Section: Othopaedics

Original Research Article

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF ACETABULUM FRACTURE MANAGEMENT

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ABSTRACT

Background: Acetabulum fractures are complex intra-articular injuries sustained following high-energy trauma, and their management continues to challenge orthopaedic surgeons worldwide. Achieving accurate anatomical reduction is central to restoring congruence of the hip joint and reducing the risk of early post-traumatic arthritis. The intricate three-dimensional anatomy of the acetabulum and forces involved in producing these injuries contribute to their surgical complexity. **Aim:** This study aimed to evaluate the functional and radiological outcomes following operative management of acetabulum fractures, and to explore the relationship between the quality of radiological reduction and functional recovery. **Materials and Methods:** Twenty patients with acetabulum fractures were enrolled in this prospective study conducted over two years at Govt. Medical College Hospital, Chidambaram. All underwent open reduction and internal fixation (ORIF) using locking plates, reconstruction plates and lag screws, with a minimum follow-up of 6 to 12 months. Functional outcomes were assessed using the Harris Hip Score (HHS) and radiological outcomes were assessed using Matta's criteria. **Results:** The cohort was predominantly male (85%), with a mean age of 38.6 ± 11.2 years. Road traffic accidents accounted for most injuries (70%), and posterior wall fractures were the most common fracture pattern (40%). At final follow-up, the mean HHS was 86.4 ± 9.8, with excellent or good outcomes in 75% of patients. Anatomical reduction was achieved in 60% of cases. A statistically significant positive correlation was found between reduction quality and functional outcome ($p < 0.05$), and the overall complication rate was 20%. **Conclusions:** Surgical fixation of acetabulum fractures with perfect anatomical reduction consistently gives satisfactory functional outcomes. The quality of reduction is a direct and significant predictor of functional recovery. Early intervention, meticulous surgical execution, and structured postoperative rehabilitation collectively determine the final outcome in these patients.

INTRODUCTION

Acetabulum fractures are severe intra-articular injuries of the hip joint that typically follow high-energy trauma, such as road traffic accidents and falls from height.[1] They pose challenge to orthopaedic surgeons, due to the complex three-dimensional anatomy of the acetabulum, its deep and somewhat inaccessible location within the pelvis, and the proximity of important neurovascular structures. Anatomically, the acetabulum is formed by the convergence of three bones — the ilium, ischium, and pubis — and is divided into an anterior column, a posterior column, and the weight-bearing dome, or tectum.

The incidence of acetabulum fractures has risen alongside the increasing prevalence of high-speed road traffic accidents, particularly affecting young adult males.[2] These injuries frequently occur in polytrauma, which adds considerably to the complexity of their management. Associated injuries — including posterior hip dislocation, femoral head damage, and sciatic nerve palsy — must be carefully sought at the time of initial evaluation.

The seminal contribution of Judet and Letournel,[3] established both the anatomical basis and the standard classification framework for acetabulum fractures, dividing them into five elementary and five associated fracture types. Precise fracture classification, derived from anteroposterior and

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oblique (Judet) radiographs together with CT scanning and three-dimensional reconstruction, is indispensable for accurate surgical planning.

The overarching goal of treatment is to restore and maintain congruence of the hip joint. Non-operative management remains appropriate for stable, minimally displaced fractures, whereas surgical intervention is warranted when displacement exceeds 2 mm, when there is hip joint incongruence, posterior wall instability, or the presence of intra-articular fragments.[4] For posterior fractures, the Kocher-Langenbeck approach is the most widely used, while the ilioinguinal and modified Stoppa approaches are preferred for anterior column injuries. Outcomes are assessed both functionally — using validated tools such as the Harris Hip Score — and radiologically, according to Matta's criteria.[5]

This study was undertaken to evaluate the functional and radiological outcomes of acetabular fracture operatively managed at a tertiary care hospital, and to determine the extent to which the quality of surgical reduction influences functional recovery.

MATERIALS AND METHODS

Study Design

This was a prospective observational study carried out in the Department of Orthopaedics, Govt. Medical College Hospital, Cuddalore District, Chidambaram, Tamil Nadu, India over a two-year period. The study was conducted in keeping with the principles of the Declaration of Helsinki and received approval from the Institutional Ethics Committee. Written informed consent was obtained from every patient before enrolment.

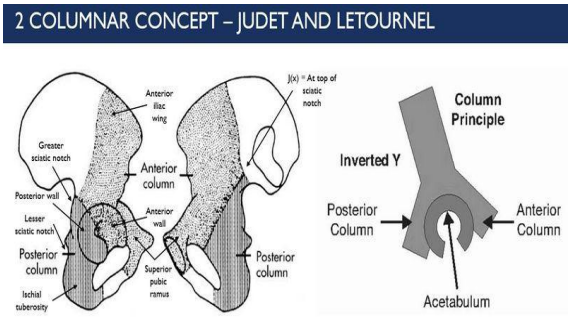
Inclusion Criteria

- Patients aged 18 years and above with acute acetabulum fractures
- Fractures with displacement >2 mm or hip joint incongruence
- Patients managed operatively with ORIF
- Minimum follow-up of 6 months

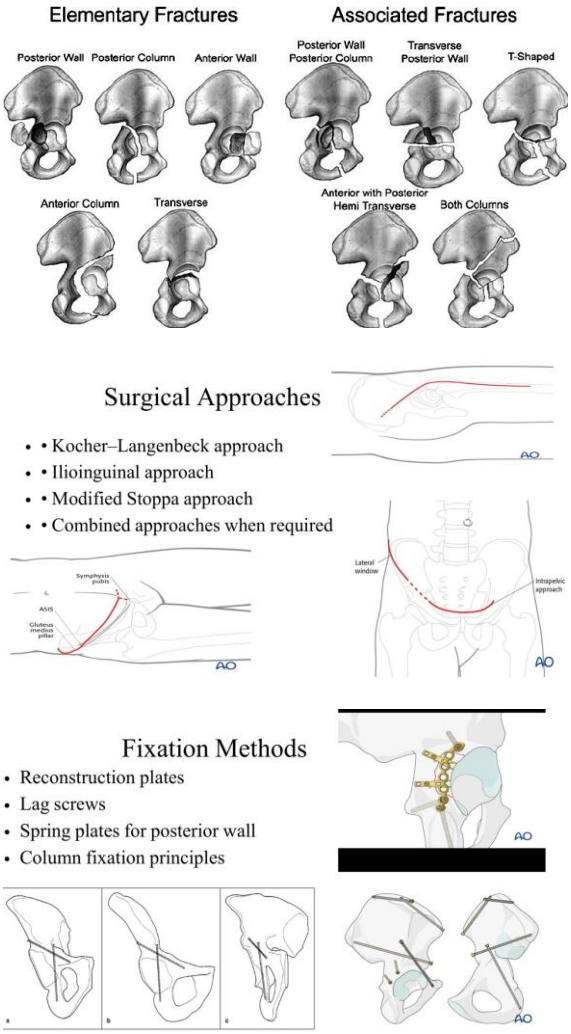
Exclusion Criteria

- Pathological fractures
- Pre-existing hip joint disease (osteoarthritis, avascular necrosis)
- Patients lost to follow-up
- Polytrauma patients with life-threatening injuries precluding early surgery

Anatomy of pelvis



Judet and Letournel classification



Preoperative Assessment

Each patient underwent a comprehensive clinical assessment covering pain, limb deformity, shortening, neurovascular status, and associated injuries. Radiological workup included an anteroposterior pelvic radiograph, Judet oblique views (obturator and iliac oblique), and a CT scan with three-dimensional reconstruction to facilitate accurate fracture classification and operative planning. Fractures were classified according to the Judet and Letournel system.

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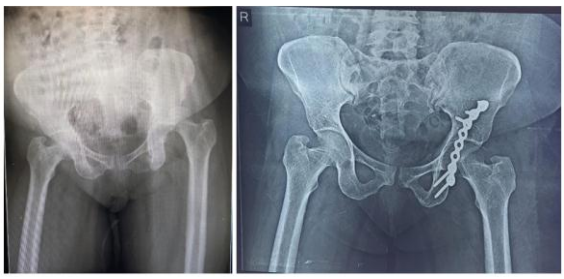
Surgical Technique

All procedures were performed under general or spinal anaesthesia, with the surgical approach selected according to the fracture pattern. The Kocher-Langenbeck approach was employed for posterior wall and posterior column fractures; the ilioinguinal or modified Stoppa approach was used for anterior column injuries; and combined approaches were applied where the fracture pattern demanded it. Intraoperative fluoroscopy (C-arm) was used throughout to verify reduction quality and confirm satisfactory implant positioning. Fixation was achieved with reconstruction plates, lag screws, and spring plates as dictated by the fracture configuration.

INCISION AND APPROACH

PRE OP: POST OP:



PRE OP

Pre Op Xray

Post Op Xray

Preop xray Post-op xray

Postoperative Protocol

In the postoperative period, all patients received DVT prophylaxis with low molecular weight heparin, and indomethacin was prescribed for heterotopic ossification prophylaxis. Mobilisation commenced on a non-weight-bearing basis for six to eight weeks, progressing to partial weight-bearing and subsequently full weight-bearing based on clinical progress. Active range-of-motion hip exercises and physiotherapy were initiated early.

Outcome Assessment

Functional outcome was evaluated using the Harris Hip Score (HHS) at 3 months, 6 months, and at final follow-up, and was categorised as Excellent (90–100), Good (80–89), Fair (70–79), or Poor (<70). Radiological outcome was graded by Matta's criteria on plain radiographs: Anatomical (residual displacement <1 mm), Imperfect (1–3 mm), or Poor (>3 mm). All complications — including post-traumatic arthritis, heterotopic ossification, avascular necrosis, wound infection, and nerve injury — were systematically recorded.

Statistical Analysis

All data were entered and analysed using SPSS version 23.0. Descriptive statistics were applied to summarise demographic and outcome variables. The correlation between radiological reduction quality (Matta's criteria) and functional outcome (HHS) was evaluated using Spearman's rank correlation coefficient, with a p-value of less than 0.05 considered statistically significant.

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RESULTS

All 20 patients who met the inclusion criteria were enrolled and included in the final analysis. The mean age was 38.6 ± 11.2 years, with ages ranging from 20 to 65 years. Seventeen patients (85%) were male and three (15%) were female, consistent with the well-recognised predominance of high-energy trauma in young men. Road traffic accidents were the leading mechanism of injury, accounting for 14 cases (70%), followed by falls from height in 4 cases (20%) and sports-related or other injuries in the remaining 2 cases (10%). Baseline demographic and clinical characteristics are summarised in Table 1.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population (N=20)

Characteristic	Value
Age (years) – Mean ± SD	38.6 ± 11.2
Range	20–65
Gender – Male, n (%)	17 (85%)
Gender – Female, n (%)	3 (15%)
Mechanism – Road Traffic Accident, n (%)	14 (70%)
Mechanism – Fall from Height, n (%)	4 (20%)
Mechanism – Sports/Other, n (%)	2 (10%)
Most common fracture type	Posterior wall
Mean follow-up (months)	9.6 ± 2.1

Based on the Judet and Letournel classification, posterior wall fractures were the most frequent injury pattern, identified in 8 patients (40%), followed by both-column fractures in 4 patients (20%). The full distribution of fracture types is presented in Table 2.

Table 2: Distribution of Fracture Types (Judet and Letournel Classification)

Fracture Type	Number of Cases (n=20)	Percentage (%)
Posterior wall	8	40%
Both-column	4	20%
Transverse + Posterior wall	3	15%
Posterior column	2	10%
Anterior column	1	5%
T-type	1	5%
Transverse	1	5%

The mean Harris Hip Score at final follow-up was 86.4 ± 9.8. Excellent outcomes were recorded in 8 patients (40%), good in 7 (35%), fair in 3 (15%), and poor in 2 (10%), giving a combined excellent and good rate of 75%. The distribution of functional outcomes is shown in Table 3.

Table 3: Functional Outcome – Harris Hip Score at Final Follow-up

Harris Hip Score	Number of Patients (n=20)	Percentage (%)
Excellent (90–100)	8	40%
Good (80–89)	7	35%
Fair (70–79)	3	15%
Poor (<70)	2	10%
Mean HHS (± SD)	86.4 ± 9.8	–

Radiological assessment by Matta's criteria showed anatomical reduction in 12 patients (60%), imperfect reduction in 6 (30%), and poor reduction in 2 (10%). These findings are summarised in Table 4.

Table 4: Radiological Outcome – Matta's Criteria

Matta's Criteria	Number of Patients (n=20)	Percentage (%)
Anatomical (<1 mm displacement)	12	60%
Imperfect (1–3 mm displacement)	6	30%
Poor (>3 mm displacement)	2	10%

A statistically significant positive correlation was identified between radiological reduction quality (Matta's criteria) and functional outcome (HHS), with a Spearman's rho of 0.78 ($p < 0.001$). Patients in whom anatomical reduction was achieved consistently recorded higher HHS values than those with imperfect or poor reduction.

Complications occurred in 4 patients overall (20%). Post-traumatic arthritis was the most frequent, affecting 3 patients (15%), while heterotopic ossification developed in 2 patients (10%). Avascular necrosis of the femoral head and superficial wound infection each occurred in one patient (5%). One patient (5%) developed a transient sciatic nerve palsy, which had resolved fully by the six-month review. The complete complication profile is presented in Table 5.

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Table 5: Complications

Complication	Number of Cases	Percentage (%)
Post-traumatic arthritis	3	15%
Heterotopic ossification	2	10%
Superficial wound infection	1	5%
Avascular necrosis of femoral head	1	5%
Sciatic nerve palsy (transient)	1	5%

DISCUSSION

Acetabulum fractures rank among the most technically demanding injuries encountered in orthopaedic practice, with outcomes hinging on the accuracy of reduction, the timing of surgery, and the rigour of postoperative rehabilitation.[6] In this series of 20 patients followed for a minimum of 6 to 12 months, a mean HHS of 86.4 ± 9.8 was achieved, and a strong, statistically significant relationship between radiological reduction quality and functional outcome was demonstrated.

The demographic profile observed in this series — predominantly young adult males (85%) sustaining injuries through road traffic accidents (70%) — aligns closely with the published literature. Letournel and Judet.[3] reported a similarly skewed sex distribution and comparable mechanisms in their landmark series. The mean patient age of 38.6 years reflects the energetically active population most vulnerable to high-velocity trauma, particularly in low- and middle-income countries.

Posterior wall fractures were the most common pattern in this series (40%), consistent with the findings of Matta,[5] and other large published cohorts. Given their frequent association with posterior hip dislocation and sciatic nerve injury, prompt closed reduction of the dislocation followed by early operative fixation remains the priority management strategy.

The Kocher-Langenbeck approach was the most frequently employed in this series, reflecting its well-established utility in providing reliable access to the posterior column and wall. Its predominance in our operative experience mirrors that reported in the wider literature, where it continues to serve as the standard approach for posterior acetabular pathology.[7] The ilioinguinal and modified Stoppa approaches were reserved for cases with predominantly anterior column involvement.

Excellent or good outcomes were recorded in 75% of patients, which compares well with comparable published series. Matta,[5] reported 76% excellent and good results in patients treated with strict anatomical reduction, and a systematic review by Briffa et al,[8] found satisfactory outcomes in 70–80% of operatively managed cases. The mean HHS of 86.4 in our cohort reflects a good level of functional recovery, most notably in those patients in whom anatomical reduction was achieved.

Anatomical reduction was achieved in 60% of cases, a figure in keeping with contemporary literature. The robust correlation between Matta's radiological grade and HHS (Spearman's rho = 0.78, $p < 0.001$) lends further weight to the widely held view that reduction quality is the single most important predictor of long-term outcome in acetabular fractures.[5,9] Not surprisingly, patients with inadequate reduction were substantially more likely to develop post-traumatic arthritis, which emerged as the most common complication in this series (15%).

Heterotopic ossification was recorded in 2 patients (10%), consistent with the reported literature range of 5–18%.[10] Despite prophylaxis with indomethacin and single-dose irradiation, ossification still developed in a small number of patients, highlighting the multifactorial aetiology of this complication.

Avascular necrosis of the femoral head occurred in one patient who had presented late with an associated posterior dislocation — a finding that underscores the critical importance of emergent closed reduction whenever dislocation is present.

One patient (5%) developed a transient sciatic nerve palsy following surgery, which had resolved completely by the six-month review. The potential for iatrogenic sciatic nerve injury during the Kocher-Langenbeck approach is well recognised, and this case reinforces the importance of meticulous nerve retraction and the use of intraoperative neuromonitoring wherever it is available.[11]

This study has several limitations that should be acknowledged. The sample size of 20 patients is modest, and the single-centre design limits the generalisability of the findings. Furthermore, the minimum follow-up of 6 to 12 months may be insufficient to capture the full extent of long-term complications such as progressive post-traumatic arthritis. Future investigations employing larger multicentre cohorts, longer follow-up periods, and patient-reported outcome measures — including the Oxford Hip Score and SF-36 — would provide a more comprehensive and robust evaluation of outcomes.

CONCLUSION

Open reduction and internal fixation of acetabulum fractures with reconstruction plates and screws yields satisfactory functional and radiological outcomes. The quality of radiological reduction, graded according to Matta's criteria, is a strong and independent predictor of functional recovery as measured by the Harris Hip Score, and anatomical reduction should therefore be pursued as the primary surgical objective in order to minimise the risk of post-traumatic arthritis. A thorough perioperative strategy — encompassing meticulous preoperative planning, technically precise surgery, prophylaxis

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against DVT and heterotopic ossification, and structured postoperative rehabilitation — is essential to achieving optimal outcomes in the management of these challenging injuries.

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