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Open reduction and internal fixation of complex acetabular fractures

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Abstract
Acetabular fractures being intra-articular, on a major weight bearing joint-the hip; pose major surgical challenges, especially the complex ones. Acetabulum fractures require systematic approach for understanding the fracture pattern and also for planning the treatment plan. The fractures have to be correctly identified radiologically and clear definition of fracture patterns should be made before planning. The radiological parameters must be kept in mind in planning of surgical approach and also the fixation method. This may require a long learning curve but these basics have to be kept in mind while dealing with acetabulum fractures. There are new techniques like 3d CT, virtual assessment of the fracture, 3D print modelling of the fractures that may help in complex fractures, but the basic principles remain the same. Advancements in technology simply refines the ways and means of interpretation and implementation of the basic principles.

Keywords: acetabular fractures, kocher-langenbeckapproach, ilioinguinal approach, matta's radiological

Introduction
Acetabular fractures are still difficult fractures to manage and are a major challenge to treating orthopaedic surgeon. Pioneering work was done byLetournal and Judet in 1964. They systematically classified acetabular fractures and developed a logical line of thinking for dealing with these fractures. They improved the understanding of morphology and popularized surgical principles for management of these injuries. Letournal and Judet put forth the two column theory of acetabulum anatomy. They envisioned acetabulum to be made of two columns. Anterior column from below the sacroiliac joint to the ischial tuberosity and posterior 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.
Patient age, fracture stability, the presence of co-morbidities and osteoporosis, combined with surgeons experience all influence treatment options and the final outcomes. The goals of the treatment should be anatomic reconstruction of articular surface and early non-weight bearing mobilisation. This goal can be achieved only when acetabulum is rigidly internally fixed.

Aim of the study
The purpose of this study was to determine the clinical and radiological outcome in patients in whom a displaced fracture of the acetabulum had been treated by open reduction and internal fixation with plates and screws.

Materials and Methods
This is a prospective study involving 15 patients with acetabular fractures treated by open reduction and internal fixation with plates and screws. All the patients were assessed at a mean of 2 years. The open reduction internal fixation functional outcome results were analyzed using the modified Merle's Aubigne and Postel grading system and the radiological outcome by the Mattas' criteria.

Inclusional criteria
Age greater than 18 years.

All simple and complex fracture patterns.
Closed fractures.

Exclusion criteria
Open fractures.
Fracture older than 2 weeks.
Unfit patients.

Clinical and radiological assessment
Detailed History was taken as the mode of injury gives the magnitude of force and its direction, upon which depends the pattern, displacement and comminution of fracture. A thorough physical examination includes inspection for external injuries, wounds, contusions and bruises. Special attention was given to look for Morel Lavelle lesion, bleeding per urethral meatus, rectal tear and other perineal injuries. Attitude of the injured limb and its distal neurovascular status was assessed. Rectal examination was done to rule out rectal tear and central dislocation of head of femur which is palpated as a globular mass.
After clinical assessment, and haemodynamic stabilization, patient was shifted for radiological assessment. Three radiographic views of acetabulum and CT scan form the standard protocol.

- Anteroposterior view of pelvis with both hips.
- Judet views- obturator and iliac oblique views.
- CT scan – with 3D reconstruction.

Open reduction and internal fixation was done within 5 to 10 days of injury.

Surgical exposure
Surgical exposure was decided preoperatively based on fracture displacement. Kocher Langenback approach was used for posterior fractures and anterior ilioinguinal approach was used for anterior fractures. After reducing and fixing one column the reduction of other column was assessed by image intensifier and the need for exposing the other column was planned accordingly.
Anterior ilioinguinal Approach: Skin incision was placed in midline 2 fingerbreadths above the symphysis pubis, extended to the anterior superior iliac spine and then continued posteriorly along the line of the iliac crest. The aponeurosis of the external oblique was incised in line with the skin incision. An incision was carefully made along the inguinal ligament from its medial attachment to the pubis to the anterior superior iliac spine along its fibres. Three windows were created for visualization. The first window was formed by medial retraction of the iliopsoas and femoral nerves allowing visualization of the entire internal iliac fossa, the sacroiliac joint, and the pelvic brim. After mobilizing the iliopsoas muscle, Iliopectineal fascia was palpated and their medial and lateral surface was defined before its division. Blunt dissection was continued below the vessels. The second window was created by lateral retraction of the iliopsoas and femoral nerve, combined with medial retraction of the external iliac vessels and third window by lateral retraction of the vessels. Ilioinguinal approach.
Posterior Kocher Langenbeck Approach: Skin incision was placed lateral to the posterior superior iliac spine, extended to the greater trochanter, and then continued along the axis of the femur to almost the midpoint of the thigh. The sciatic nerve was identified on the posterior surface of the quadratus femoris and followed proximally until it disappears beneath the piriformis. The tendons of the piriformis and obturator internus are transected at their trochanteric insertion and retracted posteriorly, exposing the greater and lesser sciatic notch. Subperiosteal elevation was done to expose the inferior aspect of the iliac wing. A trochanteric osteotomy can help in further visualization of the inferior iliac wing and the interior of the joint.

Reduction techniques: Various reduction clamps are available to facilitate reduction and holding. In anterior approach a Farabeuf clamp or a schanz pin are placed in iliac crest to manipulate and reduce. Matta‘s Quadrangular clamp of various sizes and with offsets and Picador ball spike pusher are very important instruments in Acetabular surgery.
Reduction was fixed with lag screws whenever possible. Lagging was done with 4mm cancellous screws or 3.5 mm cortical screw with washer. 3.5mm Reconstruction plates areusedas neutralization plate.

Outcome assesment tools and criteria
Patients in our study were analyzed by the Matta’s radiographic assessment post operatively and modified Merle d‘Aubigné and Postel Hip Score at each follow up.

Matta’s radiological criteria

Table 1: Post-Operative radiological assessment for degree of displacement post surgery

Displacement	Reduction grade
Zero – 1 mm	Anatomical
2-3 mm	Imperfect
>3mm	Poor

Table 2: Merle d Aubigne and postel criteria for clinical assessment

Pain	
none	6
Slight or intermillent	5
After walking but resolves	4
Moderately severe but patient is able to walk	3
Severe, prevents waking	2
Walking	
Normal	6
No cane but slight limp	5
Long distance with came or crutch	4
Limited even with support	3
Very limited	2
Unable to walk	1
Range of motion	
95-100%	6
80-94	5
70-79	4
60-69	3
50-59	2
<50	1
Clinical grade	
Excellent	18
Good	15, 16, 17
Fair	13, 14
poor	<13

Results
15 patients with simple &complex acetabular fractures were treated surgically and analyzed with average follow up of 18months ranging from 12 months to 24 months.
Mean patient age was 40 ± 5 years (range 25–60 years). The right acetabulum was involved more commonly than left hip. The mode of injury was road-traffic accident in 12 and fall from a height in three. Fracture-reduction quality postoperatively, as

measured on plain radiographs, was graded as anatomic in 8 hips, imperfect in five and poor in two patientspoor and complicated by avascular necrosis who were benefited by total hip replacement. Final d'Aubigné and Postel scores were excellent in 7 hips, fair in three and poor in three.

Discussion & conclusion

The main findings of this study were that patients with anatomical reduction have a favourable functional and radiological outcome on a long term basis. An anatomical reduction was achieved in most of the patients and the result depends on several factors of which the most important is the time of the surgery. The radiographic results are superior in cases which are operated earlier. We resorted to screw fixation alone wherever fracture configuration comprised a large, solid, single chunk of bone and plate-and-screw fixation was used in the remainder of cases. Screw fixation permits a lesser degree of soft-tissue handling and dissection compared with plate-and-screw fixation. In our study, we used minimal soft-tissue stripping, which led to favourable outcome. Soft-tissue-sparing using the modified Kocher–Langenbeck approach involves working on the posterior wall through windows between the gluteus medius and piriformis muscles superiorly and between short rotators and ischial tuberosity inferiorly without dividing the rotators and abductors.

Articular congruity reconstruction and stable fixation reduces the incidence of posttraumatic osteoarthritis. Thus, a high percentage of long term good-to-excellent results can be expected following anatomic reduction and stable internal fixation of these fractures, although anatomical reduction is not the sole criteria for a good final outcome.

Case illustrations

Fig 1: Pre op

Immediate post-op

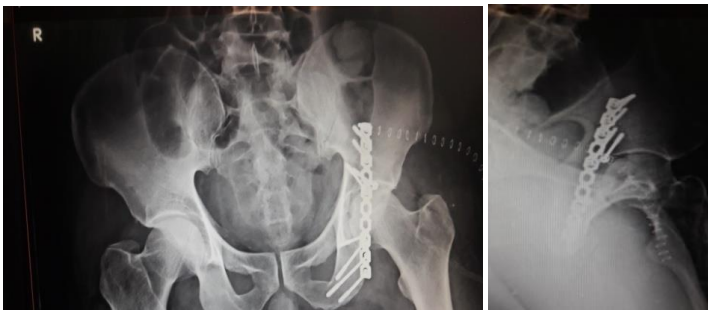

Fig 2: Posterior column fixation

4 months post-op

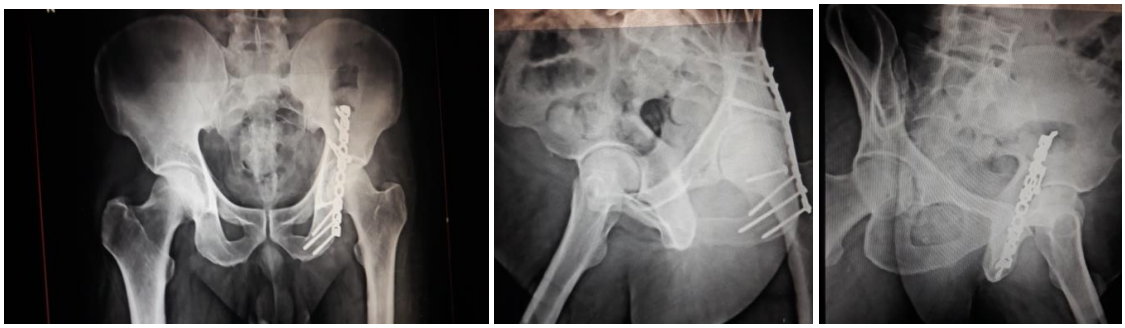

Fig 3: Obturator oblique and iliac oblique views

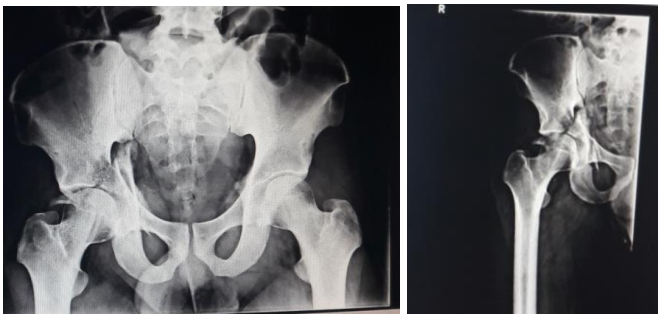

Fig 4: Pre-op

Immediate pos-op

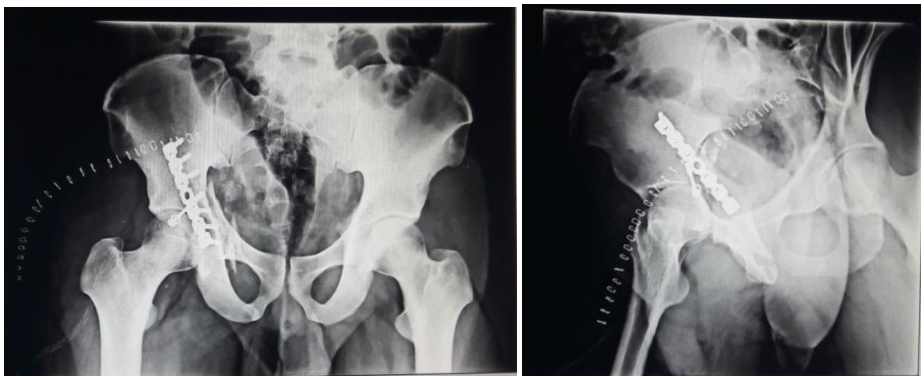

Fig 5: 5 Months postop

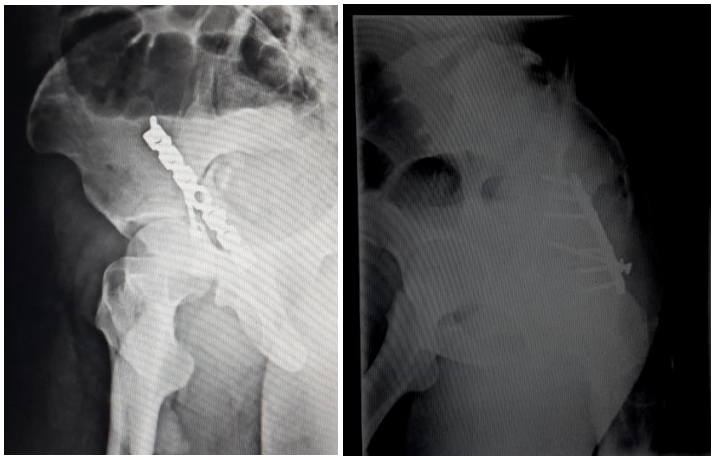

Fig 6: Anterior column

Case 3: Pre-op

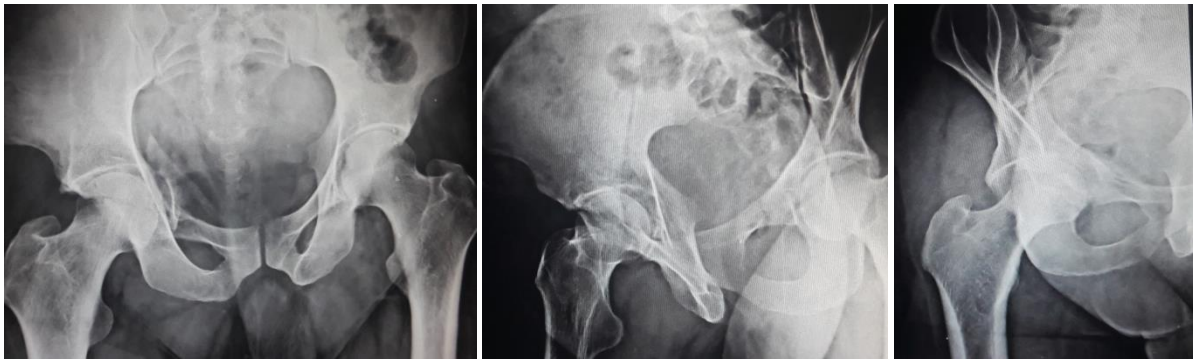

Fig 7: Ilioinguinal approach and fixation with one-third tubular plate and cancellous screws

Immediate post-op

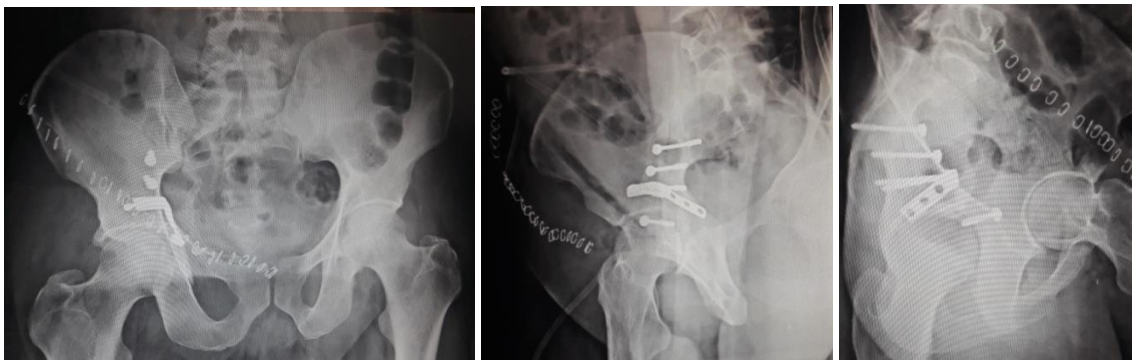

Fig 8: Judet views

4 months follow up

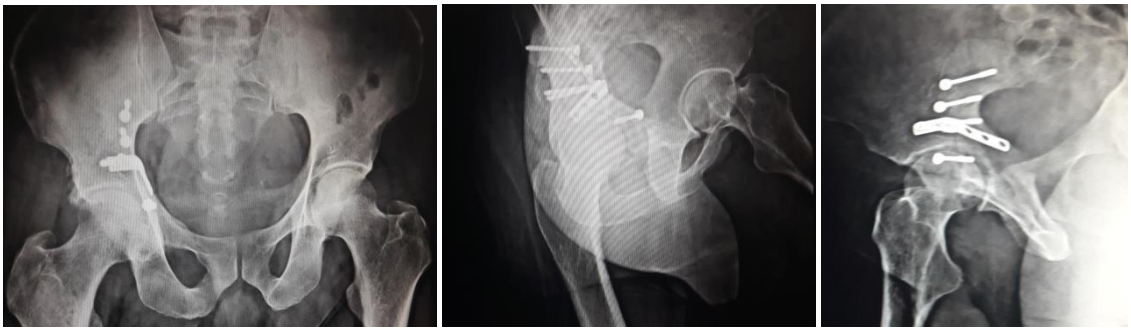

Fig 9

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