EXPERT COMMENTARY

Acetabular Fractures – Revisiting the Basics of Management with tips and pearls for fracture fixation.

Parag K Sancheti[1], Atul Patil[1], Ashok K Shyam[1].

Acetabular fractures are still an enigma and pose a major challenge to treating orthopaedic surgeon1. Pioneering work was done by Letournal and Judet in 1964[2]. They classified the acetabular fractures and developed a logical line of thinking while dealing with these fractures. They improved the understanding of morphology and popularized surgical management of these injuries. Letournal and Judet conceived acetabulum to be made of two columns. Anterior column from below the sacroiliac joint to the ischial tuberosity and anterior column from superior iliac crest to pubic symphysis with both columns attached to the sacrum by thick strut of bone lying above greater sciatic notch and called sciatic buttress [Fig 1]. Based on these anatomical factors they suggested the first systematic classification of acetabular fractures.[2] Although comprehensive classification is necessary for investigational purposes such as prognosis and outcome studies, it is less important in making decisions on individual cases. In trauma every case is different, therefore, trying to force square plug in a round hole is counterproductive. The surgeon must know the basic fracture types, but even more important, he must be able to interpret the radiographs and draw the fracture lines on a dry skeleton. Next issue is of selection of appropriate approach so as to assess the area of interest. Again innovative work was performed by Letournal and Judet and their recommendation is still valid till date.[2,3]

Restoring a congruent and stable hip with an anatomically reduced articular surface is most important factor in management of these fractures. The long-term follow-up studies of Letournel and Matta demonstrate that fractures reduced to within 1mm of residual articular displacement have less of an incidence of posttraumatic arthritis and have a more durable and long lasting functional hip joint than those fractures with 1 - 3 mm of residual displacement.[4,5]

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[1]Department of Orthopaedics, Sancheti Institute for Orthopaedics and rehabilitation, Pune Maharashtra, India.

Address for correspondence: Dr Parag Sancheti,
Sancheti Institute for Orthopaedics and Rehabilitation, first floor, Shivaji nagar, Pune, Maharashtra, India.
Email: parag@sanchetihospital.org

To meet these goals four objectives are to be kept in mind

1. Correct Interpretation of the radiographs
2. Identification and understanding the fracture pattern
3. Choosing the appropriate management
4. Striving for best surgical result.

1. Correct interpretation of radiographs-

On the antero-posterior pelvis radiograph, six lines are identified: the ilioischial line, iliopectineal line, the weight bearing dome (sourcil), teardrop, anterior rim (acetabulo-obturator line), and posterior rim (ischioacetabular line) (Fig. 2). The iliopectineal line is generally considered to represent the anterior column. The ilioischial line is mostly equated with the posterior column but is not actually created by the posterior border of the innominate bone but by the cortex of the quadrilateral surface. Thus fractures that disrupt the quadrilateral plate are seen as discontinuity of the ilioischial line even though these fractures do not disrupt the posterior border. The radiographic roof represents the cranial portion of the acetabular articular surface, the weight bearing dome of the acetabulum. The lateral limb of the teardrop represents the floor of the cotyloid fossa while the medial limb represents the lateral wall of the obturator canal. Thus, fractures through these areas may show splitting of the tear drop. The anterior and posterior rims give some idea about the wall fractures however they are better diagnosed on Judet views.

Obturator view- taken with pelvis tilted 45 degrees and injured side up. The anterior column and the posterior wall is best visualized in this view Iliac view –The posterior column and the anterior wall are visualized well (Figure 3a).

Iliac view – taken with pelvis tilted 45 degrees and injured side down. The posterior column and the anterior wall are visualized well (Figure 3b).

2. Identifying and understanding the fracture pattern-

According to Brander and Marsh6, answers to following eight questions about the radiographic observations are used to determine the acetabular fracture pattern:

A) Is a fracture of the obturator ring present? If the obturator ring is broken then the fracture is either a column type of' fracture or a T-shaped fracture.

Figure legends

Figure 1. drawing showing division of the pelvis into two columns namely the anterior and the posterior columns.

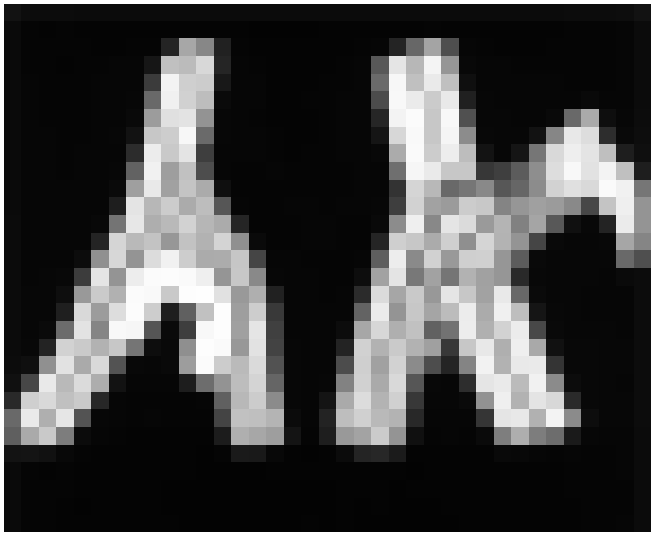


Figure 2. Anterior posterior view of the pelvis showing various radiological landmarks. The ilioischial line (blue line), iliopectineal line (red line), the weight bearing dome (green line), teardrop (yellow), anterior rim (black line), and posterior rim (brown line).

Figure 3. a- Obturator view showing posterior coloumn and anterior wall. B – iliac view showing anterior column and posterior wall

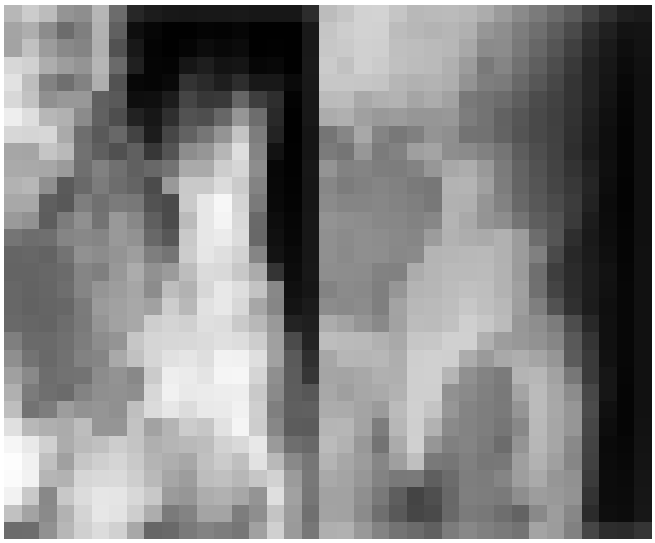


Figure 4. Showing obturator oblique view with spur sign

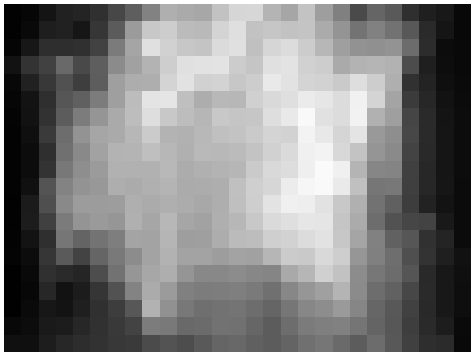


Figure 5. Kocher-Langenbeck approach – A- skin incision. B- exposing the greater tuberosity and short rotators of the hip, C- identifying and isolating the sciatic nerve, D- exposing the fracture site.

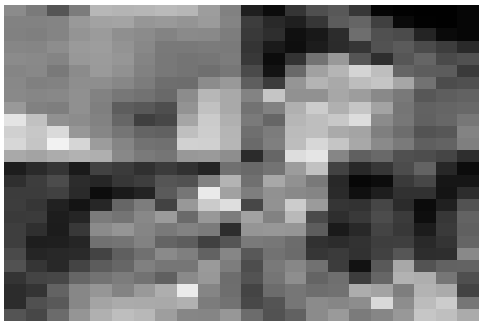


Figure 6. Kocher-Langenbeck approach – A- fracture fixed with recon plate, B- radiograph showing fixation in the same case.

Figure 7. Ilio-Inguinal approach – A- skin incision. B- subcutaneous dissection: ASIS- anterior superior iliac spine, EO – external oblique muscle, EIR- external inguinal ring. C- three windows to approach the bone A- anterior superior iliac spine, B- psoas muscle, C- femoral neurovascular bundle, D- spermatic cord. D- exposure and fixation of the fracture of anterior column.

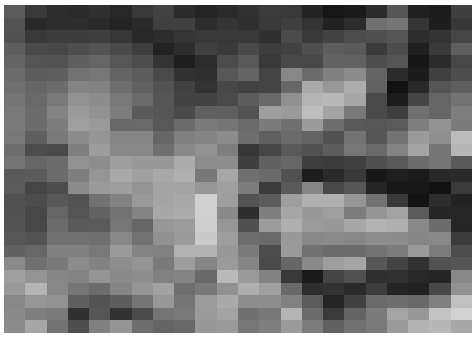


Table 1. Based on criteria by Brandser and Marsh9

B) Is the ilioischial line disrupted? Disruption of the ilioischial line occurs in fractures involving the posterior column or fractures in the transverse group.

C) Is the iliopectineal line disrupted? Disruption of the iliopectineal line indicates anterior column involvement or 1 of the transverse-type fractures.

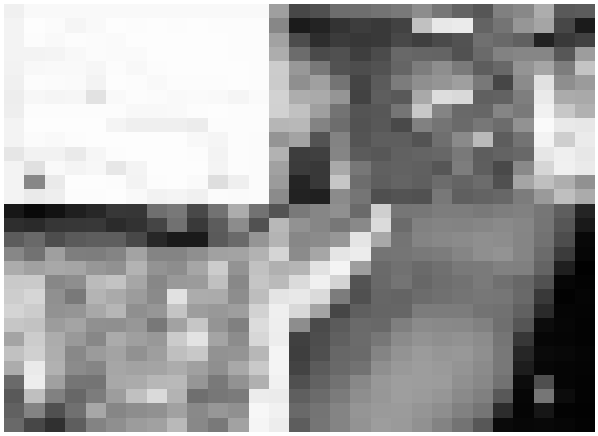
D) Is the iliac wing above the acetabulum fractured? Iliac wing fractures are observed in fractures involving the anterior column, anterior column with posterior hemitransverse or both column fractures.

E) Is the posterior wall fractured? Posterior wall fractures may occur in isolation or in combination with posterior column or transverse fractures.

F) Does the fracture divide acetabulum into front and back halves or front and bottom halves? T type fracture divides pelvis into top and bottom halves while a column type divides pelvis into front and back halves

G) Is the spur sign present? The spur sign is observed exclusively in the both-column fractures. The spur is a strut of bone extending from the sacroiliac joint. Usually, this strut of bone connects to the articular surface of the acetabulum. In the both-column fracture, this connection is disrupted; a fractured piece of bone that resembles a spur remains. The spur sign is best depicted on the obturator oblique view [Fig 4]

Figure 8. Extended Ilio-femoral approach. A- skin incision, B- exposure of the fracture site, C- fracture fixation with bi-columnar plating, D- skin scar after suture removal.



H) What is the orientation of major fracture line on CT scan?

According to the answers of these eight questions, the fractures can be classified using Letournal and Judet classification as shown in Table 1.

3. Choosing the appropriate management pathway:

Need for surgical intervention can be determined by following two criteria's

Fracture criteria's – Unstable hip [the femoral head and acetabulum are non congruent on AP radiograph], Roof arc angle is less than 45°, intraarticular fragments, marginal impaction, unreduced fracture dislocation

Patient factors – Age [>50 yrs think of conservative treatment and later date Total Hip arthroplasty when arthritis develops], severe co morbidities [ASA grade III or more - Consavative management], pre existing hip arthritis [Consavative management and THA later], severe osteopenia, patients with psychiatric disorders, patients with restricted pre injury mobility.

First decide whether radiograph will require surgery, and then assess the patient for feasibility of surgical intervention. If answer to any of the above question is negative the fracture is treated conservatively.

Few Tips in patient assessment –

Morel-Lavalle´ lesions contain liquefied hematoma and have been known to be culture positive nearly 30-50% of times. In such cases drain the hematoma and perform delayed surgery.

Complete neurological examination and documentation is necessary especially in posterior dislocation as it is associated with high incidence of sciatic nerve injuries [20%] which if discovered later gives unsatisfactory result to the patient and may lead to legal issues.

In case the surgery is delayed, skeletal traction is essential

4. Striving for best surgical result.

This involves a definite learning curve

Surgical approach is determined based on the fracture classification

Depending on fracture classification the approach for surgery is to be determined. There are four main approaches used for acetabular fractures.

A. Kocher-Langenbeck: Posterior wall, Posterior column, Transverse, Transverse PW, Posterior column PW, T shaped [Fig 5, 6].

B. Ilioinguinal: Anterior wall, Anterior column, Anterior Posterior Hemitransverse, Both- column fractures, Transverse (rare) [Fig 7].

C. Extensile iliofemoral approach: Both-column fractures, T shaped, Transverse PW, Fractures > 3 weeks involving both columns [Fig 8]

D. Combined: A single approach is always preferred however combined approaches may be needed for more complex fractures involving both columns.

4. Striving for anatomical reduction.

This is by far the most important variable affecting the outcome of acetabular surgery along with severity of initial trauma. It involves a definite learning curve, probably best documented in a report by Matta and Merritt of the first 100 acetabular fractures treated operatively by Matta.7 Grouping the surgical reductions chronologically in groups of 20 clearly showed that experience improved the ability to avoid unsatisfactory reductions and to perform anatomical reductions

Tips and pearls for acetabular surgery

Keep three points in mind - Avoid Devascularization of Fragments, Remove all Intra-articular Fragments, and try to achieve anatomical reduction.

After exposure, open and clean the fracture site and get intraarticular visibility by a wide capsulotomy which will help in assessing the intraarticular reduction.

Special instruments in form of reduction clamps etc must be kept ready and used when necessary to hold reduction and achieve provisional K wire fixation

Reduction of the fragments – this will require two things – traction to the femur and opening through the fracture.

-Traction can be applied by a traction table or direct traction via a corkscrew through femoral neck or a hook on greater trochanter might work as well.

- Open the fracture by removing the major piece out of the way and appreciate the impacted fragments. These fragments have to be reduced to achieve best result.

- In cases where there is a major posterior fragment [high transverse and major T – type], a Schantz pin with a T-handle can be introduced into the ischial tuberosity to manipulate the reduction.

Provide stable fixation – most reliable fixation is a lag screw compression. So after reduction of the fracture, provisionally fix it with Kirschner wires and then pass lag screws. The fragment can be predrilled first, then reduced and held with two 1.6-mm smooth Kirschner wires. Then each wire is then sequentially replaced by lag screws. This method will prevent shift/toggle of the fracture fragment while insertion of the lag screws.

It is desirable to have two points of fixation for each fragment, however this may not be possible because of small size although use of mini screws may be considered

After this a neutralization plate is applied to augment the fixation. Here one should keep in mind that lag screws should always be placed along the rim of posterior wall fragments, and care should be taken to ensure that the plate buttressing the posterior wall are positioned as lateral as possible. Applying the buttress plate too medially, especially without rim lag-screw

fixation, might result in loss of stabilization of the posterior wall

Keep in mind two points while fixing the fractures - Avoid Over-Contouring of Plate, Put in more lag screws rather than a bigger plate

In cases with bi columnar fractures the anterior fragment is fixed with lag screw in first stage. While reducing the posterior column sometimes the anterior column screw needs to be backed out to help get the best reduction after which the screw is re-tightened.

A word of caution about the posterior approach:

The sciatic nerve must be identified and protected by knee flexion and using the muscle belly of short rotators to protect while retraction. Keep in mind that sciatic nerve varies in its relationship with pyriformis but always lies behind the quadrates muscle where it is best identified.

. The greater sciatic notch has the superior gluteal artery and nerve which can be damaged while stripping the periosteum from this area. This artery, if damaged, can retract into the pelvis and bleed.

. Retraction of the hip abductors might be required for visualization of superior acetabulum; however this may cause traction injury to the superior gluteal nerve which supplies the major hip abductors and the gluteus medius and minimus muscles.

The risk of iatrogenic osteonecrosis of the posterior wall fracture fragments. This problem is caused by excessive stripping of their soft-tissue attachments. Every attempt should be made to maintain the capsular attachments to these posterior wall fragments.

CONCLUSTION :

Proper planning and execution will help in acheiving good result in majority of cases of acetabulor fractures.

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