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Acetabular Fractures with Marginal Impaction

Thesis submitted for partial fulfillment of the MD degree in Orthopaedics

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Definition

Marginal impaction was first described by **Letournel 1964** (French: fracture mixte) as the impaction and incarceration into the underlying cancellous bone of small osteochondral fragments from the shattered margin of the acetabulum. [1]

It represents a particular injury pattern occurring in conjunction with a pure posterior fracture-dislocation, or as part of a complex acetabular fracture. [2]

Fifty years after Emile Letournel and Robert Judet published their groundbreaking work on acetabular fractures, surgical treatment of these fractures still imposes a great challenge on orthopaedic surgeons.[3]

In recent years, different publications have demonstrated an increased rate of good postoperative outcomes

Martins et al, 2015 conducted their retrospective study on 192 subjects who underwent surgical treatment of isolated unilateral posterior acetabular wall fractures from January 2000 to January 2012, to describe the CT features of isolated posterior acetabular wall fractures with associated marginal impaction and to discuss the potential therapeutic implications of recognizing this type of fracture.[4]

Leucht et al, 2013 conducted retrospective case series on 43 patients with acetabular fractures with marginal impaction between 2002 and 2009. To compare clinical and radiological outcome between acetabular fractures with marginal impaction that were treated with either cancellous bone graft (CBG) or tricalcium phosphate cement (TPC) as bone void filler. [3]

Giannoudis et al, 2013 conducted a retrospective study on 60 patients with marginal impaction of acetabular fractures over a period of 5 years to identify risk factors associated with poor outcome in treatment of marginal impaction of acetabular fractures.[5]

Wu et al, 2003 conducted a retrospective study on 26 patients with marginal impaction of acetabular fractures over a period of 7 years to understand the diagnosis and treatment of marginal impaction of acetabular fractures.[6]

In Martins et al, 2015 anatomic reduction was achieved in 174 (90.6%) patients, and imperfect reduction was achieved in 18 (9.4%).[4]

In **Leucht et al, 2013** 25 fractures (69%) showed anatomic reduction, 8 fractures (22%) exhibited satisfactory reduction and 3 fractures (8%) were graded unsatisfactory.[3]

Giannoudis et al, 2013 reported anatomical in 44 hips (73.3%) and imperfect in 16 (26.7%).[5]

Importance of detection of marginal impaction

Without soft-tissue attachment, the fragment remains displaced when the femoral head is reduced into the acetabulum. Displacement of this fracture creates severe articular incongruity which if left untreated leads to the development of osteoarthritis. [2]

Marginal impaction destabilizes the joint and will need to be recognized and addressed. It is considered a poor prognosticator but should nonetheless be elevated and stabilized as anatomically as possible. Recognition of the articular comminution and presence of marginal impaction are necessary for proper equipment and surgical approach selection while some posterior column and transverse fractures can be reduced and stabilized through anterior approach, it is not possible to address posterior wall and posterior marginal impaction fractures**.**[7]

Marginal impaction is not the only local chondro-osseus problem related to these fractures. For this reason, the femoral head should be evaluated for resultant impaction or cleavage injuries and the hip joint inspected for debris. Common sites for debris include the fossa acetabuli, between the femoral head and acetabular dome, and between the anterior femoral head and capsule. Debris can be fragments of cartilage, cancellous bone, cortical bone, or any combination of the three. Capsular and labral tissues may also be mislocated within the hip joint**.** [8]

Incidence

Wu et al, reported that posterior wall fractures and dislocations of acetabular fractures are easily combined with marginal impaction.[6] In **Leucht et al,**

the incidence of marginal impaction with posterior wall fracture was 47%(20 out of 43) [3].However marginal impaction can well accompany all types of fractures.[1]

Giannoudis et al, 2013 reported that the incidence of marginal impaction with different types of acetabular fractures was: 60% posterior wall, 17% posterior column + posterior wall , 10% both columns, 9% Transverse + posterior wall and 5% other types.[5]

Relevant Anatomy

I-Posterior Wall

It is the inner surface of the posterior column of the acetabulum, and its anterior surface forms the posterior articular surface of the acetabulum. The posterior wall is larger and projects more laterally than the anterior wall. Its lateral edge has a nearly vertical but slightly curved route.[9]

The posterior wall is the most vulnerable portion of the acetabular structure, lying farthest from the support of the arch of the two columns. It is the most commonly and easily fractured, and the most important for stability.[9]

Fractures of the posterior wall of the acetabulum involve separation of a segment of the posterior articular surface. These fractures fall into the following distinct sub-groups:

- Typical fractures of the posterior wall confined totally below the roof.
- Postero-superior fractures in which part of the adjacent roof becomes separated.
- Postero-inferior fractures in which the detached fragment includes the inferior horn of the articular surface, the sub-cotyloid groove and often the superior portion of the ischium.[1]

II-The Articular Cartilage

The acetabular socket is covered by a cartilaginous surface. This surface has a crescent shape, as cartilage covers the anterior and posterior walls and most of the dome but is absent medially and inferiorly (Fig 1). Because of this shape, it is labeled “horseshoe” or “lunate face.” Mathematic investigation has shown that the shape of the acetabular cartilage surface results in the optimal distribution of articular contact forces and the elimination of peak stress areas.[10]

The articular cartilage is thinnest anteriorly and somewhat thicker posteriorly. Pressure studies have shown that all the surfaces play an important role in load sharing. Loss of even an insignificant piece of posterior wall leads to changes in joint pressures.[11]

The joint space is approximately 4 to 5 mm wide on an AP (anteroposterior) radiograph of the hip. It has been shown that the maximum thickness of articular cartilage lies in the position of maximum load in the roof of the acetabulum.
Thus, the most important single structure in the acetabulum is the *articular cartilage*.[11]

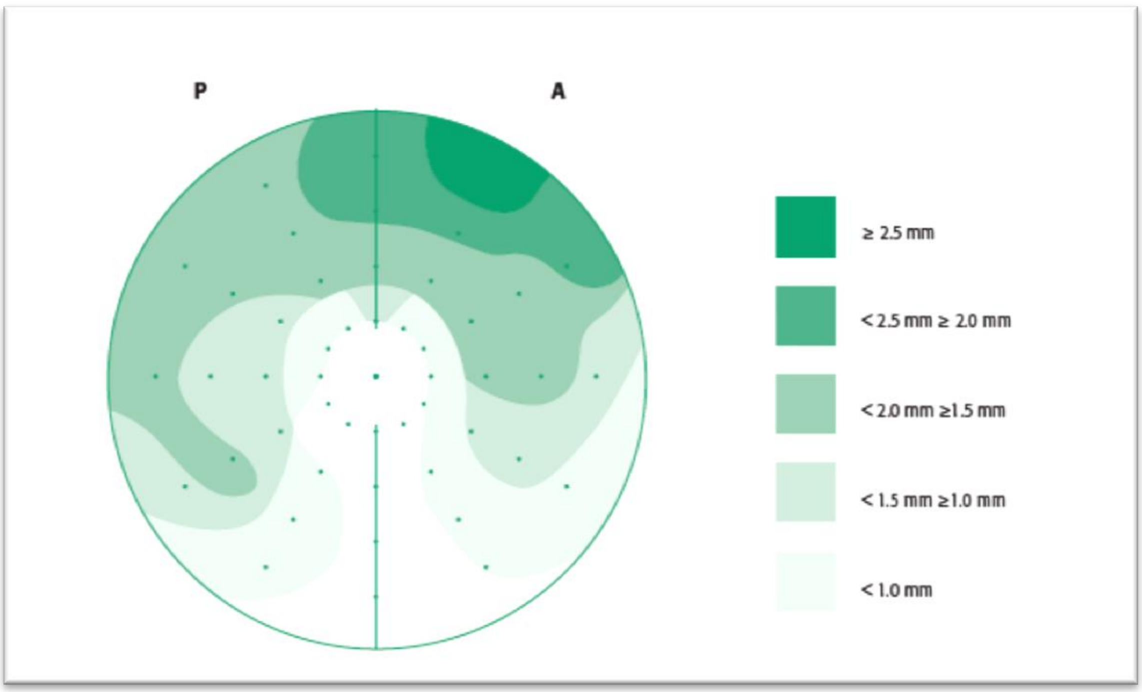

Fig1. Horseshoe-shaped cartilaginous surface of the acetabulum. The average distribution of cartilage thickness is represented as measured on ten cadavers by Kurrat et al. The sagittal plane midline is represented by the vertical line. Anterior (A) is to the right and posterior (P) is to the left.[10]

Mechanism of injury

In its displacement by the fracturing force, in whatever direction, the femoral head breaks the acetabular articular surface. Regularly the head breaks off segments of the articular surface, pushing them in front of itself. Frequently, in addition to these fragments delineated by a fracture line running through the articular surface, the femoral head also breaks the inner part, the "marginal part", of these articular segments, but instead of pushing them in front of it, it subjects them to a rotational movement, resulting in their impaction into the underlying cancellous bone. [1]

In general, there are four points of application for the energy necessary to produce a fracture of the acetabulum: the greater trochanter, the knee (when this joint is in the flexed posture), the foot (the knee being extended), and the posterior aspect of the pelvis.[1]

Many variables can cause the different types of fractures including the sitting position and load of the impact. Dashboard injuries with the hip flexed and some degree of internal rotation cause posterior wall fractures of all types, including those associated with posterior column (fig2 & fig3) .[1]

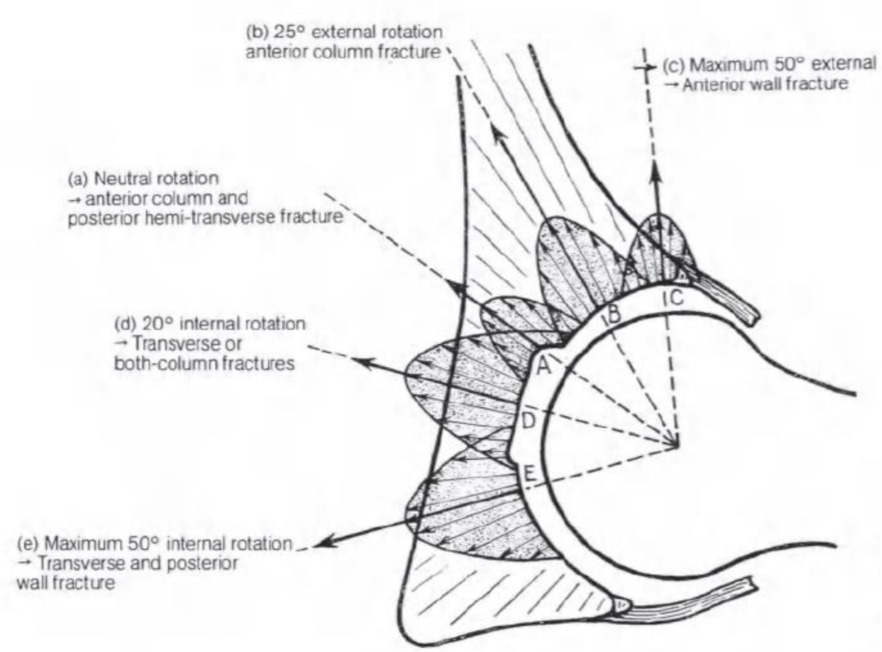

Fig2. Horizontal section through hip joint showing sites of application of force as influenced by internal and external rotation.1

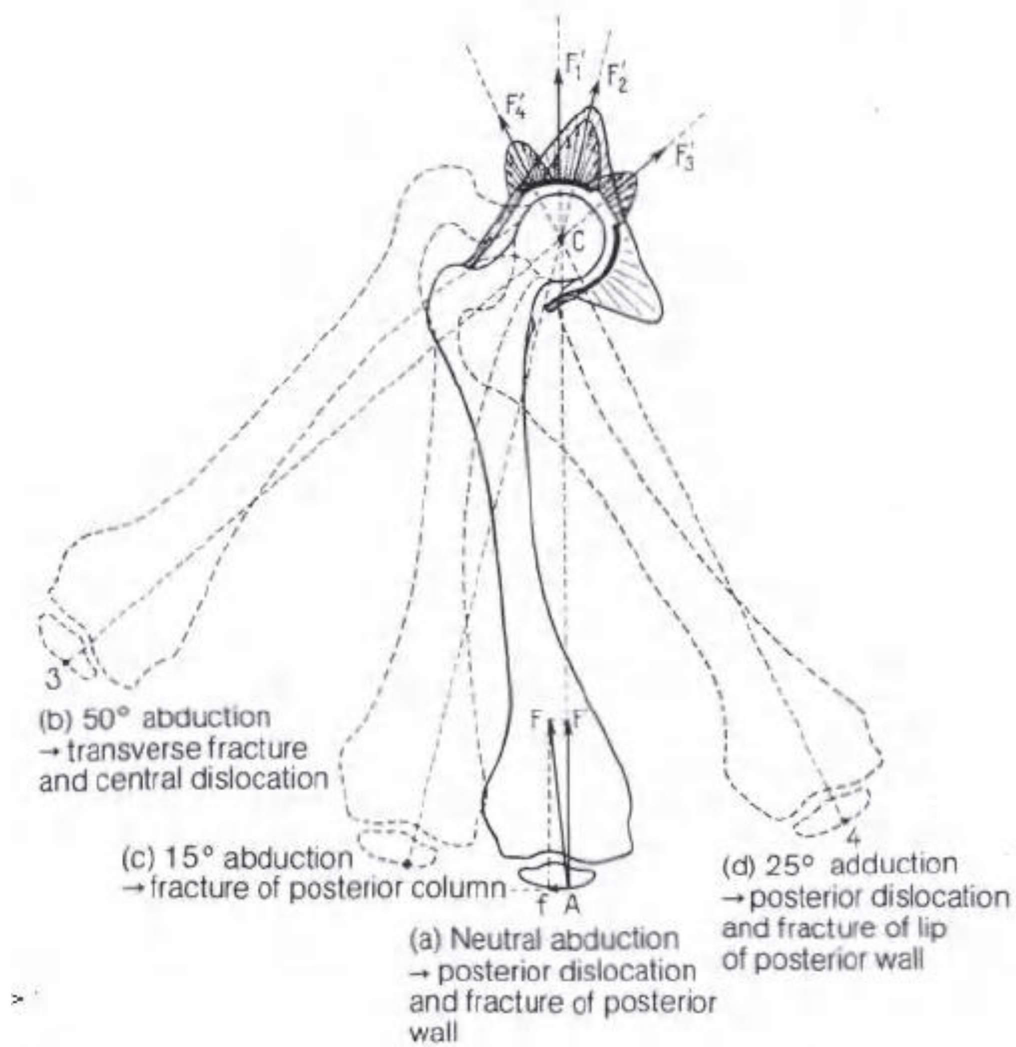

Fig3. Horizontal section through the hip Joint showing force acting through the knee.[1]

The significance of the capsular injury in mechanism of marginal impaction

Is that it facilitates the escape of the femoral head. In contrast, when the capsule remains intact, the head dislocates after fragmenting the inner edge of the fracture margin, the osteochondral segments becoming incarcerated and impacted into the underlying cancellous bone (Fig.4). [1]

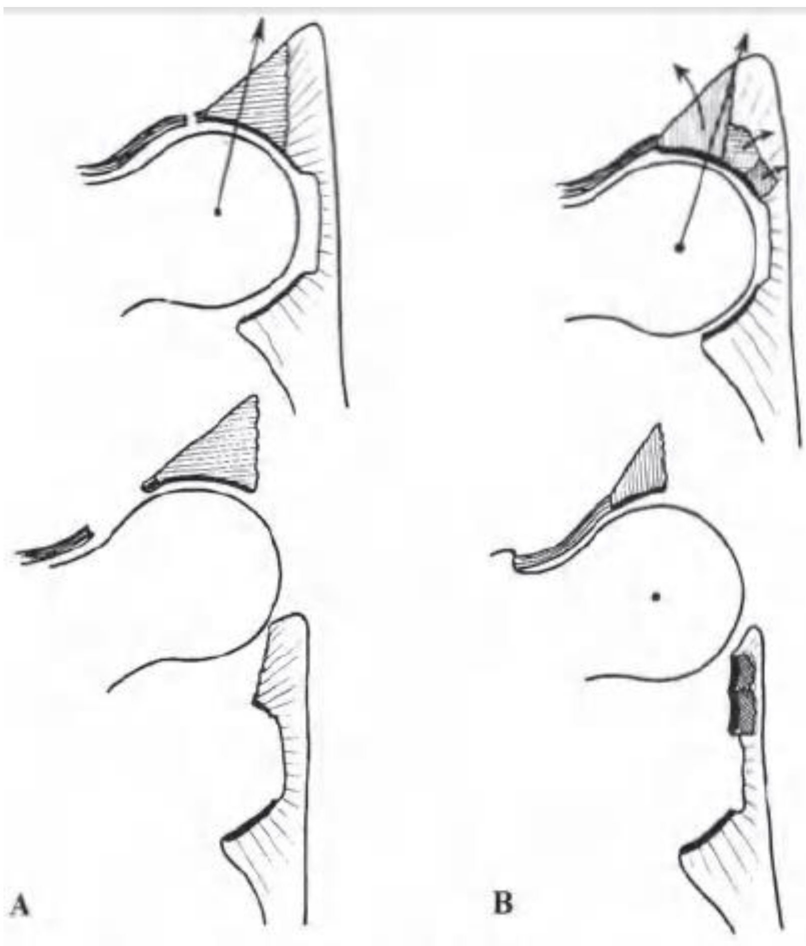

Fig4. Diagrams of posterior wall fracture. A Pure fracture-dislocation, B fracture-dislocation with marginal impaction.[1]