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Radiological Outcome Evaluation of Transverse Acetabular Fractures Treated with Reconstruction Plate Via Posterior Approach

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Abstract | **Original Research Article**

Background*:** Acetabular fractures are uncommon but clinically significant injuries, often resulting from high-energy trauma and presenting complex surgical challenges due to the anatomy of the pelvis. The purpose of the study is to evaluate the radiological outcomes of transverse acetabular fractures managed with reconstruction plate fixation via the posterior surgical approach. ***Aim of the study: The aim of the study was to assess the radiological outcomes of transverse acetabular fractures managed with reconstruction plate fixation via the posterior surgical approach. ***Methods:*** This prospective observational study of 25 patients with transverse acetabular fractures was conducted at the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh, from July 2017 to June 2019. Patients aged 21–80 years underwent open reduction and internal fixation within three weeks. Outcomes were assessed clinically and radiologically using standard scoring systems. Data were analyzed with SPSS 22. ***Results:*** In 25 patients (96% male, mean age 36.2 years), 76% were aged 20–40. Fractures were 36% transverse, 48% transverse with posterior wall, and 16% other types. Anatomical reduction was achieved in 80%, with radiological outcomes of 48% excellent, 16% good, and 36% fair. No significant link was found between reduction quality and radiological outcome. ***Conclusion:*** Reconstruction plate fixation via the posterior approach provides effective anatomical reduction and satisfactory radiological outcomes in transverse acetabular fractures.

Keywords: Radiological Outcome, Transverse Acetabular Fractures, Posterior Approach.

INTRODUCTION

Acetabular fractures are uncommon injuries, occurring at a rate of about 3 cases per 100,000 people annually worldwide [1,2]. In Western Europe and the United States, pelvic fractures occur at approximately 37 per 100,000 population, with only 10% involving the acetabulum, whereas in the Indian population, acetabular fractures account for 17.7% of pelvic fractures [3,4]. These injuries typically result from high-energy trauma, predominantly road traffic accidents (80.5%) and falls from height (10.7%) [5]. They are more frequently seen in young, active males and pose significant challenges to orthopedic surgeons due to the acetabulum's complex anatomy, complicated fracture patterns, and difficult surgical access [6]. Posterior wall fractures are the most prevalent type, representing roughly 24% of all acetabular fractures [7]. Managing these fractures remains a significant concern because of the intricate anatomy, surgical difficulties, and risk of complications [8].

Among the different subtypes of acetabular fractures, transverse fractures and related patterns—including T-type, transverse with posterior wall, and anterior column with posterior hemi transverse fractures—occur at rates of approximately 8.6%, 6.6%, 20.7%, and 5.7%, respectively [6]. These fracture types frequently present alongside other pelvic injuries, complicating reduction and fixation since both acetabular columns often need to be realigned and stabilized. While precise anatomical reconstruction and early mobilization are critical objectives, they are challenging to achieve due to the involvement of multiple fracture columns and the overall complexity of these injuries.

Surgical treatment is considered the gold standard for displaced acetabular fractures, with achieving joint stability and enabling early mobilization being vital for favorable recovery [9]. The Kocher-Langenbeck (K-L) posterior approach is commonly employed, as it offers direct visualization of the posterior wall and column and allows access to the true pelvis for effective fixation and reduction. Plate osteosynthesis—whether single or dual plating or fragment-specific fixation—is the preferred technique for addressing posterior column or wall fractures, although the intricate anatomy of the acetabulum often necessitates manual contouring of the plates [10,11]. Precise anatomical reduction and stable fixation are essential to minimize risks of complications such as posttraumatic osteoarthritis and femoral head osteonecrosis [12,13]. Radiological evaluation of the quality of fracture reduction remains a key determinant of functional outcomes and long-term prognosis.

Despite advancements in surgical techniques, limited data specifically address radiological outcomes of transverse acetabular fractures treated via the posterior approach using reconstruction plates. Existing literature often focuses broadly on acetabular fractures without isolating this subtype or evaluating the effectiveness of a single fixation strategy in terms of radiological success. The purpose of the study is to evaluate the radiological outcomes of transverse acetabular fractures managed with reconstruction plate fixation via the posterior surgical approach.

Objective

- To assess the radiological outcomes of transverse acetabular fractures managed with reconstruction plate fixation via the posterior surgical approach.

Methodology & Materials

This prospective observational study was conducted at the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Bangladesh, from July 2017 to June 2019. A total of 25 patients with radiologically confirmed transverse acetabular fractures—including associated patterns such as T-type, transverse with posterior wall, and anterior column with posterior hemitransverse—were enrolled based on defined inclusion and exclusion criteria. All patients underwent open reduction and internal fixation within 3 weeks of injury.

Inclusion Criteria:

- Patients aged between 21 and 80 years
- Both male and female patients
- Radiologically confirmed transverse acetabular fractures, including associated patterns such as T-type, transverse with posterior wall, and anterior column with posterior hemitransverse fractures
- Patients who underwent surgical fixation within 3 weeks of injury

Exclusion Criteria:

- Patients younger than 21 years or older than 80 years
- Presence of active or latent infection at the surgical site
- Open fractures of the acetabulum
- Patients with significant comorbidities (e.g., uncontrolled hypertension, diabetes mellitus, chronic obstructive pulmonary disease, or left ventricular hypertrophy) that could affect surgical outcomes

Prior approval for this study was obtained from the Ethical Review Committee of Dhaka Medical College, and written informed consent was taken from all participants or their legal guardians after explaining the study objectives, procedures, potential risks, benefits, and treatment costs in easily understandable language. This prospective observational study included 25 patients (24 males, 1 female) aged 21–80 years with transverse or associated acetabular fractures who met the inclusion criteria and underwent surgery between July 2017 and June 2019. Patient history, injury mechanism, and clinical examination findings were documented, and baseline variables such as age, gender, occupation, side involved, dislocation, and associated injuries were recorded. Surgical outcomes were evaluated using Merle d'Aubigné and Postel functional scores and Matta's radiographic criteria. Complications, fracture displacement, reduction quality, and surgical delays were also assessed. Data were collected using a structured questionnaire and analyzed using SPSS version 22, with findings presented through descriptive statistics in tables and figures.

Results

Table 1: Demographic Characteristics of the Study Subjects (n=25)

Variable		Frequency (n)	Percentage (%)
Age Group (years)	20–40	19	76.0
	41–60	4	16.0
	61–80	2	8.0
	Mean ± SD	36.2±14.12	
	Range (min–max)	21-75	
Gender	Male	24	96.0
	Female	1	4.0

Table 1 presents the demographic characteristics of 25 patients with transverse acetabular fractures. The mean age was 36.2 ± 14.12 years, with the majority of patients aged between 20 and 40 years (n = 19; 76.0%), followed by 41–60 years (n = 4; 16.0%) and 61–80 years (n = 2; 8.0%). Male patients constituted the overwhelming majority (n = 24; 96.0%), while females accounted for only one case (n = 1; 4.0%), resulting in a male-to-female ratio of 24:1.

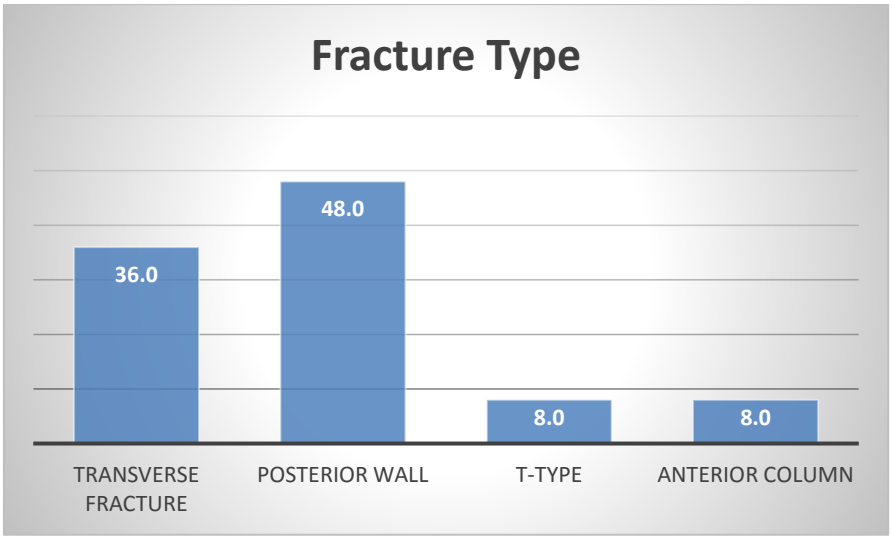

Figure 1: Distribution of Fracture Types Among Study Subjects (n=25)

Figure 1 illustrates the distribution of acetabular fracture types observed in the study population. Transverse fractures accounted for 9 patients (36.0%), while the majority, 12 patients (48.0%), presented with associated fractures involving the posterior wall. Additionally, T-type fractures and anterior column fractures were observed in 2 patients each (8.0%).

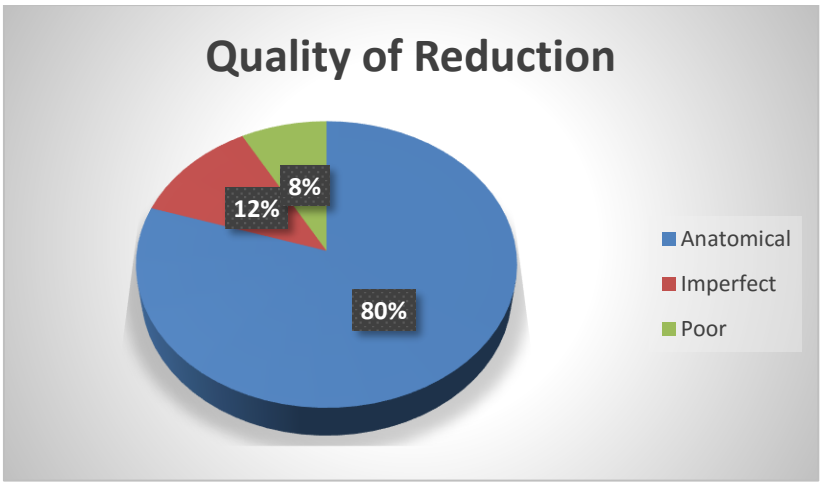

Figure 2: Quality of Reduction of Transverse Fractures (n=25)

Figure 2 depicts the quality of fracture reduction achieved in patients with transverse acetabular fractures. Anatomical reduction was achieved in 20 patients (80.0%), while imperfect reduction was noted in 3 patients (12.0%), and poor reduction in 2 patients (8.0%).

Table 2: Association Between Quality of Reduction and Radiological Outcome in Transverse Fractures (n=25)

Quality of Reduction	Frequency	Radiological outcome			p-value
		Excellent	Good	Fair	
Anatomical	20 (80.0%)	9 (36.0%)	9 (36.0%)	2 (8.0%)	0.058ns
Imperfect	3 (12.0%)	0 (0.0%)	1 (4.0%)	2 (8.0%)	
Poor	2 (8.0%)	0 (0.0%)	2 (8.0%)	0 (0.0%)	
Total	**25 (100.0%)**	**9 (36.0%)**	**12 (48.0%)**	**4 (16.0%)**	

Among the study subjects, 20 patients (80.0%) achieved anatomical reduction, while 5 patients (20.0%) had non-anatomical reductions (imperfect and poor). Of those with anatomical reduction, 18 patients (72.0%) demonstrated satisfactory radiological outcomes, whereas 2 patients (8.0%) had unsatisfactory outcomes. In the non-anatomical reduction group, 2 patients (8.0%) had satisfactory and 3 patients (12.0%) had unsatisfactory radiological outcomes. Statistical analysis revealed no significant association between quality of reduction and radiological outcome ($p > 0.05$).

Table 3: Distribution of Study Subjects by Radiological Outcome According to Matta Criteria (n=25)

Radiological Outcome	Frequency (n)	Percentage (%)
Excellent	12	48.0
Good	4	16.0
Fair	9	36.0
Total	**25**	**100.0**

Table 3 presents the radiological outcomes of patients with transverse acetabular fractures assessed by Matta radiographic criteria. An excellent radiological outcome was achieved in 12 patients (48.0%), good outcome in 4 patients (16.0%), and fair outcome in 9 patients (36.0%).

Table 4: Radiological Outcomes According to Matta Criteria and Merle d'Aubigne and Postel Scores at 6 Months Post-Operation (n=25)

Serial No.	Radiological Outcome
1	Excellent
2	Excellent
3	Fair
4	Good
5	Excellent
6	Good
7	Good
8	Good
9	Good
10	Excellent
11	Excellent
12	Good
13	Excellent
14	Excellent
15	Good
16	Good
17	Excellent
18	Good
19	Good
20	Excellent
21	Good
22	Good
23	Fair
24	Fair
25	Fair

Table 4 shows individual patient outcomes correlating radiological results based on Matta radiographic criteria with functional outcomes measured by Merle d'Aubigne and Postel scores at 6 months post-operation.

DISCUSSION

This study highlights the clinical and radiological outcomes of patients with transverse acetabular fractures managed surgically using reconstruction plates through the posterior approach at a tertiary care center in Bangladesh. Transverse fractures, often resulting from high-energy trauma, pose significant challenges due to their complex anatomy and associated displacement. The findings emphasize the effectiveness of open reduction and internal fixation in achieving satisfactory fracture reduction and functional recovery. However, the presence of associated fracture patterns and surgical delay were important factors influencing outcomes, underscoring the need for timely intervention and meticulous surgical planning.

In this study, patients with transverse acetabular fractures treated using reconstruction plates via the posterior approach were predominantly young adults, with 76.0% falling within the 20–40-year age range and a mean age of 36.2±14.12 years. This mirrors the demographic trends observed by AlRousan *et al.,*14], where the majority of acetabular fracture cases occurred in younger individuals, and aligns with the findings of Jang *et al.,*15], who also reported a comparable age distribution despite a slightly higher mean. The high prevalence in this age group underscores the role of high-energy trauma—such as road traffic accidents—as a leading mechanism in transverse fractures. Male predominance was striking in our cohort (96.0%), echoing the male-dominated samples in both AlRousan *et al.,*14] (84%) and Jang *et al.,*15], and likely reflects gender-based occupational exposure and risk behaviors. This demographic pattern reinforces existing literature that emphasizes the need for targeted preventive strategies and postoperative rehabilitation protocols specifically addressing the younger, male population frequently affected by these complex injuries.

In this study, associated posterior wall fractures were the most common subtype, observed in 48% of patients with transverse acetabular fractures. This finding closely aligns with the results reported by Gänsslen *et al.,*16], who identified a high incidence of combined transverse and posterior wall fractures—approximately 20% of all acetabular fractures—highlighting the frequent coexistence of these patterns. Similarly, AlRousan *et al.,*14] found that posterior wall fractures represented the most prevalent subtype (~37.6%), followed by transverse and associated patterns, reinforcing the predominance of posterior wall involvement in complex acetabular injuries. The proportion of isolated transverse fractures (36%) and the presence of less common variants such as T-type and anterior column fractures (each 8%) in our series further reflect the variability in acetabular fracture morphology reported across comparable cohorts.

In this study, anatomical reduction was achieved in 80.0% of patients with transverse acetabular fractures treated via the posterior approach, with imperfect and poor reductions observed in 12.0% and 8.0% of cases, respectively. These results closely align with the findings of Jang *et al.,*15], who evaluated transtectal transverse fractures using Matta's criteria and reported similar rates of anatomical reduction at approximately 80%. The consistency in reduction quality between the two studies underscores the feasibility and effectiveness of achieving precise fracture alignment in transverse acetabular fractures, thereby reinforcing the reliability and reproducibility of the surgical approach utilized in this cohort.

In this study, 80% of transverse acetabular fracture cases attained anatomical reduction, with radiological assessments revealing excellent outcomes in 36% of cases, good in another 36%, and fair in 8%. Imperfect reduction accounted for 12% of cases, while poor reduction was noted in 8%, with most of these associated with fair or suboptimal radiological outcomes. These results are consistent with the observations of Iqbal *et al.,*17], who reported a similar rate of anatomical reductions (~80%) along with instances of imperfect and poor reductions in their comparative study of the Stoppa and ilioinguinal approaches, and found no significant variation in radiological outcomes between the two techniques. Similarly, Li *et al.,*18] documented anatomical reduction in 31 out of 37 transtectal transverse fractures, with imperfect and poor results seen in 4 and 2 cases, respectively—mirroring the proportions observed in the present study. Collectively, these results underscore the importance of achieving anatomical reduction to optimize radiological outcomes, consistent with previous literature on transverse acetabular fracture management.

In this study, 48.0% of patients achieved excellent outcomes, with 16.0% demonstrating good and 36.0% fair results based on Matta's criteria. This distribution closely matches the findings of Durrani *et al.,*19], who reported excellent radiological outcomes in 45.5% of cases and a combined 54.5% showing good to fair results. The consistency in these outcome patterns underscores the effectiveness of the posterior approach combined with reconstruction plating in obtaining satisfactory reductions for transverse acetabular fractures, especially when anatomical alignment is prioritized during fixation. Additionally, these findings support Matta's grading system as a reliable standard for postoperative radiographic assessment in this fracture type.

At six months postoperatively, radiological outcomes assessed using Matta criteria demonstrated that the majority of patients achieved satisfactory alignment, with 48% classified as excellent, 32% as good, and 20% as fair. This distribution indicates that a substantial proportion of patients benefited from anatomical or near-anatomical reduction following reconstruction plate fixation via the posterior approach. The predominance of excellent and good outcomes reflects the effectiveness of the surgical technique in restoring joint congruity and minimizing residual displacement. The fair outcomes observed in a smaller subset may be attributed to factors such as initial fracture complexity, comminution, or patient-related variables affecting healing. Overall, the radiological findings suggest that this approach can reliably provide favorable anatomical restoration in transverse acetabular fractures when executed with precision.

LIMITATIONS OF THE STUDY

This study has several limitations.

- The follow-up duration was relatively short compared to other published series.

- The sample size was small, which may limit the generalizability of the findings.
- A non-randomized sampling technique was used, potentially introducing selection bias.
- The study was conducted at a single center, which may not reflect nationwide trends.

Therefore, the results may not fully represent the overall scenario of acetabular fractures in the country, limiting the ability to draw broader conclusions.

CONCLUSION

The study concludes that reconstruction plate fixation via the posterior approach yields favorable radiological outcomes in managing transverse acetabular fractures. The majority of patients were young males. Anatomical reduction was achieved in 80% of cases, correlating with a high rate of satisfactory radiological results—48% excellent, 16% good, and 36% fair outcomes per Matta criteria. Although no statistically significant association was found between reduction quality and radiological outcome, patients with anatomical reduction generally demonstrated better radiological recovery at six months, as reflected by Merle d'Aubigne and Postel scores ranging from fair to excellent. These findings support the posterior approach with reconstruction plating as an effective surgical option for restoring joint congruity in transverse acetabular fractures.

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