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# An analysis of surgical management of acetabular fractures

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**Abstract**
With increase in number of high-speed road traffic accidents the incidence of acetabular fracture is increasing. Historically satisfactory results after non operative treatment of acetabular fractures were obtained only in a minority of cases (13-30%). Non operative treatment options include traction and early mobilization with progressive weight bearing. Unsuccessful outcomes after non operative treatment were mostly related to early posttraumatic arthritis likely due to articular incongruity, hip joint instability, and muscle dysfunction. In our study, all the acetabular fractures are classified using standard investigations, operatively managed in indicated cases and followed up post-operatively with regards to improvement in clinical and radiological outcome. Out of 50 patients, 12 patients had excellent result, 24 patients had good result, 9 patients had fair result, and 5 patients had a poor result.

**Aims and Objectives**
1. To study and analyze the outcomes of open reduction and internal fixation in patients with acetabular fractures in terms of radiology, clinical and functional outcomes.
2. To study the role of early range of motion exercises in the functional outcome.
3. To study the complications associated with the surgical approaches.

**Materials and Methods**
1. Type of study: Descriptive, case series, comparison study, partly retrospective and prospective.
2. The study was done to assess the clinical, radiological and functional outcome of patients with acetabular fractures treated with open reduction and internal fixation at Goa Medical College.
3. Study setting: Inpatient ward no 103,104,105, under Department of Orthopaedics, Goa Medical College.
4. Methods: All fractures have been classified using the Letournel and Judet classification. All the cases were followed up post operatively and were analyzed for radiological, functional and clinical outcome. The radiological outcome was evaluated with radiograph pelvis AP view, Obturator oblique view and Iliac oblique views. The functional outcome was evaluated with Merle d'Aubigne and Postel modified clinical grading system and Harris hip score.

**Keywords:** Acetabular fracture, harris hip score, post traumatic arthritis, sciatic nerve palsy

## Introduction
With increase in number of high-speed road traffic accidents the incidence of acetabular fracture is increasing. Historically satisfactory results after non operative treatment of acetabular fractures were obtained only in a minority of cases (13-30%) [1, 2, 3, 4]. Non operative treatment options include traction and early mobilization with progressive weight bearing. Unsuccessful outcomes after non operative treatment were mostly related to early posttraumatic arthritis likely due to articular incongruity, hip joint instability and muscle dysfunction.

Prior to the classic work by Judet and co-workers [5, 6] and Letournel [6, 7, 8], there was little understanding of the complex patho-anatomy and proper surgical management of acetabular fractures. However, following the introduction of their classification scheme and novel surgical approaches, the last three decades have seen improvements in surgical approaches, techniques of reduction, and implants, leading to more consistently good results [5, 6, 7, 8, 9, 34].

## Inclusion Criteria
All types of acetabular fractures
Age between 20 -70 years

**Exclusion Criteria**

Acetabular fractures associated with pubic diastasis / SI joint disruption Acetabular fractures associated with femoral head fracture Surrounding the adult acetabulum are several bony landmarks that can be used internally and externally as a guide for the position of the native anatomy. The primary landmark of the hip is the anterior superior iliac spine (ASIS). This landmark lies superior and just lateral to the acetabulum and is called 'the lighthouse of the hip and acetabulum'. The iliopectineal eminence is an important internal landmark marking both the medial border of the acetabulum in the coronal plane and the iliopectineal bursa [12, 13].

**Mechnism of Injury**

Acetabular fractures are caused by the forces that drive the femoral head into the acetabulum. The fracture pattern, therefore, is dependent on the

- Position of the femoral head in the acetabulum at the time of injury,
- Direction of the force and
- Velocity of the injury [8]

**Table 1:** Position of the limb at the time of trauma and fracture pattern

| Applied force | Hip abduction/ adduction position | Hip rotation position | Fracture pattern |
|---|---|---|---|
| Along the axis of femoral neck or greater trochanter | Neutral | Neutral | Anterior column or wall and posterior hemitransverse |
| | Neutral | $25^0$ ER | Anterior column |
| | Neutral | $50^0$ ER | Anterior wall |
| | Neutral | $20^0$ IR | Variable: Transverse/ T-shaped or Both column |
| | Neutral | $50^0$ IR | Posterior column plus complete or incomplete transverse component |
| | Adduction | $20^0$ IR | Transtectal |
| | Abduction | $20^0$ IR | Juxtatectal/ infratectal |
| Along the femoral shaft (hip flexed 90) | Neutral | Any | Posterior wall ± hip dislocation |
| | Abduction $50^0$ | Any | Transverse |
| | Abduction $15^0$ | Any | Posterior column |
| | Adduction | Any | Posterior hip dislocation ± posterior wall |
| Along the axis of the femoral shaft (hip extended) | Neutral | Any | Posterior superior fracture of the transtectal wall |
| | Abduction | Any | Transtectal transverse |

The magnitude of displacement, the comminution and the degree of articular impaction depends on the velocity of the injury and the bone quality. A relatively low-velocity trauma can lead to a comminuted acetabular fracture in an osteoporotic patient.

The patients are assessed and stabilized initially in emergency department according to ATLS protocol. Once the patient is stabilized, a complete examination of the musculoskeletal system is required, especially evaluation of the peripheral nerves.

The initial examination of the patient including evaluation of the lower extremity for any injury (soft tissue or otherwise) is done. Local closed degloving soft tissue injuries about the hip (the Morel–Lavallee lesion) can harbor pathogenic bacteria and lead to wound breakdown and deep infection [14]. Those cases are treated with debridement followed by delayed wound closure and delayed fracture fixation.

Open wounds are treated with debridement and late wound closure. A thorough neurological examination is done and documented as it is important for the patient prognosis.

Sciatic nerve injury is common especially with hip dislocations associated with posterior wall fractures. Peroneal division of the nerve is affected most commonly due to its position within the nerve, tethering effect at greater sciatic notch and neck of fibula and morphological arrangement of its fibers. Sensory deficit along with ability of the patient to do ankle and toe dorsiflexion must be checked. Neurological examination done before and after the reduction of hip joint dislocation to make sure the nerve deficit if at all present is not iatrogenic.

Shortening of the lower limb can be found on physical examination in case of hip dislocation especially posterior dislocation. Characteristic deformity also can be observed which is flexion, adduction and internal rotation in case of posterior dislocation. But this classical deformity may not be observed in all the cases. Hip joint may be unstable if the hip dislocation is associated with posterior wall of acetabulum fractures.

**Radiographic Evaluation**

The acetabulum is evaluated with an AP view of pelvis with both hips and 45-degree oblique views of the pelvis (iliac and obturator view) described by Judet and Letournel, commonly called Judet views.

Fracture of the anterior column is interpreted by disruption of the iliopectineal line, whereas fracture of the posterior column is interpreted by disruption of the ilioischial line.

**Roof Arc Measurements**

Matta *et al* [15, 16, 17] developed the concept of roof-arc measurements to assess the amount of acetabulum left intact after fracture. This idea is an extension of the work of Rowe and Lowell [4] who suggested that an undefined minimum amount of intact acetabulum was necessary for a successful outcome with nonoperative treatment. Olson and Matta [18] recognized that the radiographic landmark of the roof of the acetabulum reflects the portion of the acetabulum seen in tangent by the x-ray beam on a plain x-ray. If the roof is extended to include the medial wall of the acetabulum, it forms an "arc" that is a portion of the circumference of the circular acetabulum. The roof-arc angle describes the angle between a vertical line beginning at the center of the femoral head and a line from this point and the most superior displaced fracture line through the roof of the acetabulum measured on AP, obturator oblique, and iliac oblique x-rays. The concept of roof-arc measurements was developed in a retrospective review and validated prospectively

The criteria for conservative management of acetabular fractures is a minimum of superior acetabulum is intact, as judged by roof-arc measures of at least 45° on all three plain x-ray views (AP, obturator oblique, and iliac oblique), or the CT subchondral arc is intact in the superior 10 mm of the acetabulum

**CT Scan With 3D Reconstruction**

Sophisticated software has made 3-D CT a more valuable visual tool for defining acetabular fractures. Of particular advantage is the ability to subtract unwanted structures, such as the femur, to demonstrate the exact fracture pattern and to view the 3-D CT image from any perspective. This advantage is particularly applicable to complex displaced fractures, which are difficult to describe verbally, and for which mental reconstruction of the axial sections into a 3-D configuration is a time-consuming effort. Thus, 3-D CT is obviously important for deciding which fractures require operative intervention, and especially in preoperative planning for those injuries [19, 20]. The technology in this area is improving rapidly. A 3-D CT image still is not as accurate as plain CT for examining precise anatomical details, such as marginal impaction, subtle fracture lines, or small fragments of bone in the joint [21]. For this precise detail, sagittal and coronal reconstructions may be helpful [15] and aid in decision making. Should surgery be the chosen treatment option, 3-D CT is invaluable in planning the operative approach. The ability of surgeons to examine the fracture with "virtual reality" from all directions enables them to choose the correct operative approach, which is essential in preventing complications.

**Indications for Coservative Management**

1. Stable non-displaced fracture
2. Stable and congruous minimally displaced fracture
3. Low anterior column fracture
4. Low transverse fracture
5. Low T-shaped fracture
6. Both column fracture with secondary congruence
7. Wall fractures not compromising hip stability
8. Infirm patients unable to withstand surgery
9. Severe osteoporosis precluding fixation

**Contraindications for Surgery**

- Severe head injury is a relative contraindication
- Poly trauma which may preclude prolonged surgery and blood loss
- Open wound in anticipated surgical site
- Morel-Lavallee lesion- high post op infection rate
- Supra pubic catheter for ilio-inguinal approach**.**

**Timing of the Surgery**

Late reconstruction of acetabular fractures is significantly more difficult because of fracture callous, shortening, and medialization of the proximal femur. This may change a relatively standard operation into a much more challenging case. Late reconstructions may require an extensile approach, longer duration of operation, greater blood loss, greater risk to neurovascular structures, more difficulty in obtaining a reduction, and a much greater chance of significant heterotopic ossification (HO**)**

**Choice of Surgical Approach**

"The general choice of surgical approach is as follows [22]:

**Table 2:** Various surgical approaches based on fracture pattern

| Fracture type | Kocher-Langenbeck | Ilioinguinal | Iliofemoral | Sequential combined | Extended Iliofemoral |
|---|---|---|---|---|---|
| Elementary | | | | | |
| Posterior wall | **X** | | | | |
| Posterior column | **X** | | | | |
| Anterior wall | | **X** | X | | |
| Anterior column | | **X** | X | | |
| Transverse juxtatectal/ infratectal | **X** | x | | | |
| Transverse transtectal | x | x | | | x |
| Associated | | | | | |
| Posterior column and wall | **X** | | | | |
| Anterior column / posterior hemitransverse | | **X** | | x | x |
| Transverse Juxta /infratectal and posterior wall | **X** | | | | |
| Transverse Transtectal and posterior wall | x | | | | x |
| T shaped juxta/ infratectal | **X** | x | | x | |
| T shaped transtectal | | | | x | **X** |
| Both column | | **X** | | x | x |

X – preferred approach

**Postoperative Follow Up**

Prophylactic intravenous antibiotics were used in all cases. Closed suction drain was used in all cases. Suture removal was done on 12$^{th}$ post-operative day. Deep vein thrombosis prophylaxis was not used as a routine in our study. The patients were mobilized as per individual pain tolerance. They were made to sit up on first post-operative day and they were subsequently made to perform physical therapy for muscle strengthening and active range of motion exercises. Patients were mobilized and kept non weight bearing with walker / crutches till 6 weeks, partial weight bearing till 12 weeks and then full weight bearing. This was also individualized as dictated by other injuries of the patients. Physical therapy was continued until range of motion and muscle strength were regained.

## Fracture Distribution

**Table 3:** Fracture pattern distribution

| Fracture type (Judet and Letournel) | No. of patients N=50 | Percentage % |
|---|---|---|
| Posterior wall | 15 | 30 |
| Posterior column | 1 | 2 |
| Transverse | 5 | 10 |
| Transverse with posterior wall | 10 | 20 |
| Anterior column with posterior hemitransverse | 4 | 8 |
| T type | 7 | 14 |
| Both column | 8 | 16 |

## Age-wise distribution

The mean age of the patients was 36.54 year, ranging from 20-70 years

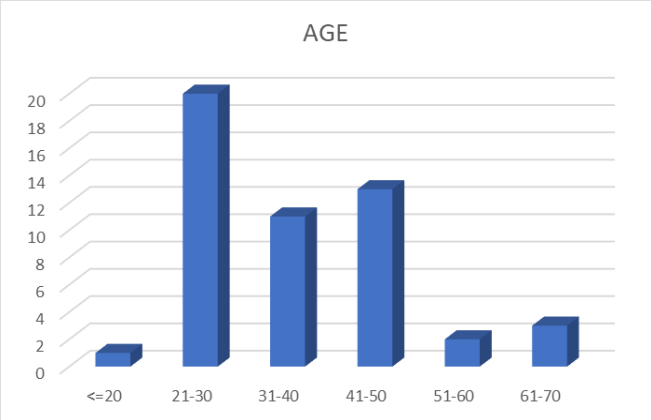


**Fig 1:** Age-wise distribution

## Sex-Wise Distribution

Males dominated in our study with 84% of cases, only 16% were females.

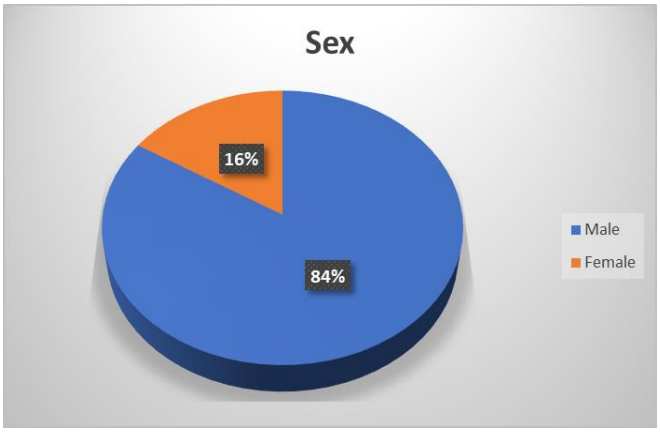


**Fig 2:** Sex- wise distribution

## Associated Injuries

In our study 20 patients had associated fractures.

**Table 4:** Associated injuries

| Associated injuries | No. of Patients |
|---|---|
| Fracture of clavicle | 5 |
| Upper limb fractures | 6 |
| Fracture of pubic rami | 3 |
| Lower limb fractures | 14 |
| Sciatic Nerve palsy | 5 |
| Blunt abdominal trauma | 6 |
| Blunt chest trauma | 8 |
| Urethral injury | 1 |

## Functional outcome

After discharge, patients were followed up at regular opd visits, with the first visit at 2 weeks after surgery and then every 4 weeks. Clinical assessment of wound healing, condition of soft tissues and pain with weight bearing was performed; sequential radiologic follow-up studies were requested at regular intervals at 6 and 12 weeks as well as 6 months postoperatively. The median follow-up of patients was 14 months with a range from 12 to 24 months.

## Merle D'aubigne Score

**Table 5:** Merle D' Aubigne score

| Merle d aubigne score | No of patients | Percent |
|---|---|---|
| Excellent | 12 | 24 |
| Good | 24 | 48 |
| Fair | 9 | 18 |
| Poor | 5 | 10 |
| Total | 50 | 100 |

## Harris Hip Score

**Table 6:** Harris hip score

| Harris hip score | No of patients | Valid Percent |
|---|---|---|
| Excellent | 12 | 24 |
| Good | 24 | 48 |
| Fair | 9 | 18 |
| Poor | 5 | 10 |
| Total | 50 | 100 |

## Observations and Results

- The incidence of acetabulum fractures is much more common in males than females.
- Commonest mode of injury is road traffic accident.
- Posterior wall fracture was the most common type in our study (15 cases).
- Twenty patients had associated skeletal injuries. Four patients had sciatic nerve injury pre-operatively while one patient operated by Kocher Langenbeck approach developed sciatic nerve palsy post-operatively.
- Out of 50 patients, 12 patients had excellent result, 24 patients had good result, 9 patients had fair result, and 5 patients had a poor result.
- Functional outcome score for the patients ranged from 10 to 18 (maximum score-18).
- One patient developed arthritis of the hip at follow-up. Patient had posterior wall fracture operated by Kocher Langenbeck approach. Total hip replacement was done for this patient at one year after the surgery.
- 2 patients had superficial infection which resolved with antibiotics.
- One patient had Morel-Lavallee lesion which settled with

conservative measures.

- None of the patients developed heterotopic ossification post-operatively.

## Discussion

Fracture of the acetabulum still remains a Bermuda Triangle for the orthopaedic surgeons of developing country such as ours due to lack of technical expertise and inadequate articular step, lost vascularity to the femoral head are also the important factors that determine the outcome, including the degenerative changes in the hip joint [23]. The anatomical reduction of the fracture is the single most important factor which determines the functional outcome [34, 24, 25, 26].

Matta *et al*, Letournel and Judet strongly suggested that the surgeons should be well trained and specialized in evaluating the radiological anatomy of the fracture, planning the optimal treatment strategy including the approach and attaining perfect anatomical reduction [34, 5, 8, 7].

Another factor which closely correlated with the outcome was the time interval between injury and fracture fixation [34, 7].

The use of single exposure for even both columns fracture with indirect reduction of the opposite column is currently recommended as the morbidity associated with extensile approaches was found to be very high. The opposite column fracture can be treated with the help of image intensifiers, traction and also with the help of Judet fracture tables [27, 28, 29].

The highlight of open reduction and internal fixation is anatomic reduction, rigid fixation and early mobilization which will keep the joint functional as described by Matta [34].

Pennal *et al* [30] reported that the quality of the clinical result depends directly on the quality of the reduction that was achieved when open reduction and internal fixation were performed.

H.J. Kreder *et al* listed factors influencing the outcome [31] degree of initial displacement, damage to the superior weight bearing dome or femoral head, degree of hip joint instability caused by posterior wall fracture, adequacy of open or closed reduction and late complications like AVN, heterotrophic ossification, chondrolysis or nerve injuries are assessed. Giannoudis *et al* [32] in his meta-analysis reported 5.6% of AVN in posterior approaches.

Giannoudis *et al* [32] reported 8% of iatrogenic sciatic nerve palsy in posterior approaches. In our study, we report five cases of sciatic nerve palsy in posterior approach (10%). Swiontkowski *et al* [33] also showed 8.3% iatrogenic sciatic nerve palsy in his study.

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