



Functional Outcome Measures after Operative Management of Acetabular Fractures*

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ABSTRACT

Objectives. This study evaluated the functional outcome of patients with acetabular injuries using the Majeed pelvic score. The specific objectives were to assess any differences in functional outcomes among patients treated with early versus delayed surgery and those with or without concomitant injuries.

Methodology. Patients from our institution, Baguio General Hospital and Medical Center, with acetabular injuries from January 2019 to December 2022, were included. Patients with acetabular fractures with or without other injuries were included. All available data sources were reviewed, such as charts from hospital records, patient census, and electronic medical records. Patients underwent physical therapy before discharge and were followed up. The patients' outcomes after surgical intervention were assessed using Majeed's pelvic score.

Results. Thirteen patients were included in the study with follow-ups ranging from one to three years. A functional assessment using Majeed's pelvic score with a mean of 83 points (range 72–100). The majority had good functional outcomes.

Conclusions. Early surgical intervention may have no advantage over delayed surgeries regarding functional outcomes. However, concomitant injuries and complications may contribute to a poor to fair functional outcome.

Keywords. acetabular, Majeed, functional outcome, operative, multiply injured

INTRODUCTION

Acetabular fractures are rare injuries with a bimodal distribution wherein young patients sustain high-velocity trauma while elderly patients sustain low-energy fragility fractures.¹ They are potentially life-threatening and are challenging since they require unique expertise to treat.² Morbidity and mortality are associated with high energy transfer to soft tissue, joint, and neurovascular structures.³ In a retrospective study conducted by Matta involving 259 patients with acetabular fractures, 50% of patients had associated injuries: 35% involving extremities, 19% involving the head, 18% involving the chest, 13% having a nerve palsy, 8% with an abdominal injury, 6% with genitourinary injury, and 4% involving the spine.⁴ Hence, a multidisciplinary approach is crucial for resuscitating and managing bone injuries. The management focuses on identifying the severity of injury and other concomitant injuries, early hemodynamic stabilization, and restoration of acetabular structures with reliable and stable rigid fixation.^{4,5} Recovery is sometimes slow and incomplete, resulting in long-term consequences. Therefore, functional and quality-of-life-related outcomes should also be considered.⁶ There are other functional scoring systems, such as the Short Form (SF-36) survey, short musculoskeletal function assessment

ISSN 0118-3362 (Print)
eISSN 2012-3264 (Online)
Printed in the Philippines.
Copyright© 2024 by Delizo et al.
Received: April 7, 2024.
Accepted: June 9, 2024.
Published Online: July 29, 2024.
<https://doi.org/10.69472/poai.2024.14>

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**This was presented at the 31st POA Midyear Conference Research Contest Podium Presentation Category on April 19-21, 2023 at SMX Convention Center, Bacolod City.*



(SMFA), Iowa pelvic score (IPS), and Orlando pelvic outcome score (OPS). The SF-36 is a validated, reliable, functional questionnaire summarized into a mental component score and a physical component score. Each domain is scored up to 100 and is comparable to a standardized value for the general population. A higher score implies a high functional outcome. The SMFA is also a validated, two-part 46-item questionnaire specifically for patients with musculoskeletal injuries. It is divided into a dysfunction index and a bother index. A lower score implies a higher function.⁷ The Iowa pelvic score is a pelvic-specific functional assessment tool focusing on the patient's conditions. It is divided into six items with a total score of 100. A higher score represents a decrease in disability.⁸ The OPS is a pelvic-specific, 40-point tool based on clinical and radiographic findings.⁹ The standards for reporting functional outcomes in patients with pelvic and acetabular fractures are still developing. The SF-36 and SMFA scores have been used, but neither has received adequate responsiveness testing.⁷ For this study, we used the Majeed pelvic score (MPS), a pelvic injury-specific functional assessment divided into the following seven items: pain, work, sitting, sexual intercourse, standing, unaided gait, and walking distance.⁸

METHODOLOGY

Study design

This case series was conducted at our institution, Baguio General Hospital and Medical Center, on patients with acetabular fractures treated with open reduction and internal fixation from 2019 to 2022. All patients with acetabular fractures, with or without other injuries, were included. All available data sources were reviewed, such as charts from hospital records, patient census, and electronic medical records. The data collected were age, gender, other associated injuries, time of surgery, and intervention.

Fixation and timing of surgery

All participants underwent surgical intervention with either definitive internal fixation, definitive external fixation, or temporary external followed by definitive internal fixation. Based on the available radiographs and CT scan images, indications were limited to displaced acetabular fractures, with or without associated injuries. The majority of the procedures were performed or assisted by a trauma specialist consultant. The timing of the surgical intervention was classified as follows: immediately upon admission (i.e., external fixation application if with pelvic injury), less than a week, within two weeks, or more than two weeks. All the patients underwent rehabilitation until discharge. Rehabilitation began one to two days after surgery, starting with general body conditioning and continuing until the patient could ambulate with assistance before discharge.

Ethical approval

This was a retrospective study. The imaging and other data used in this study were approved by the Ethics Committee of our institution, Baguio General Hospital and Medical Center, per the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Data collection and functional assessment

The following parameters were collected: age, gender, other associated injuries, time of surgery, and intervention. Functional outcome using Majeed's pelvic score was measured at follow-up. They were assessed and scored for 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). According to the total Majeed score, outcomes were graded as excellent (≥ 85), good (84 to 70), fair (69 to 55), and poor (< 55). A score of 100 points was defined as the best result. Categorical data were expressed in frequency and percentage.¹⁰

RESULTS

A total of thirteen patients were included in the study. Patients were predominantly male ($n = 11$, 85%). The majority were aged 20–39 ($n = 6$, 46%). The average age of the patients was 38 years, with a follow-up range of one to three years (Table 1).

Most patients had a posterior wall acetabular fracture (54%) based on the Judet-Letournel classification, and two patients had a combination of pelvic and acetabular injuries (15%). More than half of the patients had other injuries ($n = 8$, 62%). Among these injuries, the most common was hip dislocation ($n = 5$, 38%), whereas sciatic nerve palsy, sacral fracture, calcaneal fracture, and clavicular fracture contributed similar percentages ($n = 1$, 8%). Based on the severity of fracture patterns and other associated injuries involved, surgical intervention was warranted. All acetabular fractures underwent internal fixation ($n = 11$, 85%). Half of those with combined pelvic and acetabular fractures were treated with external fixation alone ($n = 1$, 8%), while the remaining half received combined treatment ($n = 1$, 8%). Most participants underwent surgical intervention within one to two weeks. Using Majeed's pelvic score, we compared the functional outcome of patients with acetabular fractures associated with other injuries versus those without. Isolated acetabular injuries (83 points, range 72–100) had higher functional outcomes than those with other related injuries. Eighty percent had a good functional outcome ($n = 4$), and 20% showed an excellent functional outcome ($n = 1$). Heterotopic ossification and avascular necrosis were seen in patients with poor functional outcomes.

Four of the five patients with a two-week delay in surgery still achieved good or excellent functional outcomes. Poor functional outcomes were seen in patients with concomitant injuries and complications.

Table 1. Summary of Patient Demographics (n = 13)

Case	Age/ Sex	Fracture Classification	Associated injuries	Treatment	Timing of Surgery	Rehab*	Functional Score (Majeed's Scoring)	Follow-up (year)	Complication
1	36/M	Posterior wall	Posterior Hip dislocation	ORIF	Within 2 weeks	(+)	Excellent (100)	1	None
2	35/M	Anterior column with posterior wall	Posterior hip dislocation Sciatic nerve palsy	ORIF	Within 2 weeks	(+)	Poor (23)	1	Delayed osteosynthesis- associated infection
3	50/M	Posterior wall	(-)	ORIF	Within 2 weeks	(+)	Good (82)	1	None
4	35/M	Posterior wall	Posterior hip dislocation	ORIF	<7 days	(+)	Poor (40)	1	Heterotopic ossification, AVN
5	36/M	Posterior column with posterior wall	Distal radius fracture	ORIF	<7 days	(+)	Good (76)	1	None
6	77/F	Posterior wall	(-)	ORIF	>2 weeks	(+)	Good (81)	3	None
7	47/M	Posterior wall	Clavicular fracture	ORIF	Within 2 weeks	(+)	Good (81)	1	None
8	53/M	Both column	(-)	ORIF	<7 days	(+)	Good (80)	1	None
9	25/M	Posterior wall	Posterior hip dislocation	ORIF	<7 days	(+)	Good (76)	1	None
10	51/M	Posterior wall	Posterior hip dislocation	ORIF	Within 2 weeks	(+)	Excellent (86)	2	None
11	23/M	Both column	(-)	ORIF	<7 days	(+)	Excellent (100)	1	None
12	43/M	LC II Anterior column	Sacral fracture, Bilateral Calcaneal fracture	External Fixation	Immediate***	(-)	Poor (22)	1	Post-traumatic arthritis sec to bilateral calcaneal fractures Depression
13	62/F	LC III Posterior column with posterior wall	(-)	Combined**	Immediate***	(+)	Good (72)	3	None

* Rehabilitation initiated after surgery until discharge.

** Application of External Fixture then converted to ORIF.

*** Immediate: application of External fixture upon admission.

DISCUSSION

In our study, most patients were male patients of working age (20–39 years) who also presented with limb injuries such as hip dislocation (56%), distal radius fracture (22%), sacral, clavicular, and calcaneal fractures (11%). Singh et al. presented a similar incidence.¹¹ In displaced acetabular fractures, the treatment of choice is open reduction and internal fixation, as conservative management leads to a high frequency of secondary arthritis.^{12,13} The anatomic restoration of the acetabulum will allow patients to achieve good functional outcomes and clinical results, enabling patients to return to work.¹⁴ This study uses Majeed's score to assess the outcome of patients with acetabular injuries with or without other injuries. Our study demonstrated that isolated acetabular fractures may have a better clinical outcome, with a mean score of 83 points (range 72–100) versus the 63 points (range 22–100) of those with other injuries. Among the associated injuries were hip dislocation, distal radius fracture, sacral fracture, clavicular fracture, and sciatic nerve palsy.

Complications such as infection, nerve injury, heterotopic ossification, thromboembolic issues, nonunion, and malunion are common.¹⁵ Some of our patients showed delayed osteosynthesis-related infection, heterotopic ossification, avascular necrosis, and post-traumatic arthritis.

Similarly, Borg stated that the patient's age, type of fractures, damage to the femoral head, associated injuries, quality of fracture reduction, and development of heterotopic ossifications are significant prognostic factors that correlate with poorer clinical outcomes,¹⁶ lowering the quality of life both mentally and physically, even with good radiographic healing in two years post-surgical intervention.¹⁷ Mbatha et al. also pointed out that chest injuries, traumatic brain injuries, and combined pelvic acetabular fractures are all linked to poor outcomes or complications.¹⁸ Age has been correlated with an increased risk of developing complications, with patients in the fourth decade of life being more at risk. The incidence of an associated pelvic fracture ranges from 5–15%, which is similar to our incidence of 15%. These injuries have been associated with an increased mortality rate, hemodynamic instability, and a higher rate of blood transfusion.¹⁸ The rate of heterotopic ossification was reported in up to 80% of cases treated with the posterior surgical approach.¹⁹ A concomitant hip dislocation was present in 56% ($n = 5$) of our patients, which was higher as compared to the findings of Meena et al. (41%),²⁰ Briffa et al. (33%),²¹ and Yeo et al. (20%).²² The incidence of avascular necrosis (AVN) was 5.6%, and patients with a posterior dislocation had a higher incidence of AVN than those who did not.¹⁵ Vasculature to the femoral head is compromised by hip dislocation, high-velocity injury, fracture comminution, articular impaction, and cartilage damage, ultimately resulting in AVN and poor outcomes.⁴

The timing of surgery may not have affected the functional outcome. Even when operated after two weeks, four of five participants still showed good and excellent scores. Historically, the timing of surgery has been referred to as either early or late. Some define "early" as the first eight or 24 hours, the first week, or even the first two to three post-injury, and the term "late" for periods two weeks to three months post-injury. Few studies compare the outcomes after early and late acetabular fixation. The operative treatment of acetabular fractures within 14 days of injury afforded good to excellent results in 80% of patients.²³ Multiple authors, like Plaisier et al., found that patients who underwent early acetabular ORIF (<24 hours) had significantly less organ dysfunction and improved functional outcomes.²⁴ Johnson et al. reported that delayed management of acetabular fractures (21–120 days with an average delay of 43 days) increases the difficulty of operative treatment and significantly reduces good to excellent outcomes. Furthermore, he also mentions that post-operative sciatic nerve palsy, avascular necrosis of the femoral head, and the long-term prevalence of osteoarthritis were found to be higher than for those who have earlier surgical treatments.²⁵ Oransky and Sanguinetti's study reported that displaced acetabular fractures operated at three weeks had a failure rate of 40% compared with 17% of fresh fractures.²⁶

We treated a 43-year-old man with a combination of LC II and anterior column fractures associated with a sacral fracture (Denis Zone III) and bilateral calcaneal fractures (Sanders Type III and Type IV) (Figures 1-2). The patient

was treated with external fixation and opted for conservative management for his bilateral calcaneal fractures, hence the application of bilateral short leg casts. At one year post-injury, the patient was wheelchair-ambulatory, with complaints of pain on both feet. Moreover, he was undergoing treatment for his depression. The patient presented with a Majeed score of 22, which correlates to a poor functional outcome.

Figure 1 demonstrates a 35-year-old man who sustained a posterior wall acetabular fracture with associated posterior hip dislocation from a vehicular crash. The patient underwent open reduction and internal fixation in less than a week (Figure 2). At one month postoperatively, heterotopic ossifications were visible (Figure 3). At six months postoperatively, the patient demonstrated pain and difficulty of ambulation on the operative site accompanied by limitation of movement (0–60 deg hip flexion and hip abduction could not be assessed due to pain). Avascular necrosis was more evident on radiographs at six months post-surgery (Figure 4). At one year, Majeed's pelvic score revealed a poor functional outcome score of 40. At eighteen months post ORIF, the patient underwent THA without noted complications (Figure 5).

Figure 6 represents a 50-year-old man who sustained a posterior wall acetabular fracture from a vehicular crash with no associated injuries. The patient underwent open reduction and internal fixation within two weeks (Figure 7). At one month postoperatively, the patient complained of no pain on the operative site and could ambulate toe-touch

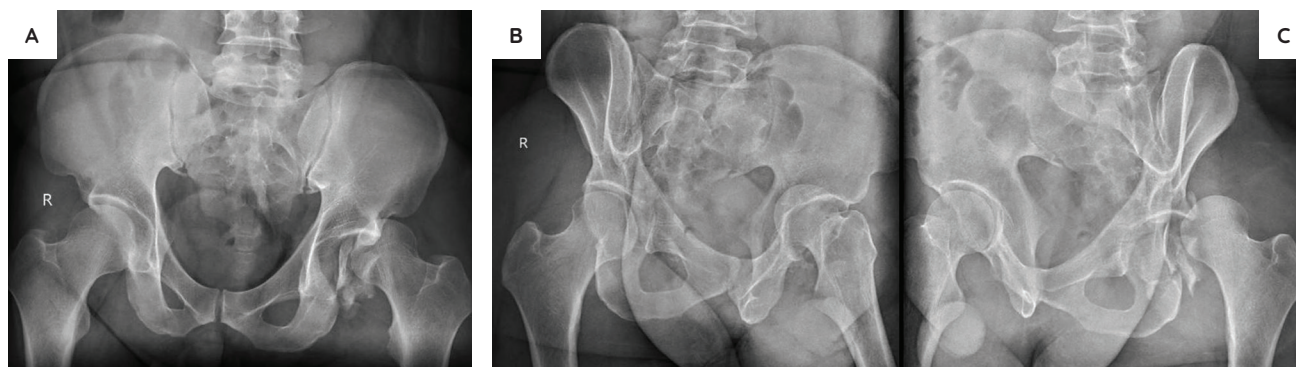


Figure 1. Injury film of 35/M, vehicular crash: posterior wall acetabulum fracture with posterior hip dislocation, left in anteroposterior (AP) (A) and Judet views (Internal obturator and External Iliac oblique) (B and C).

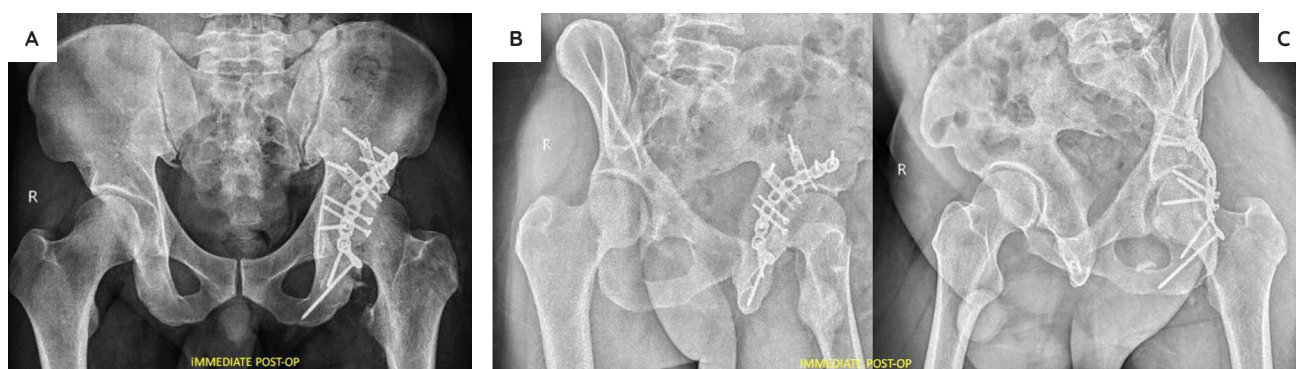


Figure 2. Immediate post-op x-ray after ORIF in AP (A) and Judet views (internal obturator and external iliac oblique) (B and C).

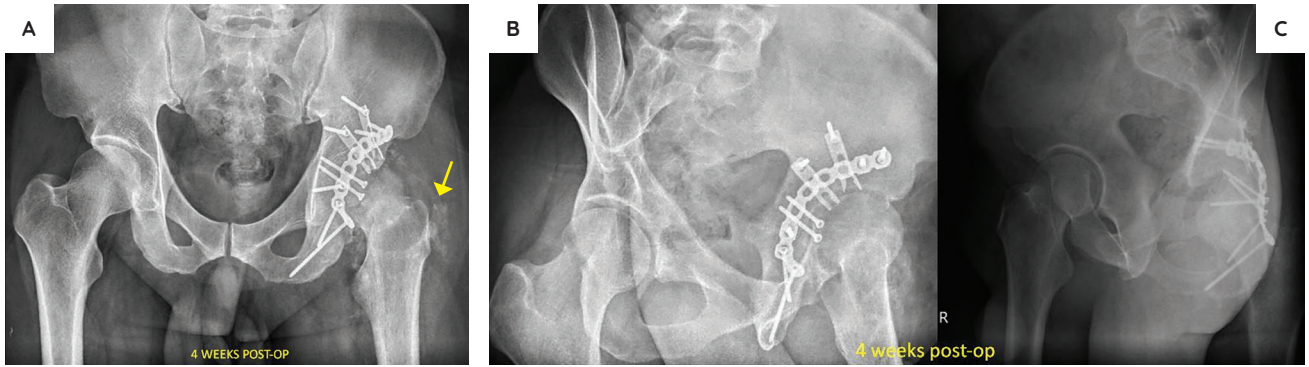


Figure 3. One month post-ORIF with visible heterotopic ossification (*arrow*) in AP (**A**) and Judet views (internal obturator and external iliac oblique) (**B and C**).

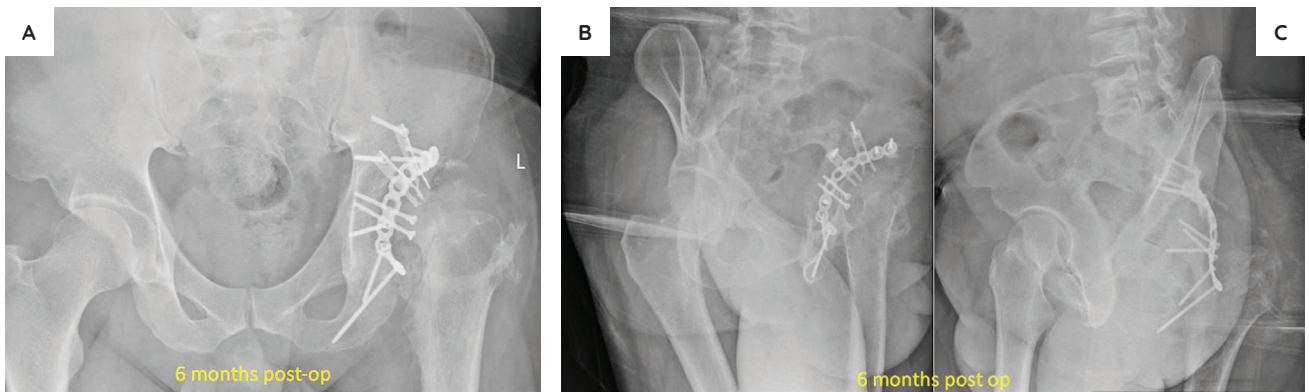


Figure 4. Six months post-op with subsequent AVN in AP (**A**) and Judet views (internal obturator and external iliac oblique) (**B and C**).

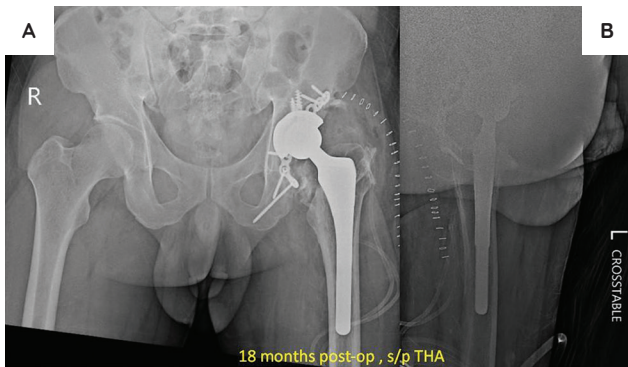


Figure 5. Eighteen months post-ORIF [hips in AP bilateral view (**A**) and crossstable left lateral view (**B**)]. The patient underwent THA.

with crutches. Fracture union was noted on radiographs at six and ten months postoperatively (Figures 8-10). He had a good functional outcome with a score of 82, was able to do full weight-bearing without assistive devices, and had a full range of motion.

The current study has limitations, such as using only one functional scoring specific for the pelvis, having a small sample size, and having no control population, making it challenging to assume that fixations may contribute to a better functional outcome. We recommend including other validated questionnaires and a larger sample size for future studies. We also recommend comparing patients treated conservatively versus surgically.



Figure 6. Injury film of a 50/M, vehicular crash. Isolated fracture of the posterior wall of the acetabulum in AP (**A**) and Judet views (internal obturator and external iliac oblique) (**B and C**).

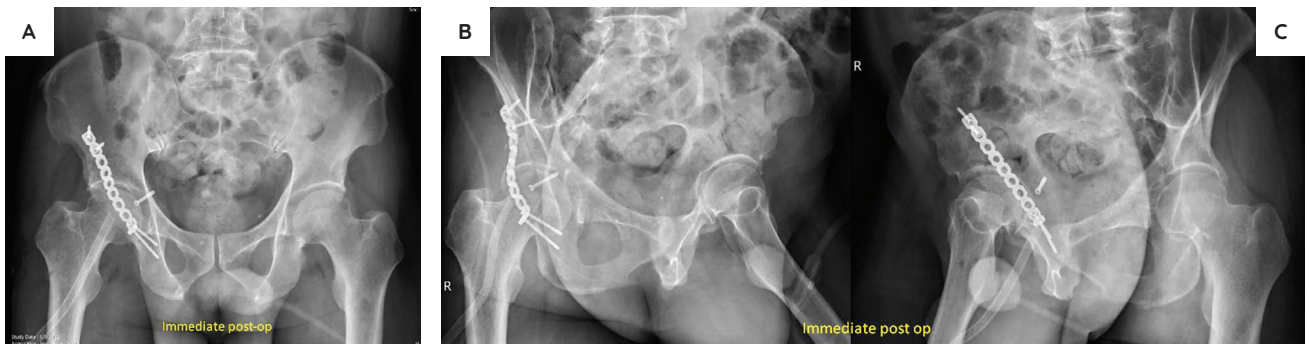


Figure 7. Immediate post-ORIF in AP (A) and Judet views (internal obturator and external iliac oblique) (B and C).

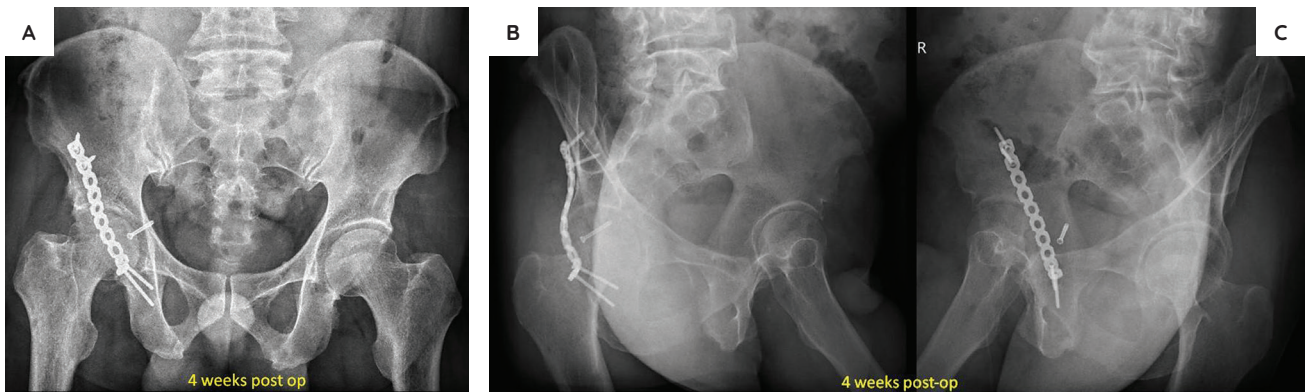


Figure 8. One month post-ORIF in AP (A) and Judet views (internal obturator and external iliac oblique) (B and C).

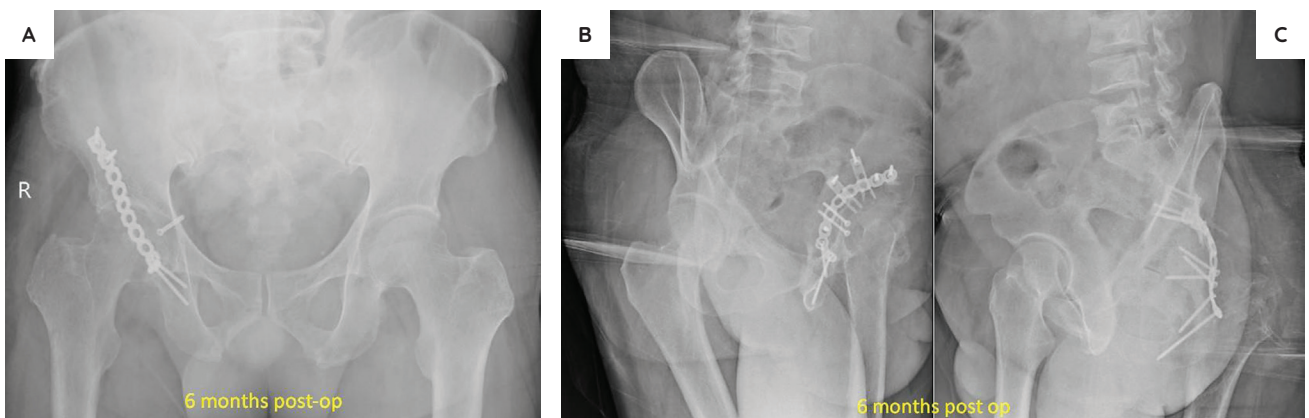


Figure 9. Six months post-ORIF in AP (A) and Judet views (internal obturator and external iliac oblique) (B and C).

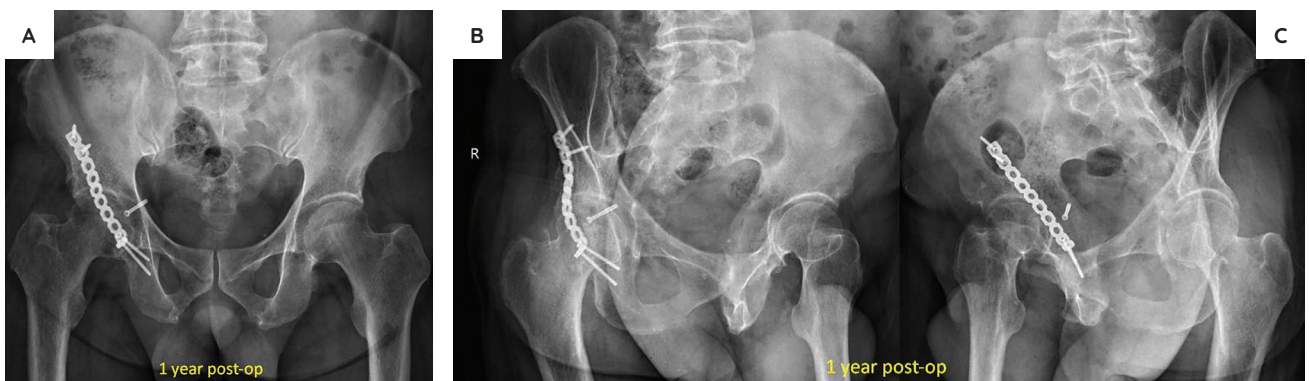


Figure 10. One year post-op in AP (A) and Judet views (internal obturator and external iliac oblique) (B and C).

CONCLUSIONS

The findings may suggest that patients may have a good to excellent functional outcome regardless of the timing of surgery. However, concomitant injuries or complication sequelae may contribute to a poor to fair functional outcome.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

AUTHOR DISCLOSURE

The authors declared no conflict of interest.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

FUNDING SOURCE

None.

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