



## Evaluation of Functional Outcomes Following Open Reduction and Internal Fixation of Young-Burgess Lateral Compression Type-II Pelvic Ring Fractures

Shah Md Faisal Eskander<sup>1\*</sup>, Proma Orchi<sup>2</sup>, Khaled Mahmud<sup>3</sup>, Nurul Mahmud Saikat<sup>4</sup>, Md. Ashiqur Rahman<sup>5</sup>

<sup>1</sup>Assistant Professor, Department of Orthopaedic Surgery, Ministry of Health and Family Welfare, Dhaka, Bangladesh.

Email: smfaisal666@gmail.com,

Orcid ID: 0009-0007-3143-0491

<sup>2</sup>Registrar, Internal Medicine, Department of Medicine, Ashiyon Medical College Hospital, Dhaka, Bangladesh.

Email: promaorchi49@gmail.com,

Orcid ID: 0009-0008-4955-7834

<sup>3</sup>Assistant Professor, Department of Orthopaedic Surgery, Pakundia Upazila Health Complex, Kishoreganj, Bangladesh.

Email: drmahmud@gmail.com,

Orcid ID: 0009-0006-5530-5639

<sup>4</sup>Junior Consultant, Department of Orthopaedic Surgery, Daulatpur Upazila Health Complex, Manikganj, Bangladesh.

Email: saikatdmc@gmail.com,

Orcid ID: 0009-0005-0593-347X

<sup>5</sup>Assistant Professor, Department of Orthopaedic Surgery, Ad-din Sakina Women's Medical College Hospital, Jashore, Bangladesh.

Email: ashiqurahman.hf10@gmail.com,

Orcid ID: 0009-0004-8423-672X

\*Corresponding author

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### Abstract

**Background:** Pelvic ring disruption is a significant challenge in traumatology. Treating Young-Burgess lateral compression type-II pelvic ring fractures through open reduction and internal fixation is crucial in addressing and managing patients with pelvic injuries. This study aimed to analyze long-term functional and radiologic outcomes in patients with lateral compression unstable pelvis fracture. **Material & Methods:** This descriptive observational was conducted at the Department of Orthopedics & Traumatology, Dhaka Medical College & Hospital, Dhaka, Bangladesh, from July 2016 to June 2018. A total of 22 patients with pelvic injuries admitted to the department were purposively enrolled as the study population. Data analysis was performed using MS Office tools. **Results:** In the unaided gait assessment, 40.90% displayed a slight limp, 45.45% had a normal gait, and 13.63% showed a moderate limp with shuffling steps; no gross limp or inability to walk was observed. The mean Majeed score ranged from 55 to 100, averaging  $85.83 \pm 11.42$ . Functional grading revealed excellent in 63.63%, good in 27.27%, and fair in 9.09%, with no poor outcomes. The procedure demonstrated success in 82.3% to 99.5% of patients, indicating a highly acceptable functional outcome. Radiologically, success ranged from 60.18% to 84.36%, further supporting the procedure's acceptability. **Conclusions:** Stabilizing lateral compression type-II pelvic ring fractures using anterior, combined, or posterior reconstruction plates and/or cancellous screws is a satisfactory and effective method for managing patients, allowing for early mobilization and rehabilitation.

**Keywords:-** Open reduction, Internal fixation, Pelvic ring fracture, Lateral compression injury, Trauma.

## INTRODUCTION

Pelvic ring disruption is a significant aspect of modern traumatology, posing a major challenge for orthopedic surgeons in terms of treatment.

Among all pelvic injuries, 46% are deemed unstable, primarily resulting from high-energy trauma and typically occurring in severely injured patients, often with additional skeletal injuries. The frequency of pelvic ring fractures

follows a bimodal pattern, with peaks in the second and third decades of life, and another peak in patients older than 65 years.<sup>[1]</sup> The representation of pelvic fractures within all fracture's ranges from 3-8.2%. In cases of multiple traumas, the frequency rises dramatically, reaching around 25%, and the overall mortality rate is reported to be 6%-10%.<sup>[2]</sup> Various authors have conducted comprehensive evaluations of the anatomy and patho-mechanics associated with pelvic ring disruptions.<sup>[3,4,5]</sup> The classification of pelvic fractures encompasses different approaches: (1) Anatomical,<sup>[6]</sup> (2) Stability and deformity,<sup>[7]</sup> (3) Vector force and associated injuries,<sup>[5]</sup> and (4) OTA research. Pennal et al,<sup>[4]</sup> introduced a mechanistic classification, categorizing pelvic fractures into a) Antero-posterior compression (APC) injuries; b) Lateral compression (LC) injuries; and c) Vertical shear injuries. Tile later modified the Pennal system,<sup>[7]</sup> classifying fractures based on the concept of stability: a) Stable fractures; b) Rotationally unstable but vertically stable; and c) Both rotationally and vertically unstable fractures.<sup>[8]</sup> APC injuries lead to external rotation of the hemi-pelvis, LC causes internal rotation, and vertical shear results in proximal displacement of the hemi-pelvis. Young et al. articulated these concepts, which continue to be fundamental in the evaluation and treatment of patients with pelvic ring injuries.<sup>[5]</sup> The definitive management of pelvic fractures is closely tied to the degree of instability. Stabilization of the pelvic ring is rarely indicated in type A fractures, stabilization of the anterior ring is usually sufficient for type B fractures, and a combination of anterior and posterior stabilization is necessary in type C fractures, as per the classification of stability and

deformity.<sup>[7,9]</sup> Biomechanical studies have demonstrated that among all forms of fixation, internal fixation of both the posterior and anterior aspects of the pelvic ring provide the greatest stability. Hesp and Goldstein et al. demonstrated that early open reduction and internal fixation result in a decrease in mortality and systemic infection, providing notable benefits.<sup>[10]</sup> In the case of lateral compression (LC) injuries involving the fracture of the pelvic ring and disruption of the sacroiliac (SI) joint, satisfactory outcomes require the healing of the SI joint. Various internal fixation implants, such as a sacral bar, Cobra plate, reconstruction plate, or ilio-sacral screw, have been advocated in recent years for posterior disruption. Open reduction and internal fixation of LC unstable fractures have been recommended to offer optimal stability of fixation and clinical stability. The objective of this study was to assess the long-term functional and radiologic outcomes in patients with lateral compression unstable pelvic fractures.

## OBJECTIVES

### General Objective

- To evaluate the outcome of combined anterior and or posterior internal fixation in Young-Burgess Lateral Compression type-II.

### Specific Objectives

- To observe the age and gender distribution of the patients.
- To know the occupation status of the respondents.
- To assess the associated injuries of the study subjects.
- To analyze the causes of injury.

- To know the type of fixation of injury among the respondents.

## MATERIAL AND METHODS

This descriptive observational study was carried out at the Department of Orthopedics & Traumatology, Dhaka Medical College & Hospital, Dhaka, Bangladesh, spanning from July 2016 to June 2018. The study population comprised all patients admitted to the respective department with pelvic injuries. A total of 22 patients were purposively selected based on inclusion and exclusion criteria.

### Inclusion Criteria

- Patients of 18 to 60 years and both genders.
- Patients with Young Burgess LC type-II pelvic fracture.
- Patients presented within 3 weeks of injury.

### Exclusion Criteria

- Patients with acetabular fracture and other types of pelvic fracture.
- Patients with active infection.
- Patients with pathological fractures.
- Patients with dysmorphic sacrum.
- Patients with complete spinal cord injury.

Data collection involved a pre-tested structured questionnaire encompassing history, clinical examination, laboratory investigations, and pre-operative, peri-operative, and post-operative follow-up findings, including complications. Comprehensive history, clinical examination, and relevant investigations were conducted. Respondents underwent open reduction and internal fixation using a reconstruction plate or anterior column lag screw for anterior stabilization, and posterior

fixation was achieved through partially threaded cancellous screws or reconstruction plates. Patients were regularly monitored on an outpatient basis for a minimum of six months and a maximum of twelve months postoperatively, with assessments at three-week intervals, followed by evaluations at 6 weeks, 3 months, and 6 months. Outcome assessments at six months and beyond utilized the Majeed functional outcome score. Data analysis was conducted using the MS Office tools. The study obtained ethical clearance from the ethics committee of Dhaka Medical College and informed written consent was obtained from all study subjects.

## RESULTS



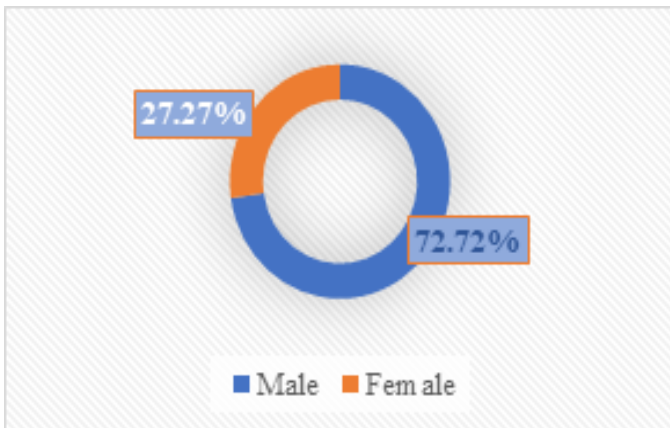
**Figure 1:** Preoperative x-ray pelvis anteroposterior inlet view



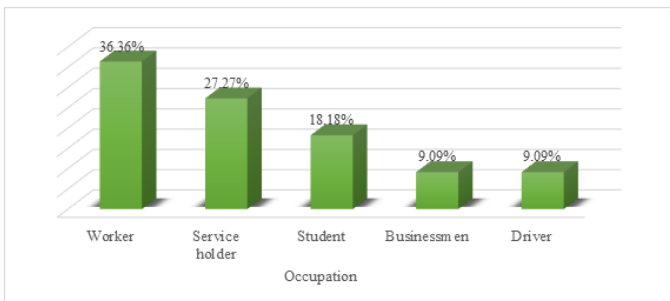
**Figure 2:** Pre-operative CT scan (3D)



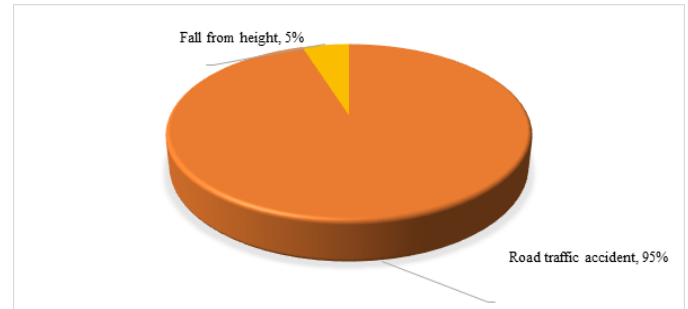
**Figure 3:** Postoperative X-ray pelvis outlet view in 6th week



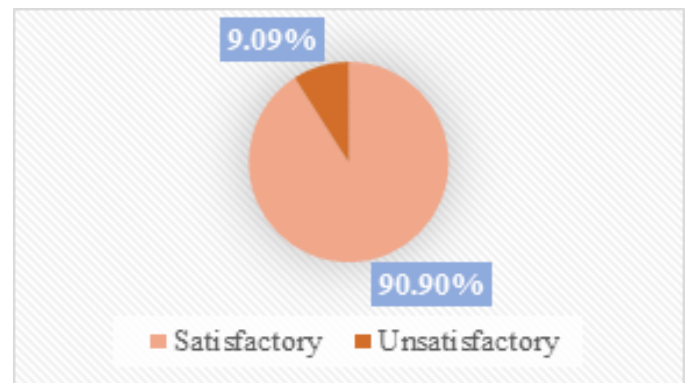
**Figure 4:** Gender distribution



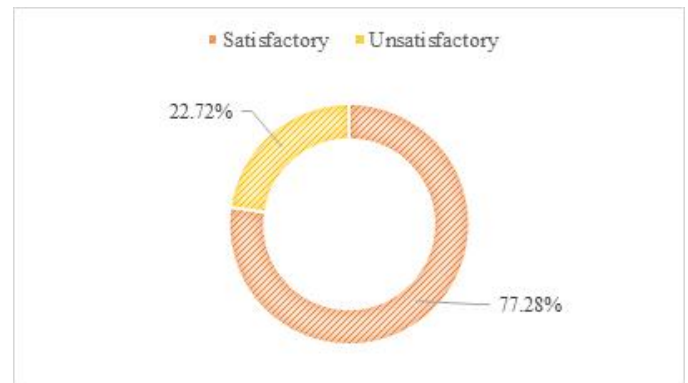
**Figure 5:** Occupational status of patients



**Figure 6:** Mode of injury among the respondents



**Figure 7:** Final functional outcome of the patients



**Figure 8:** Final radiological outcomes

In this study, the highest number of patients (12 or 54.54%) was observed in the 20-30 years age group, and the lowest number (4 or 18.18%) of patients were observed in the more than 40

years age group. The mean age was  $35.8 \pm 10.5$  years, with a range from 18 to 60 years [Table 1]. Among the study population, 16 (72.72%) were male, and 6 (27.27%) were female [Figure 4]. In this series, out of 22 patients, 8 (36.36%) were workers, 6 (27.27%) were service holders, 4 (18.18%) were students, 2 (9.09%) were businessmen, and 2 (9.09%) were drivers [Figure 5]. In this study, 21 (95%) of fractures were caused by road traffic accidents, and the rest (5.0%) were due to falls from height [Figure 6]. It was observed that 4 (18.18%) patients presented with a lacerated wound, 1 (4.5%) with a fractured shaft of the femur, 2 (9.09%) with Colles' fracture, and 5 (22.72%) with bladder tear/urethral injury. Ten (45.45%) patients had no associated injury [Table 2]. Among the 22 patients, all (100%) underwent SI joint fixation, with 21 (95.45%) undergoing unilateral fixation and 2 (9.09%) undergoing bilateral fixation. Additionally, all patients underwent anterior pelvic plating of the pubic symphysis [Table 3]. Concerning the time interval between injury and operation, 9 (40.90%) patients were operated on within 10 days of injury, while the remaining 13 (59.09%) were operated on

between 11-20 days of injury [Table 4]. In the functional assessment of unaided gait, 9 (40.90%) had a slight limp, 10 (45.45%) had a normal gait, and 3 (13.63%) had a moderate limp with shuffling small steps; no gross limp or inability to walk was observed [Table 5]. The mean Majeed score among the total participants was  $85.83 \pm 11.42$ , ranging from 55 to 100 [Table 6].

The functional score grading was excellent in 14 (63.63%), good in 6 (27.27%), and fair in 2 (0.09%), with none of the patients having poor outcomes [Table 7]. Among the study population, this procedure was successful in 82.3% to 99.5% of the patients, representing a highly acceptable functional outcome [Figure 4]. According to score grading, it was found that 4 (18.18%) had an excellent outcome, 13 (59.09%) had a good outcome, 3 (13.63%) had a fair outcome, and 2 (9.09%) had a poor outcome [Table 8]. Considering the radiological findings, success ranged from 60.18% to 84.36% with this procedure, with a 95% confidence interval, indicating a highly acceptable outcome [Figure 5].

**Table 1:** Age distribution of the study patients (N=22)

Age (in years)	n	%
20-30	12	54.54
31-40	4	18.18
>40	6	27.27
Mean $\pm$ SD	35.8 $\pm$ 10.5	
Range (Min-Max)	(18-60)	

**Table 2:** Associated injury of the study patients

Associated injury	n	%
Lacerated wound	4	18.18
Fracture shaft of the femur	1	4.5
Colles' fracture	2	9.09



Urethral injury	5	22.72
No injury	10	45.45

**Table 3:** Type of fixation of the study patients

Associated injury	n	%
SI joint fixation	22	100%
Unilateral	21	95.45%
Bilateral	1	4.54%
Anterior pelvic plating	22	100%

**Table 4:** Time interval between injury and operation

Days	n	%
0-10	9	40.90
11-20	13	59.09
Mean±SD	10.6±3.02	
Range (min-max)	(6-18)	

**Table 5:** Functional assessment on unaided gait

Gait unaided	n	%
Normal	10	45.45
Slight limp	9	40.90
Moderate limp	3	13.63
Gross limp	0	0.0
Shuffling small steps	0	0.0
Cannot walk or almost	0	0.0

**Table 6:** Majeed score distribution

Majeed score	n	%
>85	14	63.63
70-84	6	27.27
55-69	2	9.09
<55	0	0.0
Mean ±SD	85.83±11.42	
Range (min-max)	(55-100)	

**Table 7:** Functional score grading

Score grading	n	%
Excellent	14	63.63
Good	6	27.27
Fair	2	9.09
Poor	0	0.0

**Table 8:** Distribution of radiological score grading

Score grading	n	%
Excellent	4	18.18
Good	13	59.09
Fair	3	13.63
Poor	2	9.09

## DISCUSSION

In this current study, the majority of patients (54.54%) were in the 3rd decade, with the lowest number (18.18%) in the 4th decade. The mean age was  $36.41 \pm 3.4$  years, ranging from 18 to 60 years. Comparable studies by Avilucea, Whiting, and Mir, et al., observed a mean age close to the current study at 36 years.<sup>[11]</sup> Oh et al. reported an average age of 41 years (range, 23 to 61 years).<sup>[12]</sup> Kwon et al. found a mean age of  $38.4 \pm 18.0$  years.<sup>[13]</sup> Turfan, et al., reported a mean age of  $40.6 \pm 20.9$  years.<sup>[14]</sup> Zamzam, Pelvandi & Hasankhani observed almost identical mean ages of 37 years and 37.3 years, respectively.<sup>[15,16]</sup> In this series, the male-female ratio was 2.5:1, indicating male predominance, possibly attributed to males being more exposed to road traffic accidents due to outdoor work, consistent with findings by Turfan, et al., where male patients constituted 64%.<sup>[14]</sup> Similar observations regarding male predominance were also made by Zamzam et al., Van den Bosch, et al., and Matta et al.<sup>[15,17,18]</sup> Oh, et al., reported 10 male patients out of 22 total patients.<sup>[12]</sup> Kwon, et al., found that 69.6% were male.<sup>[13]</sup> In this present series, most (95.0%) of fractures were caused by road traffic accidents (RTA), with the rest (5.0%) due to falls from height. Kwon, et al., reported that RTAs accounted for 69.6%, pedestrians for 37.37%, and drivers for 10.1%.<sup>[13]</sup> Holstein, et al., also found that the most frequent causes of injury

were RTAs involving cars, motorcycles, bicycles, and falls from high altitudes.<sup>[19]</sup> Miranda, et al., reported that 78.9% of fractures were due to motor vehicle accidents, 10.5% to pedestrian versus car incidents, and 10.8% to falls from height.<sup>[20]</sup> Van den Bosch, et al., found that 62.2% of patients sustained motor vehicle accidents, 24.3% fell from a height, and 13.5% had crush injuries.<sup>[17]</sup> The findings of the above authors regarding the cause of fractures were consistent with the present series. In this series, 14 (63.63%) patients had associated injuries, including 18.18% with lacerated wounds, 4.54% with a fracture shaft of the femur, 9.09% with Colles' fracture, and 31.81% with urethral tear. Zamzam included 38 patients in his study, and 84.2% of them had associated injuries.<sup>[15]</sup> Pelvandi and Hasankhani reported almost similar findings.<sup>[16]</sup> Regarding the type of fixation in the current study, 95.45% underwent unilateral SI plating, and 1 patient (4.54%) underwent bilateral SI plating. Sixteen patients were treated with anterior rami reconstruction plate or percutaneous lag screw. Avilucea, Whiting, and Mir state that posterior fixation of LC type -2 pelvic ring injuries decreases the rate of anterior plate failure and malunion.<sup>[11]</sup> They managed 134 patients, among whom 92 patients (69%) underwent combined anterior and posterior fixation, and 42 (31%) patients had only anterior fixation alone. Anterior plate fixation failed in 5 patients (5%) in the combined group and 17 (40%) in the anterior-only group.



The results obtained in the present study, along with the findings of the above authors, indicate that both anterior and posterior fixation are necessary for satisfactory stabilization as well as good mobilization postoperatively. Regarding the time interval between injury and operation, 40% of the patients were operated on within 10 days of injury, and the remaining 60% were operated on between 11-18 days of injury. The mean duration of the time interval between injury and operation was  $10.6 \pm 3.02$  days, ranging from 9 to 18 days. In the study of Oh et al., the time interval was 17.4 days and ranged from 11 to 30 days.<sup>[12]</sup> Tornetta and Matta found the mean duration of the time interval between injury and operation was 14 days, consistent with the present study.<sup>[21]</sup> Similarly, Pelvandi and Hasankhani et al. found that all patients were operated on within 15 days of injury [16]. In this series, the mean Majeed score was  $85.13 \pm 11.42$ , ranging from 55 to 100. According to score grading in this current study, 63.63% were excellent, 27.27% were good, and 9.09% were fair. Regarding functional assessment, similar findings were obtained by Zamzam, where the investigators found 29% excellent, 42.0% good, 18.0% fair, and 11.0% poor.<sup>[15]</sup> In this present study, a satisfactory result was found in 90.90%, and unsatisfactory in 9.09%. Matta and Saucedo et al. evaluated clinical results at follow-up and found 86.0% satisfactory and 14.0% unsatisfactory, supporting the present study.<sup>[22]</sup>

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## Limitations of the study

The study was limited to a single hospital with a small sample size and a short follow-up period, potentially limiting the generalizability of the results to the broader community. Additionally, post-operative CT scans were not conducted for all patients, which could impact the comprehensiveness of the findings.

## CONCLUSIONS

The utilization of anterior, combined, or posterior reconstruction plates, along with cancellous screws, for stabilizing lateral compression type-II pelvic ring fractures has proven to be a satisfactory and effective approach to managing patients. This method facilitates early mobilization and rehabilitation, contributing to positive outcomes in the overall care of individuals with such fractures. The versatility of these stabilization techniques offers clinicians valuable options for tailoring interventions to individual patient needs, ultimately promoting successful recovery and functional restoration. The study's evaluation was conducted six months after the operation, limiting the assessment of outcomes beyond this period, such as malunion, implant failure, and long-term symptom status. Consequently, further studies with a focus on long-term evaluations are recommended.

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