

# Non-operative management of acetabular fractures

## THE USE OF DYNAMIC STRESS VIEWS

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**To assess the stability of the hip after acetabular fracture, dynamic fluoroscopic stress views were taken of 41 acetabular fractures that met the criteria for non-operative management. These included roof arcs of 45°, a subchondral CT arc of 10 mm, displacement of less than 50% of the posterior wall, and congruence on the AP and Judet views of the hip. There were three unstable hips which were treated by open reduction and internal fixation. The remaining 38 fractures were treated non-operatively with early mobilisation and delayed weight-bearing. At a mean follow-up of 2.7 years, the results were good or excellent in 91% of the cases. Three fair results were ascribed to the patients' other injuries. Dynamic stress views can identify subtle instability in patients who would normally be considered for non-operative treatment.**

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The outcome after non-operative treatment of acetabular fractures depends on the stability of the hip, the concentricity of the head under the roof of the acetabulum and the condition of the roof itself.<sup>1-9</sup> Rowe and Lowell<sup>8</sup> first reported that fractures which did not involve the dome tended to have better results than those in which the weight-bearing area was affected. Later authors defined the minimum area of the unaffected acetabular roof necessary to obtain acceptable results without surgery. They also used standard transverse CT to measure the subchondral arc.<sup>5-7</sup> These measurements are a means of assessing the fractured region of the acetabulum in relation to the weight-bearing zone. This is important because displacement within the loaded area can result in a poor outcome and lead to early arthritis.<sup>3-10</sup> The weight-bearing surface of the acetabulum

is presumed to be intact if the measurements of the roof arcs are greater than or equal to 45° and the subchondral CT arc of 10 mm is unbroken. Displacement of less than 2 mm is one criterion for non-operative treatment. Another is displacement in which the femoral head, on AP and Judet views, is congruent with the unaffected acetabular roof and a minimum of 50% of the posterior wall is intact on all CT cuts. In these cases, non-operative treatment is as effective as surgery.<sup>7</sup>

Radiological assessment and CT of hip congruence, and the amount of involvement of the posterior wall are indirect determinants of hip stability. This paper describes the use of a dynamic intraoperative fluoroscopic stress test to assess the stability of the hip in acetabular fractures that would otherwise meet the criteria for non-operative management.

## Patients and Methods

Over a period of 4.5 years 41 acetabular fractures which met the accepted criteria for non-operative treatment were seen. Fractures of the superior ramus that entered the inferior portion of the acetabulum were considered to be pelvic fractures and were excluded. There were 14 fractures of the posterior wall (62-A1), ten of the very low anterior column/wall (62-A3.1), two of the posterior column (62-A2) and nine transverse and six T-shaped fractures (62-B2.1). Six patients had posterior dislocation of the hip and one had an anterior dislocation of the opposite hip. Eleven had other injuries which required operation and nine had associated pelvic fractures of which six required surgery (three symphyseal dislocations, one sacral fracture and two injuries to the sacroiliac joint). The mean age of the patients was 34 years (17 to 58).

**Operative treatment.** Patients were either given sedatives/analgesics (19) or anaesthetised (22). The hips were rotated internally and externally in flexion, extension and abduction. In each position, the relationship of the femoral head to the roof of the acetabulum was observed fluoroscopically. Sufficient force to rock the patient on the table was then applied in the direction of the displacement for the given fracture pattern (e.g., fractures of the posterior wall were stressed posteriorly with the hip in flexion). These manoeuvres were repeated to obtain AP, obturator and iliac

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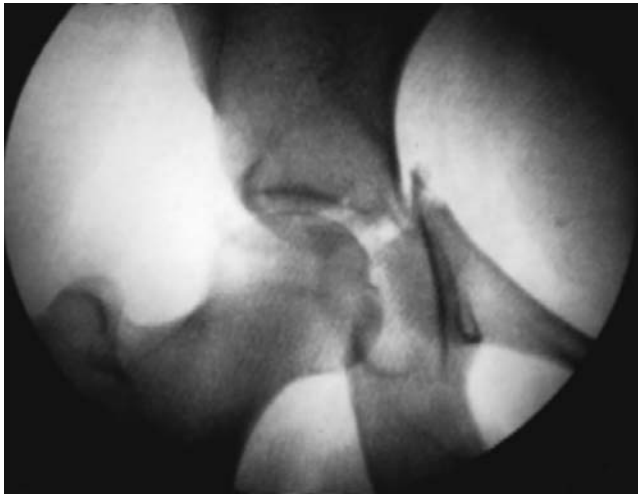


Fig. 1a

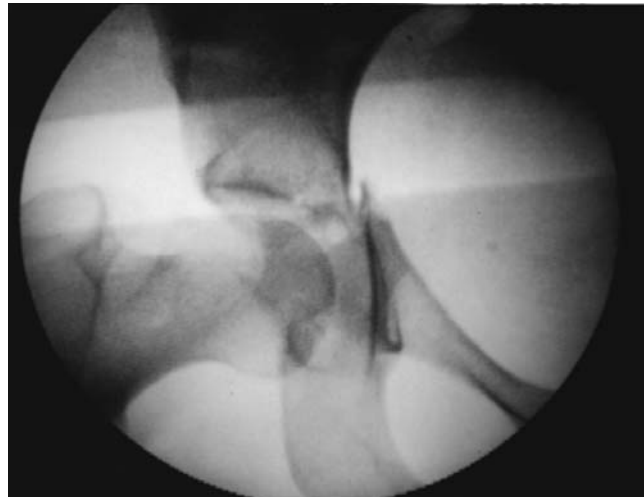


Fig. 1b



Fig. 1c

Figure 1a – AP fluoroscopic view of a transverse acetabular fracture of the hip. The femoral head is concentrically reduced under the acetabular roof. Figure 1b – As the hip is abducted, the femoral head loses congruence with the roof and becomes congruent with the ischiopubic segment in an inferomedial position. Figure 1c – Postoperative radiograph after open reduction and internal fixation of the transverse fracture through a posterior approach and stabilisation of the symphyseal dislocation. The head is congruent with the roof and the hip is stable.

oblique views. The dynamic fluoroscopic image was evaluated for a change in congruence of the femoral head with respect to the roof of the acetabulum, and the stress position was saved on the screen. When necessary the normal side was used as a comparison. Hips were considered stable if the relationship of the femoral head to the acetabular roof remained unchanged throughout.

Those patients whose hips were assessed as stable had non-operative treatment. This included early mobilisation and touch weight-bearing. Radiographs were taken at weekly intervals for 4 weeks, and then at 6, 8 and 12 weeks. Clinically, patients were assessed by a modified Merle d'Aubigné score.<sup>7</sup> Follow-up examination after union was arranged at 4, 6, 8, 12 and 18 months, and then annually.

## Results

The mean displacement of the 41 acetabular fractures was 7 mm (3 to 19). In 12 patients, the dynamic fluoroscopic stress views showed some movement of the displaced fragments. This was most evident as the femur was rotated, and was best seen at the ischium. In all patients except for three,

the relationship of the femoral head to the acetabular roof remained constant, throughout rotation and movement.

One of these three patients had a transverse fracture and posterior dislocation of the hip which was reduced within an hour. She also had an associated symphyseal dislocation. As the hip was brought into abduction, the head lost accurate contact with the roof and became congruent with the ischiopubic segment (Figs 1a and 1b). There was also some movement of the ischiopubic segment. The medial roof arc measured 45°. The transverse fracture was fixed through a Kocher-Langenbeck approach and the symphysis was then reduced and stabilised (Fig. 1c).

The second patient had a fracture of the posterior wall and an anterior dislocation of the hip on the contralateral side. Both dislocations were reduced within two hours of admission. On flexion, the femoral head subluxed posteriorly (Figs 2a and 2b). The fracture of the posterior wall measured only 15% of the posterior articular surface and was fixed with a lag screw and buttress plate. The labrum had been torn from the acetabulum but not transected.

The third patient had a fracture of the posterior wall but no frank dislocation. CT showed that 33% of the posterior articular surface was displaced. The hip remained stable



Fig. 2a

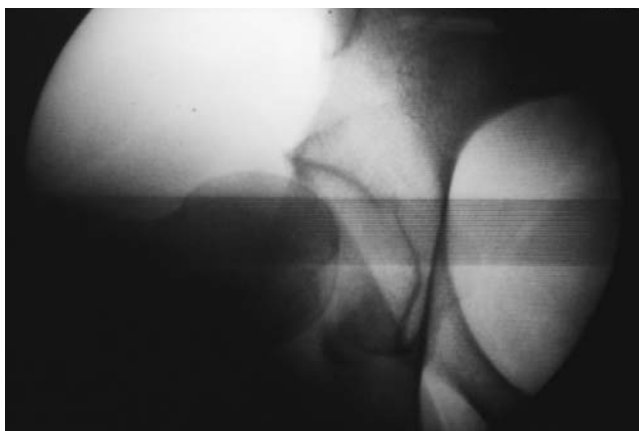


Fig. 2b

Figure 2a – AP fluoroscopic view of a fracture of the posterior wall involving only 15% of the articular surface. The hip is in neutral position and the femoral head is congruent with the acetabular roof. Figure 2b – With flexion of the hip the femoral head subluxes posteriorly and loses congruence with the roof.

through the full range of movement, but when posterior force was applied with the hip flexed and in neutral rotation, it subluxed posteriorly. The labrum was found to be transected at the inferior extent of the fracture. The fracture was fixed with lag screws and a buttress plate.

In all three patients, the subluxation could not be felt by the surgeon but was easily visible fluoroscopically.

The remaining 38 acetabular fractures were deemed stable and were treated non-operatively. In four patients, three of whom had symphyseal dislocations, pelvic fractures were stabilised. Despite being classified as Buchholz type-II injuries (unstable only in rotation), one sacral fracture and two injuries to the sacroiliac joint were fixed. Normally, fixation of the anterior ring would be sufficient, but because the acetabula were not fixed, the iliac wings were mobile. Fixing them with percutaneous iliosacral screws allowed full hip mobility without movement of the iliac wing.

Four patients, including one treated by surgery, were lost to follow-up. The others were reviewed for a mean of 2.7 years. All fractures united and, to date, avascular necrosis has not been seen. None of the patients treated non-operatively has developed significant pain in the hip or groin. After three years, one patient has slight narrowing of the joint space and minimal incongruence of the femoral head with the acetabular roof (Figs 3a and 3b). This, however, is also evident on the opposite side.

The results were good or excellent in 32 of the 35 (91%) patients treated non-operatively. In the remaining three, because of the sequelae of other injuries, the results were only fair. Of the two patients treated operatively and followed up the result was excellent in one and good in the other.

## Discussion

Acetabular fractures which do not involve the weight-bearing dome have a better prognosis than those which do.<sup>8</sup> A certain minimum fracture-free area is necessary in order to achieve a good outcome without surgical intervention. This is assessed from roof-arc measurements on plain radiographs and the subchondral arc on the transverse CT scans.<sup>5-7</sup>



Fig. 3a



Fig. 3b

Figure 3a – AP radiograph of a displaced T-shaped acetabular fracture (45° roof arcs intact), a symphyseal dislocation and a left sacral fracture. On stress testing, the femoral head remained congruent with the acetabular roof, indicating stability. The sacrum and symphysis were fixed and the acetabulum was treated non-operatively. Figure 3b – After three years the healed acetabular fracture has remodelled. There is mild incongruence of the hip, but this is similar to the opposite side. There is no loss of joint space compared with the opposite hip.

A notable exception is both-column fractures. When the entire acetabular articular surface is separated from the intact ilium, the hip may assume a position of secondary congruence. Regardless of measurements of the roof arc, non-operative management may then be considered.<sup>4,7</sup>

Measurements of the roof and subchondral arcs do not apply to fractures of the posterior wall which occur in a region beyond the plane of measurement. The posterior wall is, however, subject to major stresses, especially during the act of rising from a seated position.<sup>11</sup> In cadaver studies undertaken to determine the amount of posterior wall necessary to maintain stability, hips in which there was displacement of 20% or less of the posterior wall were always stable. When there was displacement of 50% of the posterior wall or more, they were always unstable.<sup>12,13</sup> A clinical study has shown that hips with less than 34% of the posterior wall intact were unstable and those with over 55% intact were stable.<sup>1</sup> Presumably, the condition of soft tissues such as the labrum affects the stability of hips in which intermediate amounts of the posterior wall are damaged.<sup>9</sup> Dynamic stress testing provides a direct assessment of stability in these cases.

In deciding the best way to treat an acetabular fracture, the injury and the prognosis have to be assessed and the possible benefits of surgery measured against the risks. These include iatrogenic neural or vascular injury, infection, malunion, heterotopic ossification and penetration of the hip by a fixation device.<sup>4</sup>

Of the 41 acetabular fractures meeting the standard criteria for non-operative management, three (7%) were found to be unstable on fluoroscopic examination. These were treated by operation to prevent subluxation, which may lead to post-traumatic arthritis. Subsequently, these hips were managed in the same way as those treated conservatively. All were mobilised early. At a mean follow-up of 2.7 years, there were good or excellent results in 91% of patients in whom this technique had been used to decide on treatment.

This series requires longer follow-up, but the initial findings strongly suggest that stress views are a valuable diagnostic tool in the treatment of acetabular fracture. The technique gives a more accurate assessment of hip stability than either physical examination or plain radiography, and ensures that patients can be mobilised without the risk of subluxation of the hip.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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