

The Functional Outcome of Internal Fixation by Anterior Pelvic Plating & Posterior Percutaneous Iliosacral Screw in Tile Type-C Pelvic Ring Fracture.

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Abstract

Background: Pelvic fractures constitute one of the most severe orthopedic injuries causing significant mortality & morbidity. Unstable pelvic ring disruptions result from high-energy trauma and are associated with multiple concomitant injuries. Effective emergency medical services & proper definitive management must be ensured to save lives & reduce long-term complications. **Objectives:** To evaluate the functional outcome of internal fixation by anterior pelvic plating & posterior percutaneous iliosacral screw in Tile Type-C pelvic ring fracture.

Materials and Methods: This prospective interventional study was conducted at the Department of Orthopedic Surgery, Dhaka Medical College & Hospital, Dhaka, for two years from July 2019 to June 2021. Patients of diagnosed Tile Type-C pelvic ring fractures were the study population. A total of 22 patients aged 18 to 60 years presenting within three weeks of injury were included in the study. Functional outcomes were evaluated six months after surgery according to Majeed Score. **Results:** According to Majeed score grading, the overall functional outcome of the study population revealed that 18 patients (81.82%) belonged to satisfactory (excellent + good), and four patients (18.18%) belonged to unsatisfactory (poor + fair) outcomes. Only 02 patients (9.09%) had wound infection, 02 patients (9.09%) had erectile dysfunction, 02 patients (9.09%) had urinary tract infection, 01 patient (4.55%) had implant loosening & 14 patients (63.63%) had no postoperative complications. **Conclusion and Recommendations:** Internal fixation of Tile Type - C pelvic ring fractures by anterior pelvic plating and posterior per-cutaneous iliosacral screw are a satisfactory and effective management method for early mobilization and rehabilitation of the patients.

Keywords: Internal fixation, Anterior pelvic plating, Posterior percutaneous iliosacral screw, Type-C pelvic ring fracture.

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Introduction

Traumatic disruption of the pelvic ring has become a major focus of orthopedic interest in the past two decades. Pelvic fractures constitute about 1.5% to 3% of all skeletal injuries. Hossain et al. (2020) showed that bus accident was the commonest cause of fracture pelvis in Bangladesh due to sub-optimal roads, speeding, overtaking, reckless driving, unfit vehicles, and the violence of traffic rules/signs.¹ This injury forms part of the

spectrum of polytrauma. The initial treatment of unstable pelvic ring injuries consists of bleeding management, hemodynamic restoration, stabilization of the pelvic ring, and a quick and accurate diagnosis and surgery. As a damage control procedure, patients are initially stabilized with an external fixator for temporary pelvic stabilization. When the patient's hemodynamic state is stabilized, definitive internal fixation surgery is performed, usually in 5 to 7 days.²⁰ Black et al. (2016) reported decreasing mortality rates over 13 years after initiating a multidisciplinary institutional protocol.⁴ All patients with open pelvic fractures were managed according to the standard Advanced Trauma Life Support (ATLS) protocol, and antibiotics & anti-tetanus protocol were injected appropriately. Management course was different for each patient depending on his/her hemodynamic status.² Spanjersberg et al. (2009) showed that pelvic circumferential compression devices were effective in stabilizing unstable pelvic

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fractures.³ Circumferential devices can be achieved by using a specially designed commercial device. Mortality was estimated at 28% from multiple pooled studies but can be as high as 50% in open fractures. In a multicenter retrospective review of 2551 patients with pelvic ring injuries, mortalities were closely associated with a concomitant soft tissue injury.²¹ Patients with unstable pelvic ring injuries and associated hemodynamic instability or open fractures require immediate and aggressive surgical care. However, controversies remain concerning the choice and the sequence of the life-saving surgical procedure required. Schematically, four procedures are available to control pelvic bleeding in severely hypotensive patients acutely: immediate skeletal external fixator, direct vessel ligation, angiographic embolization (which may control high-pressure arterial bleeding) and retroperitoneal pelvic packing to help control both high-pressure as well as low-pressure bleeding.⁵ Over the past decades, a “two hits” model of systemic inflammatory response in critically injured patients has been described. The initial trauma acted as the first hit that leads to the initiation of an immune-inflammatory response, with potential interventions done during this period, such as surgical interventions being potential “Second hits,” driving a patient towards a more systemic inflammatory response characterized by organ dysfunction and is a cause for later morbidity & mortality following acute trauma.⁸ An unstable pelvic fracture may be life-threatening and can be seen as “The Killing” fracture.⁷ If the ring is broken in one area and the fragments are displaced, there must be a fracture or dislocation in another part of the ring. The stability of the pelvic ring depends upon the integrity of the posterior weight-bearing sacroiliac complex, with the major sacroiliac, sacrotuberous, and sacrospinous ligaments. The extremely strong posterior sacroiliac ligament maintains the normal position of the sacrum in the pelvic ring, and the

entire complex has the appearance of a suspension bridge. The lesion in the anterior part of the ring is less critical in the stability of a pelvic ring that is intact posteriorly.¹⁰ Various surgical options for anterior ring fixation include an external fixator, retrograde retropubic screw, and plate. The most commonly used surgical approach is a pfannenstiell-type incision for symphyseal disruption and medial ramus fracture. For the plate fixation of the displaced lateral ramus fracture & anterior column, an ilioinguinal approach is widely used as the exposure of choice, which may require a long operation time, meticulous handling around the neurovascular bundle, and significant blood loss. Based on the current concept of minimally invasive surgery that emphasizes less tissue dissection, the modified stoop approach has been introduced to treat pelvic-acetabular fractures, allowing easy exposure of the pelvic brim, where bone quality is optimal for screw fixation.⁸ Biomechanical studies showed that the best stability in type - C pelvic ring fractures can be achieved by internal fixation of the posterior and anterior pelvic injuries.²² Unstable pelvic ring injuries are frequently associated with various types of combined injuries. The conservative treatment of these injuries had been disappointing. Early rigid fixation and anatomical reduction of the pelvic ring are recommended to reduce mortality and allow early ambulation. The complicated vertical shear type of injury, an unstable lateral compression injury, or external rotation instability requires anatomical reduction, anteriorly and posteriorly. Displaced unstable pelvic ring injuries are commonly associated with the disrupted osteoarticular junction of the sacroiliac joint. Plating or sacral bars are widely used for posterior lesions, but they need wide exposure, which may be susceptible to infection & post-operative complications. Given these problems, the percutaneous iliosacral screw fixation is a far less invasive technique than those of previous options and sacral fractures commonly

encountered in unstable pelvic ring injuries.¹³ Reduction of a hemipelvis involves a combination of traction and rotation to correct the deformity. For unstable pelvic ring injury, the anterior ring is fixed with a plate, and posterior fixation is aided by an accurate definition of the injury pattern using preoperative traction, early surgical treatment, and identification of posterior sacral foramina, which are used as a guide to allow accurate screw placement into the Sacrum. The technique risked damage to the L5 and S1 nerve roots and iliac vessels anterior to the body of the sacrum and the sacral nerve roots within the vertebral canal, and it requires excellent radiographic technique and a thorough understanding of the three-dimensional anatomy of the pelvis. In unstable pelvic ring injuries, good results were also reported with percutaneous iliosacral screw fixation.¹⁴ The purpose of the study is to evaluate the functional outcome of the patients treated with anterior pelvic plating & posterior percutaneous iliosacral screw fixation in Tile Type-C pelvic ring fracture.

Materials and Methods

This prospective interventional study was conducted at the Department of Orthopedic surgery, Dhaka Medical College & Hospital, Dhaka, for two years from July 2019 to June 2021. Patients of diagnosed unilateral or bilateral Tile Type-C pelvic ring fractures were the study population. A total of 22 patients aged 18 to 60 years presenting within three weeks of injury were included in the study. Functional outcome were evaluated six months after surgery according to Majeed Score. Data included demography of the patients, mechanism of injuries, associated injuries, emergency interventions, fracture types, post-operative complications & length of hospital stay. Morbidly obese patients, patients with

acetabular fracture, complete spinal injury, dysmorphic sacrum and patients who lost follow up were excluded from the study.

Before the commencement of the study, the protocol was approved by a research review committee of the department of Orthopedic surgery, DMCH. The ethical clearance was obtained from the ethical review committee of DMCH. After written and valid consent from all voluntarily agreed participants data were collected with a pre-tested structured questionnaire containing history, clinical examination, laboratory investigations, pre-operative, per-operative, and post-operative follow-up findings, and complications. Collected data were analyzed using the software SPSS (Statistical Package for Social Sciences) version 23.0 for windows. Descriptive statistics were used to analyze the data. Analyzed data were presented in tables and charts with appropriate interpretations.

Results

Table 1 shows the distribution of patients by age. In this study, the highest number of patients, 08(36.36%), were observed in the third decade, and the lowest number, 01(4.55%), was observed in the second decade. The mean age was 37.82 ± 14.82 years, ranging from 18 to 60 years. Among 22 patients, 18(81.82%) were male, and 04(18.18%) were female (Figure 1). Maximum patients 10(45.45%) had right side injury, 07(31.82%) had bilateral injury & 05(22.73%) had left side involvement (Table 2). In this series out of 22 patients 8(36.36%) were worker, 6(27.27%) service holder, 4(18.18%) student, 2(9.09%) businessman and 2(9.09%) driver (Figure 2). Regarding the associated injury, it was observed that 01(4.55%) patient had an associated open fracture shaft of tibia-fibula, 01(4.55%) patient had fracture patella, 01(4.55%) patient had

fracture calcaneum, 01(4.55%) patient had fracture shaft of fibula, 01(4.55%) patient had fracture distal radius, 04(18.18%) patient had urethral injury, 02(9.09%) patient had a neurological injury, 01(4.55%) patient had Morel-Lavallee lesion, 01(4.55%) patient had chest injury, and 08(36.36%) patient had no associated injury (Table 3). The mean duration of hospital stay was 24.09 ± 10.14 days, with a range from 14 to 64 days. Moreover, most patients stay at the hospital for 21 to 30 days (Table 4). The functional outcome revealed that 18 patients (81.82%) belonged to satisfactory & 04 patients (18.18%) belonged to unsatisfactory (Figure 3).

Table I: Demographic information of study population (N=22).

Characteristic	Frequency	Percentage
Age (in years)		
18-20	1	4.55
21-30	8	36.36
31-40	6	27.27
41-50	3	13.64
51-60	4	18.18
Total	22	100
Mean±SD	37.82±14.82	
Range	(18 – 60)	
Gender		
Male	18	81.82
Female	4	18.18
Occupational s tatus		
Worker	8	36.36
Service Holder	6	27.27
Student	5	22.73
Businessman	2	9.09
Driver	2	9.09

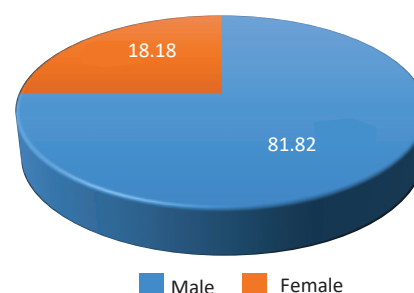


Figure 1 : Pie chart showing the distribution of the patients by gender.

Table II: Mode of injury of the study population (N=22).

Characteristic	Frequency	Percentage
Mode of injury		
Bus accident	6	27.27
Motorcycle accident	5	22.73
Car accident	3	13.64
CNG has driven 3 wheeler	3	13.64
Fall from a height of more than 12 feet	2	9.09
Truck accident	2	9.09
Fall of a heavy object	1	4.55
Side of Injury		
Right	10	45.45
Left	5	22.73
Bilateral	7	31.82

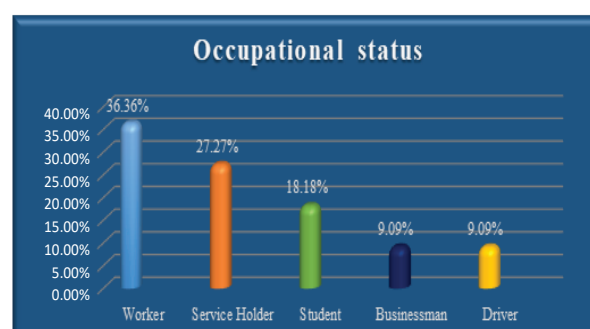


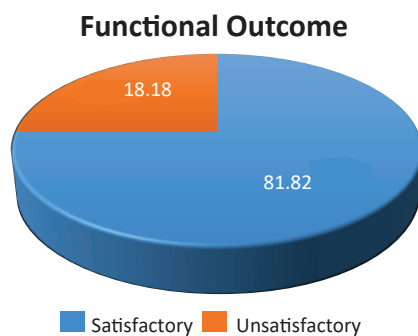
Figure 2 : Bar diagram showing the distribution of the patients by occupational status.

Table III: Distribution of patients according to associated injuries (n=22).

Associated injury	Frequency	Percentage
Orthopedic injury		
Open fracture shaft of tibia-fibula	1	4.55
Fracture patella	1	4.55
Fracture calcaneum	1	4.55
Fracture shaft of fibula	1	4.55
Distal radial fracture	1	4.55
Non-orthopedic injury		
Urethral injury	4	18.18
Neurological injury	2	9.09
Perineal injury	1	4.55
Morel-Lavallee lesion	1	4.55
Chest injury	1	4.55

Table IV: Distribution of patients according to hospital stay (n=22).

Hospital stay (days)	Frequency	Percentage
(11-20)	8	36.36
21-30	11	50
>30	3	13.64
Total	22	100
Mean±SD	24.09±10.14	
Range (min-max)	(14 – 64)	

**Figure 3 : Pie Chart showing the final functional outcome.**

Discussion

This prospective interventional study was carried out to evaluate the radiological outcomes of the Tile Type-C pelvic ring fracture. Twenty-two patients with unstable pelvic ring fractures (Tile Type-C) were enrolled in this study within three weeks of incidence. They were admitted to Dhaka Medical College & Hospital (DMCH) from July 2019 to June 2021. In this study, the highest number of patients, 09(40.91%), were in the third decade, and the lowest number, 03(13.64%), were in the fifth decade. The mean age was 37.82 ± 14.82 years, ranging from 18 to 60 years. Similarly, Mardanpour and Rahbar (2013), Moon et al. (2014) & Hossain et al. (2020) have observed almost identical mean ages of the patients, which were 37 ± 10 years, 42.4 years & 37.75 ± 13.4 years.^{12,13,1} In this current series, it was observed that among 22 patients, 18 (81.82%) were male, and 04(18.18%) were female. Similarly, Mardanpour and Rahbar (2013) showed that out of 27 patients with C-Type pelvic ring injuries, 22 (81.48%) were male & 05 (18.52%) were female patients.¹³ Kokubo et al. (2017) showed that out of 31 patients, 24(77.42%) were male & 07(22.58%) were female patients.¹⁴ In this series, it was observed that RTA caused most of the (86.36%) fractures, others due to falling from height (9.09%), and the fall of a heavy object (4.55%). Similarly, Mardanpour and Rahbar (2013) showed that the most frequent mode of injury in RTA is about 91%.¹³ Moon et al. (2014) showed that 75.47% of pelvic fractures are due to road traffic accidents, crush injuries in 11.32% of cases, falls in 7.55% of cases & falls of heavy objects in 5.66% of cases.¹² Mohammed (2004) observed that the cause of injury was a road traffic accident in 92.1% of patients and a fall from height in 7.9% of patients.¹⁵ Regarding associated injuries in this series, it was observed that 04(18.18%) patients had associated urethral injury, 04(18.18%)

patients had lower limb fractures, 01(4.55%) patients had associated upper limb fractures, 02(9.09%) patient with associated lumbosacral plexus injury, 01(4.55%) patient had associated chest injury, 01(4.55%) patient had associated perineal injury, 01(4.55%) patients had associated Morel-Lavallee lesion & 36.36% patients had no associated injury. Similarly, Vidyarthi and Nayak (2018) showed that 17.6% had associated lower limb fracture, 14.3% of patients had associated upper limb fracture, and 12.7% had associated urethral injury.¹⁷ Hossain et al. (2020) showed that 16.09% of patients had associated urethral injuries & 12.93% of patients had associated lower limb fractures.¹ Mardanpour and Rahbar. (2013) showed that 31.5% had a urologic injury, 29% had neurological injuries, 15.7% had an intra-abdominal hemorrhage, and 5.2% had a head injury.¹³ Choy et al. (2012) showed that 53% of the patients had associated injuries or other site fractures.¹⁰ Mohammed (2004) included thirty-eight patients in his study, and 84.2% of patients had associated injuries.¹⁵ Regarding emergency interventions, it was observed in this study that an anterior external fixator was applied in 5(22.73%) patients, suprapubic cystostomy was done in 4(18.18%), upper tibial skeletal traction was given in 4(18.18%), tube thoracostomy done in 1(4.55%) & colostomy done in 01(4.55%) patient. Similarly, Hossain et al. (2020) showed that in 15% of cases anterior external fixator was applied, tube thoracostomy was done in 6%, suprapubic cystostomy in 17%, laparotomy in 3% & upper tibial skeletal traction in 10% cases.¹ The time interval between the injury & the operation was observed in this study that a maximum of patients 12(54.55%) were operated within 08-14 days, 09(40.90%) after 14 days & 01(4.55%) within 5-7 days after admission. Similarly, in the study of Kokubo et al. (2017), the time interval between injury & the operation was 0-18 days.¹⁴ In the study of Oh et al. (2016), the time interval was

17.4 days and ranged from 11 to 30 days.⁸ In the study of Moon et al. (2014), the mean time from injury to operation was 7.8 days (range: 4-19 days).¹² In the study of Hasan-khani and Omid-Kashani (2013), all patients were operated on within 15 days of injury.² In this current study, it was observed that the mean duration of hospital stay was 24.09 ± 10.14 days with a range from 14 to 64 days. Similarly, Rafael Portela et al. (2019) showed that the mean time between admission & hospital discharge was 31.9 days.²⁰ Wu et al. (2021) the average duration of hospital stay was 22.2 days with a range of 6 to 61 days.¹⁸ Mohammed (2004) reported that the total hospital stay was 29 days, ranging from 14 to 75 days.¹⁵ This current study observed postoperative complications in 36.36% of cases. Among them 02(9.09%) patients had wound infection, 02(9.09%) developed erectile dysfunction & 02(9.09%) developed urinary tract infection, 01(4.55%) patient developed screw loosening & 01(4.55%) patient developed pelvic obliquity. Similarly, in the study of Mardanpour and Rahbar (2013), 10.5% of patients developed deep wound infections, and 5.2% developed urinary tract infections.¹³ 2.6% of patients had device failure, and 5.2% developed pelvic obliquity. In this series, functional outcome was assessed according to Majeed score which is made up of 07 sections: pain (30 points), work (20 points), sitting (10 points), sexual intercourse (4 points), walking aids (12 points), unaided gait (12 points) & walking distance (12 points). Out of a perfect Majeed score of 100 points, it was observed that the mean Majeed score in this study was 80.95 ± 10.78 . According to score grading in this study, excellent 12(54.55%), good 6(27.27%), fair 03(13.64%) & poor 01(4.55%). Similarly, in the study of Moon et al. (2014) the functional outcomes were excellent in 67.92% cases, good in 28.30% cases, fair in 3.77% cases.

Limitations

There are some limitations of this study; the study and follow-up period were short-term compared to other series, and a small sample size was taken in this study. Difficulties in the follow-up of patients due to the Covid-19 pandemic situation and post-operative CT scans could not be made in all patients. The results may not represent the scenario of unstable pelvic ring injuries in the whole country, so it will not be possible to reach an appropriate inference from this study.

Conflict of interest

The authors declare no conflict of interest. No funding was received from any source for conducting this study.

Conclusion and Recommendations

It is concluded that internal fixation of Tile Type-C pelvic ring fractures by anterior pelvic plating and posterior per-cutaneous iliosacral screw is a satisfactory and effective management method for early mobilization and rehabilitation of the patients. As the outcome evaluation was done six months after the operation, changes in outcome beyond six months, like mal-union, implant failure, infection, and symptom status could not be ascertained. So further study should be contemplated considering long-term evaluation. A large sample size should be taken for a further prospective study. A postoperative CT scan of the pelvis with 3-D reconstruction in all patients is recommended.

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