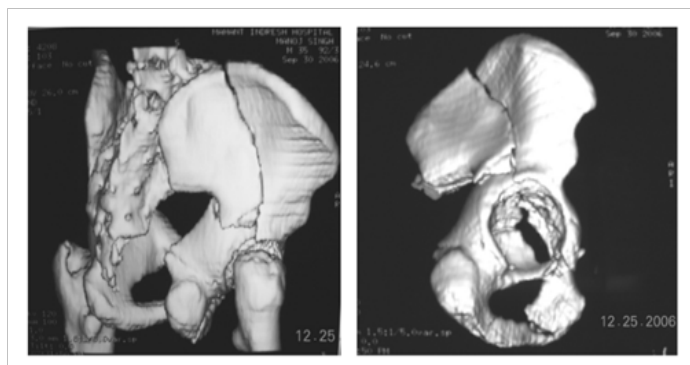


**Figure 1** Preoperative radiograph showing anterior column fracture acetabulum.

## Operative technique

On the basis of the classification and the specific configuration of the fracture judged on radiographs and 3D CT scans a single operative approach was selected if the entire reduction could be performed with use of one approach (Figure 2A & 2B). The Kocher-Langenbeck approach was used in 12 hips (43 per cent); the ilioinguinal approach was used in 12 hips (43 per cent); and the extended iliofemoral approach was used in one (4 per cent). In three hips (11 per cent), an

initial Kocher-Langenbeck or ilioinguinal approach was inadequate to complete the reduction and fixation and a combined ilioinguinal and Kocher-Langenbeck approach was used, during the same session of anesthesia. The extended iliofemoral approach was used for associated anterior wall and anterior column fractures. The Kocher-Langenbeck approach was used for posterior wall, posterior column, and posterior column-posterior wall fractures. The ilioinguinal approach<sup>4</sup> was used for anterior column, and both column fractures with greater displacement of anterior column. The reduction was performed by direct manipulation of the bone with special reduction instruments with the goal to achieve an anatomical reduction of the acetabulum. The posterior stable fragment attached to the sacroiliac joint was used as the starting point and all fractures were reduced from posterior to anterior. The fixation was performed with plates and screws in 27 hips (96 per cent) and with screws alone in 1 hip (4 per cent) with a posterior wall fracture.<sup>2</sup> Fixation with interfragmentary screws, with the reduction held with reduction forceps or clamps, was usually performed before fixation with a plate. Kirschner wire fixation was used for very small fragments to augment fixation achieved by a screw. Duration of Surgery ranged from 2 1/2 hours to 5 hours. The duration of the operation varied according to the operative approach. Combined approaches were the most time consuming. The duration of the operation decreased with increasing familiarity with the surgical approaches.



**Figure 2 (A,B)** Dimensional CT scan of the same patient as in Figure 1 showing displaced fracture anterior column acetabulum with posterior hemi transverse fracture.

Various kinds of articular cartilage injuries were noted like free intra-articular fragments, chondral fissures on the cartilage of the femoral head and impacted fractures on the acetabular surface were observed in seven fractures operated by the Kocher-Langenbeck approach. Removal of intra-articular fragments required redislocation of the hips in five patients. Patients operated by ilioinguinal approach had limited visualization of the intra-articular injury and cartilage injuries could not be observed (Figure 3). Postoperatively, immobilization or traction was not used. Non weight bearing exercises were commenced within one week of the operation. Partial weight bearing was allowed after eight weeks and full weight-bearing was allowed twelve weeks after the operation. Low molecular weight heparin was used as prophylaxis against deep venous thrombosis in all patients. No routine prophylaxis against heterotopic ossification was used.

## Results

Clinical and radiographic examinations were performed and data were recorded at three months, six months, one year, and two years. At

the last follow-up examination, radiographic and clinical grades were assigned (Figure 4). The clinical grade was based on a modification of the system of Merle d'Aubigne and Postel (Table 1).



**Figure 3** Postoperative radiograph of the same patient as in Figure 1 operated by the Ilioinguinal approach showing anatomical reduction.



**Figure 4** Follow up radiograph at 3 months showing congruent hip joint and maintenance of anatomical reduction graded as excellent radiologically.

## Operative reduction

The mean postoperative displacement measured on x-rays was two millimeter (range, one to twelve millimeters). The postoperative reduction was graded as anatomical for 20 hips as the displacement was zero to two millimeters (71 per cent), imperfect for 3 hips as the residual displacement was two to four millimeters (11 per cent), poor for 5 hips as the residual displacement was more than four millimeters (18 per cent). At the time of recent follow up all had united (Table 2). Most of the simpler fracture types could be reduced anatomically. In one case fixation of posterior lip failed because of non compliance of the patient who started unrestricted weight bearing in the immediate post operative period. Of the associated fracture types seven fractures could not be reduced anatomically (32 per cent). The over-all clinical

result was excellent for 11 hips (39 per cent), good for 10 hips (36 per cent), fair for 3 hips (11 per cent), and poor for four hips (14 per cent).

**Table 1** Data of Clinical and Radiographic results

Clinical Grading System	Points
Pain	
None	6
Slight or intermittent	5
After walking but resolves	4
Moderately severe but patient is able to walk	3
Severe, prevents walking	2
Walking	
Normal	6
No cane but slight limp	5
Long distance with cane or crutch	4
Limited even with support	3
Very limited	2
Unable to walk	1
<b>Range of motion*</b>	
95–100%	6
80–94%	5
70–79%	4
60–69%	3
50–59%	2
<50%	1
<b>Clinical grade†</b>	
Excellent	18
Good	15, 16, or 17
Fair	13 to 14
Poor	<13

## Complications

Osteonecrosis of the femoral head was noted in one hip (3 per cent), and progressive wear of the femoral head was seen in two hips (6 per cent). Loss of reduction occurred in one posterior hip fracture because of noncompliance which resulted in incongruence of the hip which was treated by total hip replacement. Heterotopic ossification was noted in two cases (Brooker class I). We had one preoperative complication of initial tear of the external iliac artery which was repaired immediately with no untoward complication afterwards. Screw pullout of the trochanteric osteotomy happened in one case which needed revision surgery. We had no post-operative infection in our patients.

**Table 2** Radiological Grading System

Radiological Grading System	
Excellent	Normal appearance of the hip
Good	Mild changes, small osteophyte, moderate (one-millimeter) narrowing of the joint, and minimum sclerosis
Fair	Intermediate changes, moderate osteophyte, moderate (less than 50 per cent), narrowing of the joint, and moderate sclerosis
Poor	Advanced changes, large osteophyte, severe (more than 50 per cent) narrowing of the joint, collapse or wear of the femoral head, and acetabular wear.

## Discussion

Displaced fractures of the Acetabulum are a diverse group of serious injuries which are difficult to treat with various complications like post-traumatic osteoarthritis, osteonecrosis of the femoral head, acetabular non-union and bone defects which may require revision to total hip arthroplasty.<sup>5,6</sup> Saterbak et al.<sup>7</sup> in a study performed to evaluate the factors that predict clinical failure after posterior wall fractures of the acetabulum, reported a mean Musculoskeletal Function Assessment score of 47.3 for ten patients who had a failure of treatment and a mean score of 26.1 for thirty-one patients who did not have failure.<sup>8</sup>

The success of the operation after high-energy trauma is contingent on the articular cartilage of the hip remaining viable. If post-traumatic osteoarthritis develops in the presence of viable cartilage, it is primarily the result of altered pressure distribution of the femoral head articulating with an inaccurately reduced acetabulum. Specifically, the contact area between the head of the femur and the acetabulum is markedly reduced by a malreduction, and the force per unit area to the articular cartilage increases. This results in loss of the joint space and, sometimes in wear of the femoral head. The most clearly predictive initial factor was injury to the cartilage or bone, or both, of the femoral head; this factor was significantly predictive of a worse prognosis but not all potentially deleterious effects of the initial injury can be completely countered in all patients. In our study over-all clinical result was excellent for 11 hips (39 per cent), good for 10 hips (36 per cent), fair for 3 hips (11 per cent), and poor for four hips (14 per cent), which clearly shows 75 percent patient have excellent to good midterm results.

The goal of treatment is anatomical reconstruction and rigid internal fixation resulting in a functional, mobile, painless hip joint that continues to function for the rest of the patient's life.<sup>7</sup> This goal can be achieved by properly planned approaches. However, despite the appearance of an anatomical reduction on radiographs, there may still be imperfections on areas of the articular surface that are invisible on standard plain radiographs or are hidden by plates and screws. It must therefore be hypothesized that satisfactory clinical and radiographic results are due in part to the capability of the acetabulum in an adult to tolerate limited changes in the distribution of pressure and perhaps to reshape itself over time. As the learning curve for the complex fracture patterns is long with potential disastrous complications because of the deep location of the acetabulum, the presence of the proximal femur with its tenuous blood supply and close proximity of various neurovascular structures but as more experience is gaining over years hopefully the outcomes will also improve.

## Conclusion

The relationship between the quality of the reduction and the clinical result closely parallels the findings of Letournel and Judet and some other studies in the recent year.<sup>9-12</sup> It can therefore be concluded that the positive results reported by Letournel<sup>9</sup> and Judet<sup>2</sup> can be reproduced by the concentrated efforts of a team of surgeons who treats these fractures frequently and can give better outcomes to patients for extended periods of time.

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