Functional Outcome of Surgically-Managed Pelvic Ring Fractures and Acetabular Fractures by Internal Fixation in a Tertiary Hospital in the Philippines 2014–2019

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ABSTRACT

Objective. To evaluate morbidity and functional outcome of surgically treated pelvic fractures and acetabular fractures in our institution.

Methods. A chart review was done to identify subjects with pelvic and acetabular injuries treated with open reduction and internal fixation from 2014–2019. We collected data for blood loss, time of surgery, post-surgical intervention, and the Majeed score functional outcome score.

Results. We included 11 patients (8 males, 3 females; mean age 38 years) with range of follow up of 1 to 6 years. We performed a functional assessment using the Majeed functional outcome score. The mean score was 81 ± 18 points (range, 53 to 100). Excellent clinical results were seen in 63% of cases (100% of pelvic fractures and 50% of acetabular fractures).

Conclusion. There was excellent functional outcome of patients treated with internal fixation.

Keywords: fracture fixation, internal fixation, functional outcome, morbidity, pelvic bones

INTRODUCTION

Management of polytrauma with pelvic ring and acetabular fractures is difficult. Pelvic and acetabular fractures are among the most serious injuries handled by orthopedic surgeons.[1] The incidence of pelvic and acetabular fractures is 20–23 per 100,000 per year and 3 in 100,000 per year, respectively. The most common cause of pelvic and acetabular fractures is high-energy injury such as those caused by traffic accidents, high-falling injury and crush by heavy objects.[2-3] The purpose of surgical intervention for pelvic and acetabular fractures is to correct and restore pelvic ring and acetabular structure while applying a reliable and rigid fixation.[4] For displaced fractures, aggressive surgical treatment is usually advocated.[2] Mortality is greater for pelvic fractures (5–15%) than acetabular fractures (1%).[3] Pelvic and acetabular fractures have long-term consequences on quality of life after surgical treatment.[2] Studies on acetabular fractures have focused more on the functional outcome and complications.[4-5] Early surgical intervention and anatomic restoration of pelvic ring and acetabulum correlated with good functional and clinical results.[4,6] However, to the best of our knowledge, there is no local retrospective or prospective study on the functional

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outcome after pelvic and acetabular injury. The purpose of this study is to determine both morbidity and functional outcome of surgically treated pelvic fractures and acetabular fractures in our institution.

MATERIALS AND METHODS

A descriptive study was conducted at the orthopedics department in a tertiary hospital after being approved by the Institutional Review Board. Chart review was done to identify patients with pelvic and acetabular injuries treated with open reduction and internal fixation from 2014–2019. We collected the following data: blood loss, time of surgery and duration, post-surgical intervention, and the Majeed score functional outcome score. We assessed the following: pain (0–30 points), return to work (0–20 points), gait (0–12 points), use of walking aid (0–12 points), sitting tolerance (10 points), sexual intercourse (0–4 points), and performance at work (0–20 points). A score of 100 points was defined as the best result. According to the total Majeed score, outcomes were graded as excellent (≥85), good (84 to 70), fair (69 to 55) and poor (<55). (Appendix 1) Categorical data were expressed in frequency and percentage.

RESULTS

Out of 24 identified patients, only 11 were available for assessment of functional outcome score after a period of at least 6 months post-injury. There were eight men and three women, with mean age of 38 years (range: 20–63 years). The mechanism of injury for all patients involved a motor vehicular accident. Nine patients were motorcycle drivers and two were either a pedestrian or passenger. Two patients presented with fracture dislocation of the affected hip on arrival; two were noted to have poor functional outcome score on follow up. Reduction was done in an average of 16 hours post-injury (range:12–20 hours). Mean time to surgery was 5.7 days (range: 20 hours to 12 days). Associated injuries include: 2 open tibia shaft fractures, 1 iliac wing fracture, 1 femoral shaft, 1 tibial tuberosity avulsion, 1 distal radius fracture, and multiple lacerations. Three patients had pelvic fractures, while 8 had acetabular fractures (6 left, 2 right). Injuries occurred in the following areas: 5 posterior wall, 1 both anterior column and posterior wall, 1 both anterior and posterior column and 1 had both anterior and posterior acetabular wall fracture. Three out of 11 (27%) patients had a concomitant posterior hip dislocation on arrival. The pelvic fractures were classified as follows: two patients were Tile A, and one was Tile C2 with a classification of anteroposterior compression (APC) III and Lateral compression (LC) III. (Tables 1 and 2)

The surgical approach was dependent on the fracture type. The Kocher-Lagenbeck approach was used for posterior wall or column fractures in 6/11 patients. A combined approach was used in two patients, one of which had a concomitant iliac wing fracture with a posterior wall of acetabulum fracture. One patient presented with both anterior and posterior wall or column fractures. In two patients with unstable pelvic fractures, the Pfannensteil approach was used. The Ilioinguinal approach was used in one patient with an anterior pelvic ring injury. The average blood loss was 645 ml (range of 300 to 1800). Rigid internal fixation was used for all patients, which included plates and screws. The mean follow-up period was 3.5 years (range, 1-6). The mean duration of operation was 2.5 hours (range, 2 to 4).

Functional assessment of patients after injury was taken using the Majeed score. At a mean follow up of 3.5 years, 7/11 patients showed excellent functional outcome while one patient each showed both fair and good outcome. Two patients had poor outcome (Table 3). Overall, mean score was 81.0 ± 18.9 points, with excellent outcome for the majority of both pelvic and acetabular cases treated with internal fixation. (Table 4)

Three patients were advised or scheduled for revision surgery or total hip replacement. Two patients had poor outcome and one had fair outcome. Two out of three patients had an acetabular fracture over the posterior acetabular wall with a posterior dislocation of the femoral head on arrival. One patient with an outcome score of 53 had associated open II tibia shaft fracture. Time-to-surgery was 20 hours with note of post-operative subluxation, for which revision surgery was done four days after the initial surgical intervention. The second patient with a poor functional outcome score had minor associated injuries, lacerated wounds, with time-to-surgery of 120 hours; revision surgery was done seven days post-injury. (Tables 5 and 6) One patient presented with foot drop immediately post-operatively but improved with rehabilitation. (Appendix 2)

Table 1. Location/Type Acetabulum Fracture

Elementary Fracture	Side Involved	
	Right	Left
Posterior	1	4
Anterior column Posterior wall		1
T-shaped	1	
Anterior and Posterior wall		1
Total	2	6

Table 2. Type of Pelvis Fractures

Type of Pelvis Fractures	No.	
Tile A	2	APCIII
Tile B		
Tile C	1	LC III

APC, Anteroposterior compression
LC, Lateral compression

Table 3. Evaluation of patient's functional outcome using Majeed score

Majeed score (points)	Outcome	Pelvis	Acetabulum
>85	Excellent	3	4
70-84	Good	0	1
55-69	Fair	0	1
<55	Poor	0	2

DISCUSSION

Pelvic ring and acetabular fractures are uncommon injuries that are usually caused by high- energy trauma. Majority are due to motor vehicular accidents. Management of both fractures are challenging for trauma surgeons and require a multi-disciplinary approach.[4-6]

Table 4. Mean Majeed score per category

Majeed Score Criteria	Pelvis (n=3)	Acetabulum (n=8)	All (N=11)
Pain	30	23.1 ± 5.9	25 ± 5.9
Work	20	13.0 ± 5.1	14.9 ± 5.4
Sitting	10	7.6 ± 2.5	8.3 ± 2.4
Sexual Intercourse	4	3.0 ± 0.8	3.3 ± 0.8
Walking Aids	12	10.5 ± 2.8	10.9 ± 2.4
Gait	11.3 ± 1.2	8.0 ± 2.8	8.9 ± 2.9
Walking Distance	12	9.0 ± 3.4	9.8 ± 3.2
Total	99.3 ± 1.2	74.3 ± 17.7	81.0 ± 18.9

The goal of surgical treatment is to achieve good functional outcome that will allow patients to return to work and previous daily activities. In this study, we assessed the functional outcome of patients with pelvic ring or acetabular fractures who underwent internal fixation. The grading scale is specific to determine functional status in certain aspects of life and is divided into seven categories. Although simple, it considers important aspects that can be limited after injury.

The mean age of patients with pelvic fractures was 33.7 ± 13.1 years and acetabular fractures, 39.5 ± 13.98 years. The mechanism of injury was road traffic accident for all patients. Since pelvic and acetabular injuries result from a large force, which indicates a high energy impact, they are often accompanied by other injuries. In this study, some associated injuries noted were other long bone fractures, and vascular injury. Studies suggest that severity of associated injuries may be a better predictor of outcome than pelvic instability.[7-9] However, due to our limited sample size, a significant comparative analysis could not be made.

Table 5. Summary of clinical characteristics of patients with acetabular injuries

Patient No.	Age	Gender	Acetabular Involvement	Associated Injuries	Time to Reduction (hrs.)	Time to Surgery (hrs.)	Approach	Duration of Surgery (hrs.)	Blood Loss (ml)	Time to Revision	Functional Outcome Score
1	41	M	Anterior wall Posterior wall	Open II tibia shaft fracture	20	20	Kocher-Lagenbeck	2	1000	4 days	59
2	49	M	Posterior wall	Iliac wing	16	120	Ilioinguinal and Kocher-Lagenbeck	4	1800	N/A	63
3	20	M	Posterior wall	N/A	12	72	Kocher-Lagenbeck	2	300	N/A	87
4	36	M	Anterior column Posterior wall	N/A	N/A	72	Ilioinguinal and Kocher-Lagenbeck	3	500	N/A	93
5	24	M	Posterior wall	Closed femoral shaft fracture, tibial tuberosity avulsion, distal radius fracture, submacular hemorrhage	N/A	96	Kocher-Lagenbeck	3	500	N/A	88
6	63	M	Posterior wall	Lacerated wound, left hand	N/A	72	Kocher-Lagenbeck	3	500	7 days	48
7	48	M	Anterior column Posterior column	Open III tibial shaft fracture (S/P arteriorrraphy)	N/A	264	Kocher-Lagenbeck	3	400	N/A	89
8	35	M	Posterior wall	N/A	N/A	216	Kocher-Lagenbeck	3	400	N/A	73

Table 6. Summary of clinical characteristics of patients with pelvic injuries

Patient No.	Age	Gender	Associated Injuries	Time to Reduction	Time to Surgery (hrs.)	Approach	Duration of Surgery	Blood Loss (ml)	Time to Revision	Blood Loss (ml)
1	35	F	Open I comminuted distal tibia and fibula	N/A	144	Ilioinguinal	2	400	N/A	100
2	20	F	n/a	N/A	268	Pfannensteil	3	300	N/A	98
3	46	F	n/a	N/A	144	Pfannensteil	3	1000	N/A	100

Table 7. Functional outcome results of pelvis or acetabulum fractures in the current study compared to previous studies for functional results of patients who underwent internal fixation

Reference	Functional Result				Mean follow-up (months)
	Excellent (%)	Good (%)	Fair/Moderate (%)	Poor (%)	
Mardanpour et al.[8] (pelvic ring fractures)	7 (66) type B	2 (15) type B	1 (11) type B	1 (7) type B	45.6
	23 (46) type C	7 (27) type C	7 (27) type C	0 (0) type C	
Ismail et al.[13] (pelvic fracture)	11 (78.6) type B	3 (21.4) type B			25
	5 (50) type C	5 (50) type C			
Naseem et al.[5] (acetabular fractures)	18 (24)	41 (54.6)	12 (16)	4 (5.4)	3
Mardanpour et al.[12] (acetabular fractures) n=200	139 (69.5)	43 (21.5)	18 (9)	0	82.34 ± 12.48
Giannoudis et al.[11] (meta-analysis - acetabular fractures 6 studies 600 patients Harris hip score)	263 (43.9)	176 (29.3)	69 (11.5)	92 (15.3)	>36
Giannoudis et al.[11] (meta-analysis - acetabular fractures 16 studies used the merle d aubigne score 6 studies 600 patients Harris hip score)	810 (50.3)	468 (29.1)	138 (8.6)	194 (12)	>36
Current Study					
Pelvic Ring	100	0	0	0	42
Acetabular	50	12.5	12.5	25	
Total	63.64	9.09	9.09	18.1	

Table 8. Comparative analysis of the functional results of acetabular fractures treated with internal fixation

Functional Results	Study A vs Study E		Study B vs Study E		Study C vs Study E		Study D vs Study E	
	A	E	B	E	C	E	D	E
Excellent	18	4	139	4	263	4	810	4
Good	41	1	43	1	176	1	468	1
Fair/Moderate	12	1	18	1	69	1	138	1
Poor	4	2	0	2	92	2	194	2
P-Value	0.02**		0.002**		0.62		0.37	

Note: Significant at 0.05 using Fisher's Exact Test
Study A - by Naseem et al.[5] (acetabular fractures)
Study B - by Mardanpour et al.[7] (acetabular fractures)
Study C - meta-analysis by Giannoudis et al.[10] - Harris hip score
Study D - meta-analysis by Giannoudis et al.[10] - Merle d aubigne score

Mardanpour et. al, in a review of 38 patients with unstable pelvic ring fractures, showed that anterior and posterior fixation could restore stability and adequate consolidation in an unstable pelvic fracture (Type C).[8] (Table 7) Our study showed excellent functional outcome (100%) in patients after a mean follow up of 42 months. The stability of the pelvic ring influences the long-term clinical outcome and is shown to worsen with fracture type. Nerve damage is identified as a significant determinant of outcome.[10] However due to the limited sample size, identification of variables affecting outcome and post-operative complications was not possible.

A meta-analysis by Giannoudis, et al showed that the Kocher-Lagenbeck approach was used in 48.7% of cases, similar to our study (45% of cases).[11] Currently, surgical intervention is the treatment of choice, as restoration of the joint is important to decrease the incidence of post-traumatic arthritis of the hip.

Our study results showing excellent functional outcome in 50% of patients, is similar to a previous study of 200 patients with complex acetabular fractures (74.6%)[12] and a meta-analysis of 16 studies (50.3%). A comparative analysis of the functional results of acetabular fractures treated with internal fixation in this study showed comparable results to the meta-analysis by Giannoudis, et al using the Harris hip score and the Merle d aubigne score with a p-value of 0.6281 and 0.3734 respectively (Table 8). The table shows that the functional results of study E are comparable to the results of Studies C and D, which are involving large sample sizes. While the functional results are significantly different from those results in studies A and B.

A limitation of our study was that, owing to the relatively small number of patients, analysis of clinical outcomes in relation to age, associated injuries, quality of reduction, timing of surgery, surgical approach, operation time was not possible. The functional outcome in pelvic and acetabular fractures depends on a number of multifactorial variables. Future studies should focus on patients' quality of life after pelvic and acetabular fractures. Other recommendations for

further prospective studies are the use of multiple validated questionnaires, larger sample size, assessment of pre-injury data and post-injury functional outcomes at regular time intervals with possible comparison of normative data from age-matched general population.

CONCLUSION

The functional outcome after open reduction and internal fixation of both pelvic and acetabular fractures are dependent on multiple factors such as fracture type, fracture dislocation, and possibly associated injuries. There is excellent functional outcome of patients treated with internal fixation at our institution.

Statement of Authorship

Both authors participated in data collection and analysis, and approved the final version submitted.

Author Disclosure

Both authors declared no conflicts of interest.

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APPENDICES

Appendix 1

Name:
Age:
Sex:
Date of Procedure:

Contact number:
Address:
Email address:

Majeed – Grading the Outcome of Pelvic Fractures

How are you doing?
Functional Assessment after pelvic fractures

Pain

☐ Intense, continuous at rest
☐ Intense with activity
☐ Tolerable, but limits activity
☐ With moderate activity, abolished by rest
☐ Mild, intermittent, normal activity
☐ Slight, occasional or no pain

Work

☐ No regular work
☐ Light work
☐ Change of job
☐ Same job, reduced performance
☐ Same job, same perormance

Sitting

☐ Painful
☐ Painful if prolonged or awkward
☐ Uncomfortable
☐ Free

Sexual intercourse

☐ Painful
☐ Painful if prolonged or awkward
☐ Uncomfortable
☐ Free

Standing

A. Walking aids
   ☐ Bedridden or almost
   ☐ Wheelchair
   ☐ Two crutches
   ☐ Two sticks
   ☐ One sticks
   ☐ No sticks

B. Gait unaided
   ☐ Cannot walk or almost
   ☐ Shuffing small steps
   ☐ Gross limp
   ☐ Moderate limp
   ☐ Slight limp
   ☐ Normal

C. Walking distance
   ☐ Bedridden or few meters
   ☐ Very limited time and distance
   ☐ Limited with sticks, difficult without prolonged standing possible
   ☐ One hour with a stick limited without
   ☐ One hour without sticks slight pain or limp
   ☐ Normal for age and general condition

Appendix 2

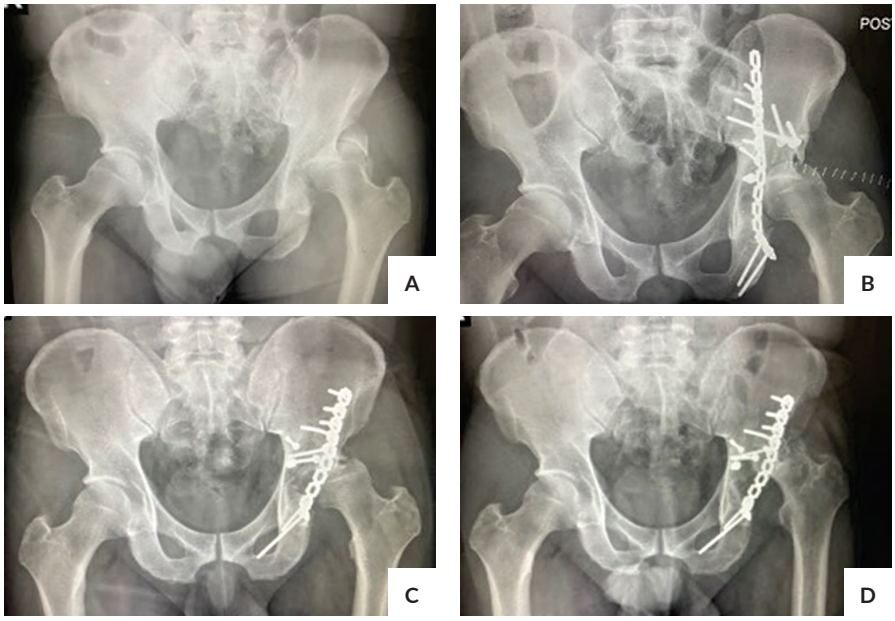

Figure 1. ***Radiographs from Patient 1 – Male, 41-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative, **(C)** Revision, **(D)** 1 year post-operative.

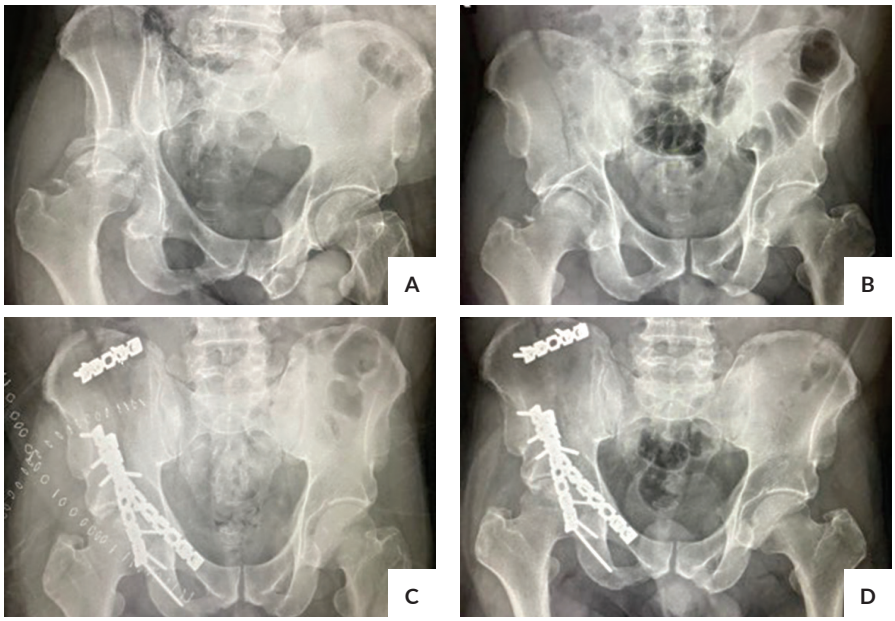

Figure 2. ***Radiographs from Patient 2 – Male, 49-year-old, car accident.*** **(A)** Preoperative, posterior acetabular wall fracture and iliac wing fracture, **(B)** Preoperative – with traction, **(C)** Immediate post-operative, **(D)** 3 months post-operative.

Figure 3. ***Radiographs from Patient 3 – Male, 20-year-old, car accident.*** **(A)** Preoperative, **(B)** Post-reduction, **(C)** Immediate post-operative.

Figure 4. ***Radiographs from Patient 4 – Male, 36-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative, **(C)** 2 months post-operative.

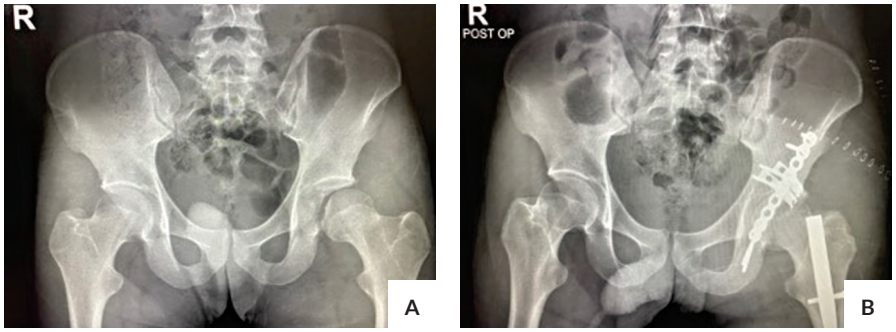

Figure 5. ***Radiographs from Patient 5 – Male, 24-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative.

Figure 6. ***Radiographs from Patient 6 – Male, 63-year-old, car accident.*** **(A)** Preoperative posterior wall fracture, **(B)** Immediate post-operative, **(C)** Revision.

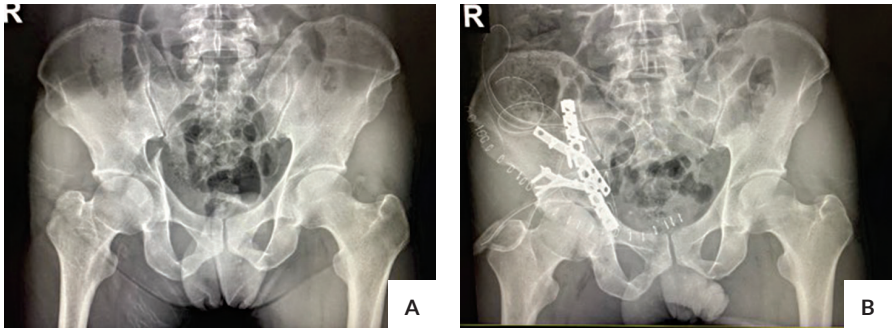

Figure 7. ***Radiographs from Patient 7 – Male, 48-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative.

Figure 8. ***Radiographs from Patient 8 – Female, 35-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative, **(C)** 7 months post-operative.

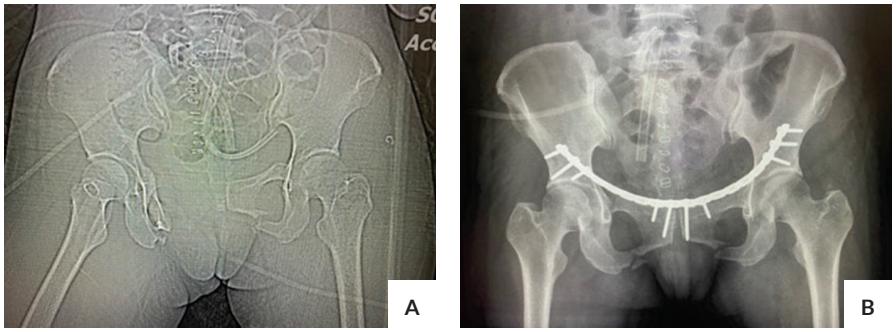

Figure 9. ***Radiographs from Patient 9 – Female, 35-year-old, car accident.*** **(A)** Pre-operative CT scan, **(B)** Immediate post-operative.

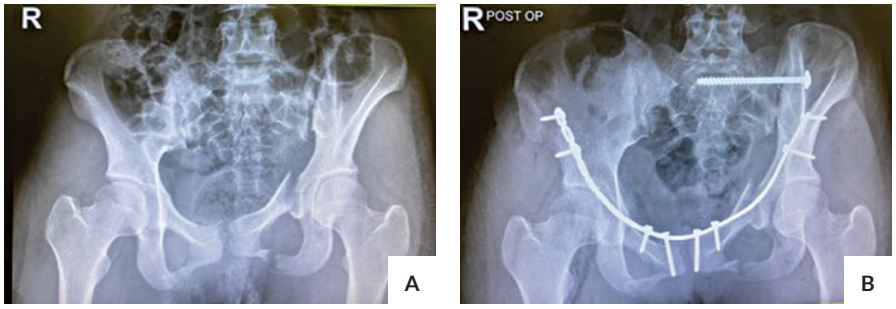

Figure 10. ***Radiographs from Patient 10 – Female, 20-year-old, car accident.*** **(A)** Pre-operative lateral compression injury, **(B)** Immediate post-operative.

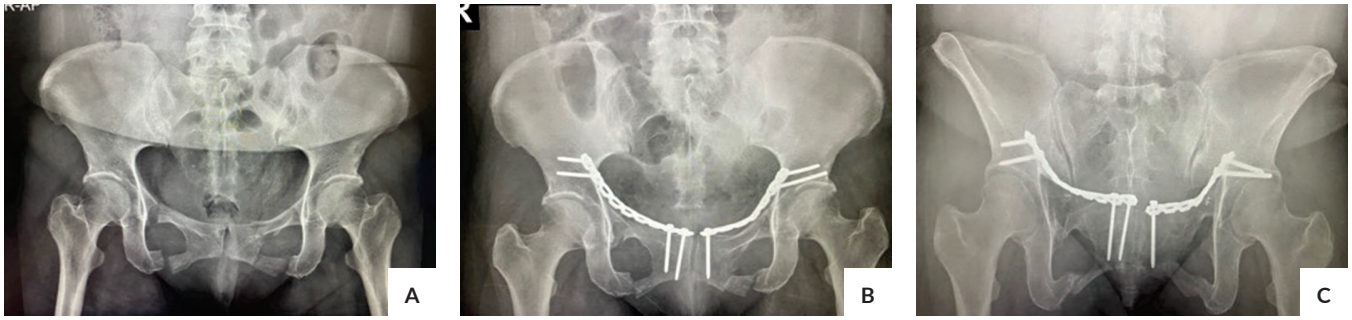

Figure 11. ***Radiographs from Patient 11 – Female, 46-year-old, car accident.*** **(A)** Preoperative, **(B)** Immediate post-operative, **(C)** 5 months post-operative.