

Clinical and Radiological Outcomes of Unstable Posterior Acetabular Wall Fractures with Associated Hip Dislocation Treated by Open Reduction and Internal Fixation: A Prospective Study

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Abstract

Background: Unstable posterior acetabular wall fractures associated with hip dislocation are severe injuries resulting from high-energy trauma and are associated with significant morbidity if not managed appropriately. This study evaluate the clinical and radiological outcomes of unstable posterior acetabular wall fractures with hip dislocation following surgical management and to assess the correlation between functional and radiological outcomes. **Material and Methods:** This prospective observational study included 15 patients with unstable posterior acetabular wall fractures and hip dislocation treated with open reduction and internal fixation. Clinical outcomes were assessed using the Harris Hip Score and Merle d'Aubigné and Postel score, while radiological outcomes were evaluated using Matta's criteria over a minimum 12-month follow-up. Statistical analysis was performed using paired t-test and Chi-square test, with $p < 0.05$ considered significant. **Results:** The majority of patients were males (80.0%) aged 31–40 years (40.0%), and road traffic accidents were the predominant mechanism of injury (73.3%). At final follow-up, 73.3% of patients achieved excellent-to-good functional outcomes, while 80.0% demonstrated excellent-to-good radiological outcomes. Mean functional scores improved significantly from 6.2 ± 1.1 preoperatively to 15.6 ± 1.4 at 12 months. A significant association was observed between radiological and functional outcomes ($\chi^2 = 9.545$, $p = 0.023$). Heterotopic ossification and avascular necrosis were the most common complications, occurring in 13.3% of patients each, resulted in a slight decline in long-term outcomes. **Conclusion:** Early anatomical reduction and surgical fixation provide favorable clinical and radiological outcomes in unstable posterior acetabular wall fractures with hip dislocation. Radiological outcome is a significant predictor of functional recovery.

Keywords: Harris Hip Score, Hip dislocation, Posterior acetabular wall fracture, Open reduction and internal fixation, Radiological outcome.

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INTRODUCTION

Acetabular fractures are complex injuries of the hip joint, with posterior acetabular wall fractures being the most common subtype, accounting for nearly 25–30% of all acetabular fractures.^[1] Posterior hip dislocations are common with these fractures, and typically follow high-energy trauma from road traffic accidents, falls from height and industrial accidents, mainly in the young and economically active population.^[2] The injuries result in hip instability and loss of limb function which causes considerable morbidity and social costs.

Posterior acetabular wall has a crucial role in preserving congruency and stability of the hip joint. Damage to this will lead to instability, incongruent articulation and early degenerative change if not properly treated.^[3] The mechanism is usually axial trauma to the femur with the hip flexed, such as a dashboard injury, in which the head of the femur is pushed posteriorly against the acetabular wall.^[4] Severity of fractures can range from simple wall fractures to highly comminuted with impaction of the margins. Posterior hip dislocation occurs in almost 60 – 80% of posterior wall fractures.^[5] Important factors to reduce the risk of avascular

necrosis and maintain the viability of the femoral head is getting the hip back in place as soon as possible, ideally within 6 hours.^[6] Delayed reduction causes increase in complications like post-traumatic arthritis and femoral head collapse.

The standard radiograph and computed tomography (CT) with three-dimensional reconstruction are useful for radiological evaluation in determining the fracture morphology, size of the fracture fragments and any intra-articular injuries.^[7] Classification, such as Judet–Letournel classification, help direct treatment and surgical planning.^[8] The gold standard treatment for displaced and unstable posterior wall fractures is open

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reduction and internal fixation (ORIF).^[9] The goal is to obtain anatomical reduction, reconstruct the congruency of the joints and enable early movement. Comminution, marginal impaction, injury to the femur head and age of the patient also have an impact on prognosis; the quality of the reduction is stated to be most important. Functional outcomes are usually evaluated on the Harris Hip Score and Merle d'Aubigné and Postel score, while radiological outcomes are evaluated by Matta's criteria.^[10] Although imaging and surgical techniques are improving there are still potential complications such as heterotopic ossification, avascular necrosis, sciatic nerve injury, and post-traumatic osteoarthritis. Furthermore, there is paucity of prospective data available with respect to unstable posterior wall fractures associated with hip dislocation, especially in the Indian population. Complete prospective assessment is therefore required to correlate the clinical with radiological results and better evidence base management of these complex injuries.

MATERIALS AND METHODS

Study Design: The current study is a prospective, observational study in order to evaluate the clinical and radiological results of unstable posterior acetabular wall fractures that have occurred with hip dislocation.

Study Setting: The study was conducted at Department of Orthopaedics, Mysore Medical College and Research Institute (MMCRI), Mysuru which is a tertiary care referral hospital with advanced facilities for trauma care.

Study Duration: The study was conducted over a period of two years, during which patients presenting with unstable posterior acetabular wall fractures associated with hip dislocation were enrolled.

Participants

Inclusion Criteria:

- Patients diagnosed with unstable posterior acetabular wall fractures.
- Patients with associated posterior hip dislocation.
- Patients aged above 18 years.
- Patients who underwent surgical management (open reduction and internal fixation).
- Patients willing to provide informed consent and comply with follow-up.

Exclusion Criteria:

- Patients with stable or non-displaced acetabular fractures managed conservatively.
- Patients with pathological fractures or previous hip pathology.
- Patients with polytrauma who were medically unfit for surgery.
- Patients lost to follow-up before completion of study period.
- Patients with incomplete clinical or radiological data.

Study Sampling: A consecutive sampling method was employed in the study. Patients who attended the ED and/or the OPD during the study period who met the inclusion criteria were included. The approach ensured that there was minimal selection bias and real-world cases were included

which were routinely encountered in clinical practice.

Study Sample Size: In all, 15 patients with unstable posterior acetabular wall fracture that was associated with hip dislocation were included in the study. There were a limited number of eligible cases available during the study period, and the feasibility of conducting the study in a single center. There was a limited number of eligible cases available during the study period and feasibility consideration in a single center. The sample size was not large but was sufficient for descriptive and correlational analysis of the outcome in a prospective study.

Study Groups: It was an observational single arm study and there were no comparative groups in this study. No one had non-operative treatment; all were treated by open reduction and internal fixation (ORIF). Subgroup analysis was performed, however, by fracture reduction (good or poor), complications, and radiological grading, to evaluate their influence on functional outcomes.

Study Parameters: Main study parameters were clinical and radiological outcome. The clinical outcomes were evaluated with the Merle d'Aubigné and Postel score as well as the Harris Hip Score parameters that included pain, mobility and functional capacity. The radiological evaluation was performed according to Matta's criteria with special emphasis on quality of reduction, congruency of the joints and the presence of degenerative changes. Secondary parameters were intraoperative observations, surgery time, blood loss, time to reduction, and complications (poroperative avascular necrosis, heterotopic ossification, and post-traumatic arthritis).

Study Procedure: The initial evaluation of all patients with suspected acetabular fracture was conducted in accordance with the Advanced Trauma Life Support (ATLS) approach. After stabilization, a detailed clinical examination and radiological evaluation was conducted by obtaining the conventional pelvic radiographs and computed tomography (CT) scans with three-dimensional reconstruction. The fractures were classified using the Judet–Letournel classification system. Instability was defined by the presence of posterior hip dislocation, a large amount of posterior wall involvement, impaction in the margins, comminution, intra-articular fragments or instability seen at examination. The hip dislocation was reduced in an emergency, as soon as possible. Open reduction and internal fixation was performed for definitive surgical treatment, mainly via the Kocher–Langenbeck approach. Anatomical reduction and fixation of fracture fragments was achieved by reconstruction plates and screws. Postoperative treatment consisted of pain control, management of blood circulation, physiotherapy and early mobilization as per standard rehabilitation protocol.

Study Data Collection: A structured proforma for each patient was used when collecting data. A demographic baseline, injury mechanism, fracture type and any associated injury was recorded. Details of surgical approach, fixation technique, operation time and blood loss were recorded. The patients were evaluated clinically and radiologically at regular intervals (2 weeks, 1 month, 6 months and 12 months). Functional score and radiological grading was obtained at every follow up visit.

Data Analysis: The data obtained was processed in Microsoft Excel and analyzed using the SPSS (software package for social sciences) software. Demographic and clinical variables were summarized using descriptive statistics including means,

standard deviations and percentages. Paired t-test was employed for comparison of the pre- and post-operative scores. Chi square test was used to assess the correlation between clinical and radiological results. Statistically significant was set at a p-value of < 0.05.

Ethical Considerations: The study was carried out after getting approval from Institutional Ethics Committee (IEC) of Mysore Medical College and Research Institute, Mysuru (IEC Ref. No. MMC EC 140/24/05; Approval Date: 20.02.2024). All subjects gave informed consent orally before entering the study. All the data were anonymised and patient confidentiality was respected. The study was conducted following the guidelines of the Declaration of

Helsinki. No extra financial burden and no extra risk has been placed on the patients in addition to the normal course of therapy.

RESULTS

The age and gender distribution of the study participants demonstrated that the majority of patients belonged to the 31–40 years age group (40.0%), followed by 18–30 years (33.3%). Patients above 50 years constituted only 6.7% of the study population, suggesting a lower incidence in the elderly age group. A marked male predominance was observed, with males accounting for 80.0% of the cases, while females represented only 20.0%.

Table 1: Clinical Characteristics, Surgical Management, and Functional Outcome of Study Participants (n = 15)

Variable	Category	Number (n)	Percentage (%)
Mechanism of Injury	Road Traffic Accident	11	73.3
	Fall from Height	3	20.0
	Industrial Injury	1	6.7
Side of Injury	Right	9	60.0
	Left	6	40.0
Time to Hip Reduction	<6 hours	10	66.7
	6–12 hours	4	26.7
	>12 hours	1	6.7
Surgical Approach Used	Kocher–Langenbeck	13	86.7
	Combined Approach	2	13.3
Functional Outcome (Harris Hip Score at 12 Months)	Excellent	6	40.0
	Good	5	33.3
	Fair	3	20.0
	Poor	1	6.7

The clinical profile [Table 1] revealed that road traffic accidents were the most common cause of injury (73.3%), followed by falls from height (20.0%) and industrial injuries (6.7%), highlighting the role of high-energy trauma in these fractures. The right hip was affected more frequently (60.0%) than the left (40.0%). Most patients (66.7%) underwent hip reduction within 6 hours of injury, and the Kocher–Langenbeck approach was the most commonly used surgical technique (86.7%). At 12 months, Harris Hip Score assessment demonstrated excellent outcomes in 40.0% and good outcomes in 33.3% of patients, with an overall excellent-to-good functional recovery rate of 73.3%, indicating favorable outcomes following early reduction and

surgical management, however, late complications, including heterotopic ossification, avascular necrosis, and post-traumatic arthritis, contributed to a mild decline in outcomes.

According to the Judet–Letournel classification, isolated posterior wall fractures were the most common fracture pattern (80.0%), while 20.0% had associated posterior column involvement. All patients presented with posterior hip dislocation, confirming instability. Additional instability features included marginal impaction (33.3%), posterior wall comminution (26.7%), and intra-articular fragments (20.0%).

Table 2: Mean Functional Scores Over Time

Follow-up Period	Mean Score ± SD
Preoperative	6.2 ± 1.1
1 Month	10.5 ± 1.3
6 Months	14.8 ± 1.5
12 Months	15.6 ± 1.4

There was a progressive improvement in functional scores over time, with maximum improvement observed at 6–12

months [Table 2], indicating effective rehabilitation and surgical outcome.

Table 3: Radiological Outcome and Postoperative Complications Among Study Participants (n = 15)

Variable	Category	Number (n)	Percentage (%)
Radiological Outcome (Matta Criteria)	Excellent	7	46.7
	Good	5	33.3
	Fair	2	13.3
	Poor	1	6.7
Postoperative Complications	None	9	60.0

	Heterotopic Ossification	2	13.3
	Avascular Necrosis	2	13.3
	Post-traumatic Arthritis	1	6.7
	Sciatic Nerve Injury	1	6.7

Radiological assessment according to Matta's criteria showed favorable outcomes, with 46.7% of patients achieving excellent and 33.3% good results, resulting in 80.0% satisfactory radiological outcomes overall [Table 3]. Most patients (60.0%) remained free of complications during follow-up. Heterotopic ossification and avascular necrosis were the most common complications (13.3% each), while post-traumatic arthritis and sciatic nerve injury occurred in 6.7% of patients each.

Patients with better radiological reduction showed superior functional outcomes, with most excellent radiological results

corresponding to excellent or good postoperative recovery [Figure 1]. In contrast, fair or poor radiological outcomes were associated with poorer functional results, highlighting the importance of accurate anatomical reduction during surgery. Early hip reduction within 6 hours was associated with fewer postoperative complications, with 80.0% of patients remaining complication-free. Delayed reduction beyond 6 hours showed higher rates of complications such as avascular necrosis and post-traumatic arthritis, emphasizing the importance of timely management in improving outcomes [Figure 2].

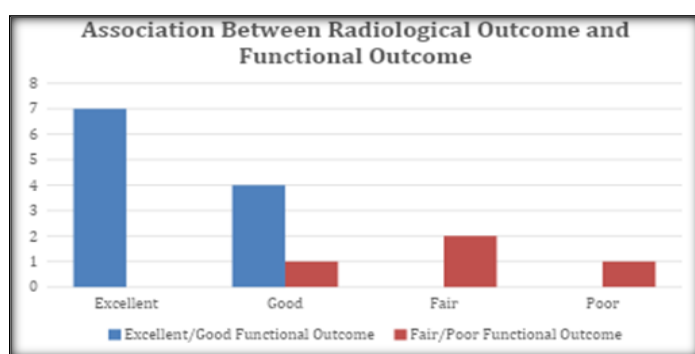


Figure 1: Association of Radiological Outcome with Functional Outcome and Time to Hip Reduction with Postoperative Complications (n = 15)

Figure 1 & 2: Patients with better radiological reduction showed superior functional outcomes, with most excellent radiological results corresponding to excellent or good postoperative recovery. In contrast, fair or poor radiological outcomes were associated with poorer functional results, highlighting the importance of accurate anatomical reduction during surgery. Early hip reduction within 6 hours was

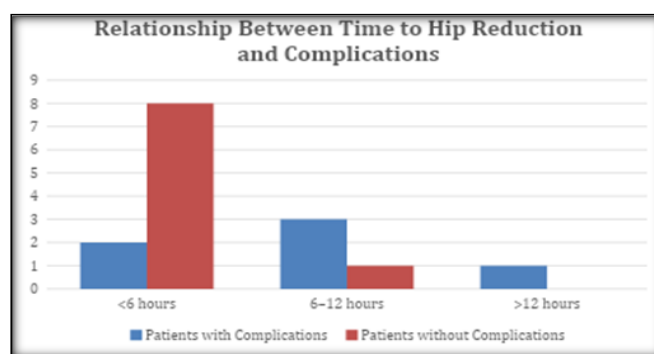


Figure 2: Association of Radiological Outcome with Functional Outcome and Time to Hip Reduction with Postoperative Complications (n = 15)

associated with fewer postoperative complications, with 80.0% of patients remaining complication-free. Delayed reduction beyond 6 hours showed higher rates of complications such as avascular necrosis and post-traumatic arthritis, emphasizing the importance of timely management in improving outcomes.

Table 4: Association Between Radiological Outcome and Functional Outcome (n = 15)

Radiological Outcome (Matta Criteria)	Excellent/Good Functional Outcome n (%)	Fair/Poor Functional Outcome n (%)	Total (n)
Excellent	7 (100.0)	0 (0.0)	7
Good	4 (80.0)	1 (20.0)	5
Fair	0 (0.0)	2 (100.0)	2
Poor	0 (0.0)	1 (100.0)	1
Total	11 (73.3)	4 (26.7)	15
Chi-square (χ^2)	9.545	df = 3	p = 0.023*

[Table 4] demonstrates the association between radiological outcome according to Matta criteria and functional outcome assessed using the Harris Hip Score. Patients with excellent radiological outcomes consistently achieved excellent or good functional recovery, whereas fair and poor radiological outcomes were associated with less favorable functional

results. Chi-square analysis demonstrated a statistically significant association between radiological and functional outcomes ($\chi^2 = 9.545$, df = 3, p = 0.023), indicating that anatomical reduction is an important predictor of postoperative functional recovery.

Table 5: Operative Details and Overall Clinical Outcome of Study Participants (n = 15)

Variable	Category	Number (n)	Percentage (%)
Operative Duration	<2 hours	3	20.0
	2–3 hours	9	60.0
	>3 hours	3	20.0
Intraoperative Blood Loss	<500 mL	5	33.3
	500–1000 mL	8	53.3
	>1000 mL	2	13.3
Overall Clinical Outcome (Merle d'Aubigné and Postel Score)	Excellent	5	33.3
	Good	6	40.0
	Fair	3	20.0
	Poor	1	6.7

The operative profile showed that most surgeries (60.0%) were completed within 2–3 hours, while 20.0% lasted less than 2 hours and 20.0% exceeded 3 hours. Longer operative times were mainly seen in complex fractures requiring combined surgical approaches. More than half of the patients (53.3%) had intraoperative blood loss of 500–1000 mL, 33.3% lost less than 500 mL, and only 13.3% had blood loss exceeding 1000 mL, mainly in comminuted fractures and prolonged surgeries. Functional assessment using the Merle d'Aubigné and Postel score showed excellent outcomes in 33.3% and good outcomes in 40.0% of patients. Fair and poor outcomes were observed in 20.0% and 6.7% respectively [Table 5]. Overall, 73.3% achieved excellent to good functional recovery following surgical management.

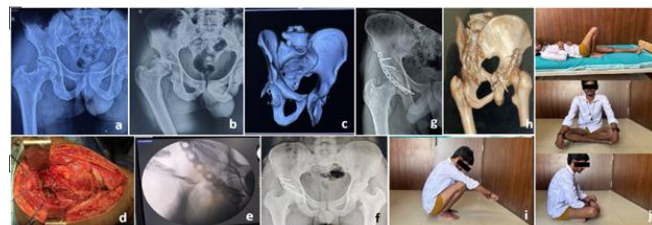


Figure 3: (a–c) Preoperative X-rays and CT images showing a right posterior acetabular wall fracture with posterior dislocation of the right hip. (d–e) Intraoperative images demonstrating posterior wall fracture and reconstruction plate fixation. (f) Immediate postoperative X-ray. (g–h) Postoperative X-rays and CT at 6-month follow-up. (i–j) Range of movement at 6 months.

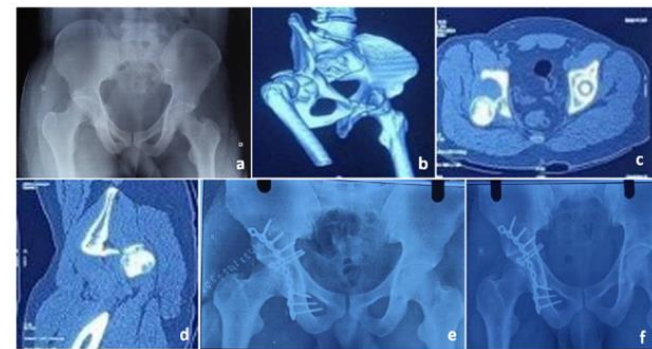


Figure 4: (a–d) Preoperative X-ray and CT images showing a right posterior acetabular wall fracture with posterior dislocation of the right hip. (e) Immediate postoperative X-ray. (f) Follow-up X-ray.



Figure 5: (a–c) Preoperative X-ray and CT images showing a right posterior acetabular wall fracture with posterior hip dislocation. (d–e) Intraoperative images demonstrating skin incision and reconstruction plate fixation. (f) Immediate postoperative X-ray. (g–h) X-ray and CT images at 12-month follow-up. (i) MRI at 12-month follow-up. (j) Clinical photograph showing range of movement at 12 months following surgery. (k) X-ray at 18 months showing heterotopic ossification and arthritic changes. (l) Clinical photograph showing range of movement at 18 months.

DISCUSSION

The present prospective study evaluated the clinical and radiological outcomes of unstable posterior acetabular wall fractures associated with hip dislocation and demonstrated favorable results following surgical management with open reduction and internal fixation. Most patients belonged to the young and middle-aged population, with 40% in the 31–40 years age group and 33.3% in the 18–30 years group. Males constituted 80% of cases, which is comparable to the findings of Bhandari et al,^[11] and Mitsionis et al,^[12] who also reported male predominance in such injuries. Road traffic accidents were the major cause of injury (73.3%), followed by falls from height and industrial injuries, consistent with previous reports emphasizing high-energy trauma as the primary mechanism.^[11]

Early reduction of hip dislocation is considered essential in preventing avascular necrosis. In the present study, 66.7% of patients underwent reduction within 6 hours and showed fewer postoperative complications. Although Bhandari et al,^[11] suggested that timing may be less critical than reduction quality, both studies emphasized that anatomical reduction significantly influences outcomes.

The Kocher–Langenbeck approach was used in most patients (86.7%). Radiological evaluation using Matta's criteria revealed excellent outcomes in 46.7% and good outcomes in 33.3%, resulting in 80% satisfactory radiological outcomes. Similar findings were reported by Mitsionis et al,^[12] where the majority of patients achieved excellent or good radiological results. Functional outcomes were also satisfactory, with Harris Hip

Score showing excellent results in 40% and good results in 33.3% of patients at 12 months. Comparable outcomes were reported by de Palma et al,^[13] and Mitsionis et al.^[12] Progressive improvement in functional scores from preoperative assessment to 12 months indicated the effectiveness of surgical treatment and rehabilitation. However, a mild decline in outcomes after 12 months was likely due to heterotopic ossification (13.3%), avascular necrosis (13.3%) and post-traumatic arthritis (6.7%).

The present study demonstrated a statistically significant association between radiological and functional outcomes ($\chi^2 = 9.545$, $p = 0.023$). Patients who achieved excellent radiological reduction according to Matta criteria consistently demonstrated excellent or good functional recovery [Figure 3], whereas fair or poor radiological outcomes were associated with inferior functional results. The results support the concept of anatomical fracture reduction for the restoration of hip joint congruity and subsequent improved function. The same finding has been reported by Bhandari et al,^[11] and Mitsionis et al,^[12] who concluded that quality of reduction is one of the most important factors associated with long term clinical outcome after posterior acetabular wall fracture. Lin et al,^[14] also found that fracture comminution, residual displacement, and greater age negatively impact both function and radiology, and raise the risk for post-traumatic osteoarthritis and osteonecrosis. The significant relationship found in the current study also helps support the principle of proper anatomical reduction as it is the foundation of a successful surgical management of unstable posterior acetabular wall fractures associated with a hip dislocation [Figure 4].

Forty per cent of patients had postoperative complications, with 13.3% developing heterotopic ossification and avascular necrosis [Figure 5], and 13.3% having post-traumatic arthritis and a 10% incidence of sciatic nerve injury. These results are similar to previous research.^[12,14] Notwithstanding this, 60% of patients did not experience any complications, suggesting a generally safe and effective surgical approach. The present study confirms that good clinical and radiological results are only achieved with early intervention, anatomical reduction and adequate postoperative treatment in a fracture of the posterior acetabular wall in a dislocated hip.

Limitations: There are some limitations of the present study. The number of samples ($n=15$) was small and might not represent all students with these needs. This study did not involve a comparison group and was performed at one tertiary care center. For most patients, the follow up time was one year, and this could underestimate the occurrence of late complications like Osteoarthritis and Avascular necrosis. These findings need to be confirmed with larger multicentre studies with longer follow-up.

CONCLUSION

Posterior wall hip fractures with hip displacement are complicated fractures and need prompt and correct diagnosis and treatment for best outcome. In the present study, early reduction of the hip dislocation and open reduction and internal fixation (ORIF) yielded favorable clinical and

radiological results and good to excellent functional recovery was achieved in majority of cases. The strongest association with good functional score and radiological outcome of anatomical reduction was identified, indicating its importance. Avascular necrotic lesions, heterotopic ossification and post traumatic arthritis were noted in a few patients, but the incidence was low. So prompt surgical management, stable fixation, careful reduction and adequate rehabilitation is crucial to the restoration of hip function and the minimisation of long-term morbidity.

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Conflicts of interest

There are no conflicts of interest.

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