International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2023; 9(3): 432-439

https://www.orthopaper.com
Received: 15-05-2023
Accepted: 20-06-2023

Ravi Malhotra
Associate Consultant, Department of Orthopedics and Joint Replacement Surgery, Deep Hospital, Ludhiana, Punjab, India

Mohammad Yamin
HOD, Department of Orthopedics and Joint Replacement Surgery, Deep Hospital, Ludhiana, Punjab, India

Peeyush Verma
Senior Resident, Department of ENT and Head Neck Surgery, ESIC Model Hospital, Ludhiana, Punjab, India

Ayushi Dogra
M.B.B.S, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India

Corresponding Author:
Ravi Malhotra
Associate Consultant, Department of Orthopedics and Joint Replacement Surgery, Deep Hospital, Ludhiana, Punjab, India

Functional and radiological outcome of operative treatment for unstable pelvic ring fractures: A 2 year prospective observational study

Ravi Malhotra, Mohammad Yamin, Peeyush Verma and Ayushi Dogra

DOI: https://doi.org/10.22271/ortho.2023.v9.i3f.3455

Abstract
Background: Pelvic injures are challenging to treating surgeon. Operative treatment outcomes of pelvic injuries have been sparsely studied in India. This study was performed to evaluate functional and radiological results of pelvic ring fractures treated operatively.
Methodology: 40 unstable pelvic injury patients managed operatively were reviewed prospectively and retrospectively between January 2016 and May 2018 at Dayanand Medical College & hospital, Ludhiana. Functional assessment was made using Majeed score at 6 months follow up. Radiological assessment was also done to study for union, malunion or non-union of fractures.
Results: Mean age was 35.05 years (range 19-62). 23 were males and 17 were females. 31 patients were managed primarily with definitive fixation while 9 were initially managed with external fixator application. Radiological grading was done according to residual displacement in anterior or posterior pelvic ring.
There were 19 patients with tile type B & 21 with type C pelvic injuries.33 patients (82.5%) had one or more associated injuries. Functional outcome was excellent in 15 patients (40.5%), good in 19 patients (51.4%), fair in 1 patient (2.7%) and poor in 2 patients (5.4%). Radiological outcome was poor in 3 patients (8.1%), fair in 7patients (18.9%), good in 11 patients (29.7%) and excellent in 16patients (43.2%). The difference between radiological and functional results was found insignificant statistically (p value = 0.059).
Conclusion: Operative management of pelvic fractures results in good clinical and radiographic results. Concomitant injuries add on to morbidity and mortality, so have deleterious effect on the functional outcome. Tile type C injuries are more devastating than type B pelvic injuries.

Keywords: Unstable pelvic injury, tiles classification, majeed scoring, pelvic fractures, pelvis fixation

Introduction
High energy pelvic injuries are potentially life threatening and challenging to treating surgeon. Pelvic ring lesions are present in 3 to 10% of all patients admitted to hospitals after trauma [1]. The mortality has been reported between 18% and 25% [2]. These lethal injuries require timely and highly dedicated emergency trauma control and stabilization including multidisciplinary approach for initial management and subsequent fixation. This necessitates thorough knowledge of shock management, pelvic anatomy, and different stabilization techniques. The morbidity and mortality associated with disruption of the pelvic ring are frequently compounded by other associated injuries including long-bone fractures, intra-abdominal and thoracic injuries, and traumatic brain injury [3]. And have a deleterious effect on the functional outcome. Outcome after fixation of pelvic ring disruptions has been sparsely studied in India. The present study has been conducted to review and analyze the functional and radiological outcome of fixation of unstable pelvic injuries and to assess the complications associated with pelvic injuries.

Materials and Methods
The present study enrolled a total of 40 patients with pelvic injuries which were managed operatively. Data of these cases (40 patients) using various parameters like age, sex, mechanism of injury, type of fracture, associated injuries, operative procedures, complications, radiological outcome and functional outcome using majeed score had been compiled and analysed.

Associated injuries were managed in same admission period and appropriate multispecialty teams involvement. Two patients expired during hospital stay. 38 patients with complete treatment details and X-rays were called to the outpatient department for follow-up 6 months post-operatively. Of these patients, 37 attended follow-up.

The following data were recorded: age, sex, mode of accident, fracture type as per tile classification, associated injuries including urogenital and neurologic damage, operative procedures, mortality, complications, and length of hospital stay. Preoperative X-ray protocol included a pelvis with both hips, inlet and outlet views, and a pelvic computed tomography scan with 3-d reconstruction if required in case of complex fractures. There were 21 patients with Tile type B (rotationally unstable) and 19 with type C (rotationally and vertically unstable) pelvic injuries. Four cases with associated acetabular fracture were classified in tile type C pelvic injuries.

Post-operative x-rays were done to check the reduction of fracture. Traction was given if necessary. Patient underwent appropriate physiotherapy in the form of quadriceps exercises, ankle pumps and hip mobilization exercises once the patient was pain free. IV antibiotics and IV analgesics were continued as required for soft tissue healing. All patients received antibiotic against infection and low molecular weight heparin (Enoxaparin 40-60IUs/c) for Prophylaxis against Deep Venous thrombosis.

After the patient was discharged from the hospital, he/she was on regular follow up and assessment of progress and union on x-rays was made at monthly intervals. Weight bearing was allowed according to radiological progress of union on follow up.

Radiological outcome of fixation was determined through post-operative plain radiographs of the three standard views. The radiological result was graded by the maximum residual displacement in the posterior or anterior pelvic ring injuries as; excellent for 0 to 5 mm, good for 6 to 10 mm, fair for 11 to 15 mm and poor for more than 15 mm of displacement or established non-union.

Functional outcome was evaluated using Majeed score. The Majeed score is one of the most often used functional outcome grading system of pelvic injuries. There are seven items, divided into five ‘subscales’, given the following weightings: pain (30 points), work (20 points), sitting (10 points), standing (36 points: walking aids (12), gait unaided (12) and walking distance (12)) and sexual intercourse (4 points). Majeed scoring cut-offs for excellent, good, fair and poor results in those working before the injury (> 85 points, 70 to 84 points, 55 to 69 points, and < 55 points, respectively) and those not working before the injury (> 70, 55 to 69, 45 to 54, and < 45, respectively).

The data was assessed statistically using SPSS 11.0 software. Pearson’s chi-square test was used for the assessment of statistical significance. The study protocol was approved by the Institutional Review Board for Ethical Clearance of Dayanand Medical College and Hospital Ludhiana India and it was performed in accordance with the Code of Ethics of the World Medical Association according to the Declaration of Helsinki of 1975, as revised in 2000.

Operative Procedure

Posterior stabilization- Injuries of the posterior part of the pelvic ring were most commonly operated on first. If the initial displacement of the disruption of the symphysis pubis (diastases and/or translation) or the rami fractures were wide (> 10 mm), a subsequent anterior approach was done. Sacral fractures were stabilized with the patient in the prone position. The posterior longitudinal skin incision was made slightly medial to the postero-superior iliac spine without releasing the gluteal muscles from the outer side of the iliac crest. The sacral fracture was observed and reduced with forceps and fixed with transiliac sacral plating using 3.5 mm reconstruction plates. In minimally displaced lateral sacral fractures, a closed reduction and percutaneous iliosacral screw fixation was done in supine position. In all patients, the screws were placed at least past the midline of the sacrum. One patient with sacroiliac fracture dislocation was fixed with iliosacral screw and posterior iliac plating with the patient in the supine position. One patient with sacroiliac fracture dislocation fixation was done with anterior 3.5- mm reconstruction plates using an incision at the iliac crest and exposing the internal aspect of the wing and the sacroiliac joint. Posterior column fracture stabilization was carried out by Kocher-Langenbeck approach, the patient was placed in prone position.

Anterior stabilization- Disruption of the symphysis pubis was exposed through either a vertical or a transverse Pfannenstiel's incisions. In case of concomitant acetabular fracture, the anterior column and the quadrilateral surface were exposed using ilioinguinal approach. In bilateral rami fractures, both sides were exposed. Displaced fractures of the pubic rami / pubic diastasis were fixed internally with a curved reconstruction plate using 3.5-mm screws or stabilized by application of external fixator across pelvic with supra-acetabular schanz pins. In one patient with displaced and rotated rami fragments combined anterior pelvic plating and external fixator application was done.

Results

The patients were in the age group ranging from 18 to 62 years with mean age of 34.25 years (range 18-62 years). Majority of high energy pelvic fractures were observed in 3rd and 4th decade of life with male preponderance. Road traffic accidents (82.5%; 33 patients) were most common cause of these fractures followed by fall from height (12.5%; 5 patients).

All pelvic injuries were classified according to Tile classification and majority of these fractures were type C (21 patients; 52.5%) and type B were (19 patients; 47.5%), 35 were closed fractures and 5 were open fractures. Among the 40 patients enrolled in this study, Majority (33 patients; 82.5%) had associated injuries. 17 patients (42.5%) had long bone fractures, 4 patients had acetabular fractures, 6 patients had multiple rib fractures, 3 patients had blunt trauma abdomen, 4 patients had head injury, 12 patients had urogenital injuries, 2 patients had neurological injuries, 6 had morel lavallee lesion.

Radiological outcome in our study - 3 patients (8.1%) had poor radiological outcome, 7 patients (18.9%) had fair radiological outcome, 11 patients (29.7%) had good radiological outcome, and 16 patients (43.2%) had excellent radiological outcome. Combined good and excellent radiological outcomes were observed in 73.7% cases of tile type B fractures and in 72.2% cases of tile type C fractures.

Functional outcome in our study - 15 patients (40.5%) had excellent score, 19 patients (51.4%) had good score, 1 patient (2.7%) had fair score and 2 patients (5.4%) had poor score. Combined good and excellent majeed score were observed in all cases of tile type B fractures and in 83.3% cases of tile type C fractures. Out of 24 working patients in our study, 19

patients (79.2%) returned to their previous occupation by the end of 6 months post-operatively, 2 patients (8.3%) changed their profession, 2 patients (8.3%) were not able to return to work, all of them had associated long bone fractures and other injuries. It is important to consider that most patients with pelvic ring fracture sustain multiple injuries and there can often be difficulties in interpretation because the other concomitant injuries may affect the functional outcome.

Complications in the form of intraoperative hypotension (4 patients), superficial soft tissue infection (3 patients), pin site infection (3 patients), loss of reduction (3 patients), neurological injury (4 patients), UTI (4 patients), skin necrosis (1 patient), mortality due to multi-organ failure (2 patients) were reported. Two patients had delayed complications; one with associated acetabular fracture developed hip degeneration, 1 had screw breakage in anterior pubic plate without any complaints.

Discussion

Radiological results

In our study out of 37 patients available for final follow up, 35 patients (94.6%) had union of fracture, 2 patients (5.4%) had non-union of rami fractures. 3 patients (8.1%) had poor radiological results, out of them 2 had non-union of rami fractures and 1 had more than 15 mm displacement in anterior pelvic ring. 7 patients (18.9%) with fair radiological result had 11 to 15 mm displacement in anterior or posterior pelvic ring. 11 patients (29.7%) with good radiological result had 6 to 10 mm displacement in anterior or posterior pelvic ring. 16 patients (43.2%) with excellent radiological result had only 0 to 5 mm displacement in anterior or posterior pelvic ring.

Most of the authors of various studies conducted in past have graded the radiological results by quantifying the residual displacement in anterior or posterior pelvic ring in post-operative / follow up x-rays.

Pohlemann *et al*. in their study of outcome after pelvic injuries analysed the maximum anterior or posterior pelvic ring displacement in their study and showed that 15 patients (50%) had no displacement, 9 patients (30%) had 1-5 mm displacement, 4 patients (13%) had 6-10 mm displacement, 2 patients (7%) had >10 mm displacement in anterior or posterior pelvic ring [4]. Suzuki *et al*. in their study of 57 patients showed that the average of the largest residual displacement was 7.3 (range, 0-30) mm anteriorly and 5.2 (range, 0-40) mm posteriorly, which was classified as 29 excellent, 13 good, 9 fair, and 6 poor according to the Majeed radiographic score [5]. Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that out of 15 patient treated with iliosacral screw fixation, 2 had residual displacement >5 mm and 13 had residual displacement <5mm. 17 patients were managed conservatively, out of them 16 had residual displacement >5mm and only 1 had residual displacement <5 mm [6].

Mardanpor *et al*. in their study of 37 patients with displaced fractures showed that excellent radiological results occurred in 15 patients (40.54%), good in 7 patients (18.92%), fair in 7 patients (18.92%) and poor in 8 patients (21.62%) using the same radiological grading as in our study [7].

Return to occupation

Out of 37 patients available for final follow up 24 were working before injury and 13 were not working, out of them 10 patients returned to their previous occupation at or less than 3 months, 9 patients returned to their previous occupation at or less than 6 months, 2 patients had returned to their previous occupation by 6 months because of not healing of associated long bone fractures, 2 patients with associated long bone fractures changed their profession because of associated pain and decreased working ability.

Miranda *et al*. in their study on pelvic ring injuries of eighty patients reported that 80% returned to their previous occupation [8]. Tornetta *et al*. in their study in which forty-six patients with 48 operatively fixed unstable posterior pelvic ring disruptions were observed for an average of 44 months. Two thirds of the patients returned to their original jobs and 16% changed jobs because of an associated injury [9]. Gruen *et al*. reported in their study that 54 had unstable fractures requiring ORIF, out of them 48 were available for follow up. Out of the patients who were employed pre-injury, 76% returned to their occupation 1 year post injury; 62% had returned to full time work and 14% had returned with job modification [10]. Kabak S *et al*. in their study reported that out of 36 patients treated with anterior and posterior internal fixation for unstable pelvic ring fractures, 26 returned to their original jobs at the last follow-up visit [11].

Mardanpor *et al*. in their study reported that out of 38 patients, three patients with type C fracture suffered from severe durable pain that couldn't back to their work. Totally thirty five patients returned to their original job which shows that a durable pain is the most important factor to prevent returning to their job [7].

Majeed score

In our study According to Majeed functional outcome grading, out of 37 patients available for final follow up, out of them 15 patients (40.5%) had excellent score, 19 patients (51.4%) had good score, 1 patient (2.7%) had fair score, this patient also had associated acetabulum fracture and developed hip degeneration and 2 patients (5.4%) had poor score, both of them had associated multiple fractures of long bones of lower limb with vascular injury. So in our study morbidity due to associated injuries led to decreased majeed score. It is important to consider that most patients with pelvic ring fracture sustain multiple injuries and there can often be difficulties in interpretation because the other concomitant injuries may affect the functional outcome.

Majeed SA *et al*. in their study of functional results in forty-two patients all treated by external fixation reported that the average Majeed function score was 75.6 (range: 12 to 100). In cases with horizontal instability (stage B), this score was 84.8 (12 to 100). In cases with vertical instability (stage C), the score was 68 (16 to 100) [12]. Pohlemann *et al*. in their study of 58 patients who had received surgical stabilization of Tile B- and C-type fractures with follow up for an average of 28 months reported that patients suffering B-type fractures showed 79% good and excellent results, only 27% of the patients with C-type fractures were rated good or excellent. The results were summarized using a new pelvic outcome score. The scoring included the radiological result (I = max. 3 points) and the clinical result with rating of function, neurological, urological and sexual deficits (II = max. 4 points). The "critical value" for the radiological evaluation was a 5-mm residual posterior displacement or a 15-mm anterior displacement in the pelvic ring defining a "poor" result (1 point). Social reintegration, an overall reflection of all accident-related sequelae, was rated independently (III = max. 3 points). I + II were summarized as "pelvic outcome," with 7 points rated as excellent, 6 points as good, 5 and 4 points as moderate, and 3 and 2 points as a poor result [4]. Rommens *et al*. in their study used their own criteria for

evaluating functional outcome by estimation of pain, gait, and walking distance. The result was estimated excellent when patients had no pain and showed a normal gait with unlimited walking distance. The result was good when there was limited pain, slightly abnormal gait, and/or slightly limited walking distance. The result was moderate when there was regular pain, abnormal gait, and limited walking distance. The result was poor if the patient had severe pain, abnormal gait, and very limited walking distance. They reported that 81.9% of all B-type injuries had a good or excellent end result; this was the case in only 71.6% of C-type lesions [13]. Mardanpor *et al*. using Majeed score in their study reported that out of 38 patients 20 patients (52.63%) had excellent score, 9 patients (23.68%) had good score, 8 patients (21.05%) had fair score and only 1 patients (2.63%) had poor score [7]. Vallier *et al*. in their study of 87 all women patients with high energy pelvic injuries (49 operated and 38 conservatively managed) used Musculoskeletal Functional Assessment (MFA) questionnaires. Results were - mean MFA score was 33. Mean scores were 32.3 after surgery and 34.0 after nonoperative management (P = 0.67). The MFA is a functional outcome instrument with documented reliability, validity, consistency, and responsiveness. There are 10 categories within the MFA: mobility, hand and fine motor, housework, self-care, sleep and rest, leisure and recreation, family relationships, cognition and thinking, emotional adjustment and adaptation, and employment. Overall scores range from 0 to 100 with low scores indicating better function [14].

Many authors have used a variety of outcome measures to describe the outcome following treatment in pelvic injury patients. Widely used generic instruments have established the degree of disability associated with these injuries. Several injury-specific instruments have been developed in an effort to capture the widespread effect of these injuries. Three of these measures, the Majeed score, the Iowa pelvis score and the Orlando pelvis score, had been used widely. However, the ability of these instruments to differentiate between methods of treatment had not been shown. Overall, the existing literature in the functional assessment is inadequate to inform surgeons or patients in a meaningful way about the functional outcomes of these fractures after fixation [20].

Pain criteria of majeed score

According to Pain criteria in Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 4 patients (10.8%) had score of 30 with no pain, 24 patients (64.9%) had score of 25 with mild intermittent pain not interfering with activities of daily living, 9 patients (24.3%) with score of 20 had pain with moderate activities which got relieved by rest, no patient had pain that was unbearable, intense or led to limitation of his/her activities. Most of them had associated long bone fractures Mean pain criteria score was 24.32 with minimum score of 20 and maximum score of 30 with standard deviation of 2.93.

Tornetta *et al*. in their study of Twenty-nine patients with unstable rotational injuries treated operatively reported that 96% patients had no pain or pain only on strenuous activity, ambulated without assistance or limitations, and returned to work [15]. Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that 15 patient managed operatively had mean Pain score of 25.00 with standard deviation of 7.32 which was statistically significant as compared to 17 patients managed conservatively (mean pain score 20.59±6.09, p value- 0.028) [6].

Mardanpor *et al*. in their study of 38 patients reported that 13 of 27 patients with type B fractures were pain-free at the time of study as opposed to 3 of 11 patients with type C fractures. Three patients with type C fracture suffered from severe durable pain who couldn't return back to their work [7]. Sullivan *et al*. in their study of functional outcome of posterior ring injuries treated with percutaneous screw fixation reported that most of the patients experienced mild pain that went away with rest or pain with moderate activity. Average pain score was 23.8 [16].

Work criteria of majeed score

Out of 37 patients available for final follow up in the study, 13 patients (35.1%) were not working and 24 patients (64.9%) were working before injury. According to Work criteria in Majeed functional outcome grading at 6 months follow up, out of 24 working patients, 8 patients (33.3%) had score of 20 who continued with their profession and had same working performance as compared to pre-injury level, 11 patients (45.8%) had score of 16 who continued their profession but had reduced working performance as compared to pre-injury level, 2 patients (8.3%) had score of 12 who changed their profession because of pain and difficulty to perform their duties at work, out of them both had associated long bone fractures and one had associated acetabulum fracture also. 1 patient (4.2%) who had score of 8 was able to do light work only, this patient also had associated long bone fractures, 2 patients (8.3%) who had score of 4 were not able to do regular work, both of them had associated long bone fractures with vascular injury and other injuries. Mean work criteria score was 15.67 with minimum score of 4 and maximum score of 20 with standard deviation of 4.71.

Tornetta *et al*. in their study in which forty-six patients with 48 operatively fixed unstable posterior pelvic ring disruptions were observed for an average of 44 months. Two thirds of the patients returned to their original jobs and 16% changed jobs because of an associated injury [9]. Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that 15 patient managed operatively had mean work score of 16.33 with standard deviation of 4.33 which was statistically significant as compared to 17 patients managed conservatively (mean work score 10.5±4.60, p value- 0.006) [6]. Mardanpor *et al*. in their study reported that out of 38 patients, three patients with type C fracture suffered from severe durable pain that couldn't back to their work. Totally thirty five patients returned to their original job. They concluded that a durable pain is the most important factor to prevent returning to job [7].

Sitting criteria of majeed score

According to Sitting criteria in Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 20 patients (54.1%) had score of 10 with no difficulty in sitting, 16 patients (43.2%) had score of 8 with uncomfortable sitting, 1 patient (2.7%) with score of 6 had painful prolonged sitting, this patient had skin necrosis over gluteal and sacral region and was managed with skin grafting by plastic surgery team, no patient had painful sitting. Mean sitting criteria score was 9.03 with maximum score of 10 and minimum score of 6 with standard deviation of 1.12.

Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that 15 patient managed operatively had mean sitting score of 8.00 with standard deviation of 1.85 which was statistically significant as compared to 17 patients managed conservatively (mean

sitting score 6.71±1.72, p value- 0.049) [6]. Sullivan *et al*. in their study of functional outcome of posterior ring injuries treated with percutaneous screw fixation reported that most of the patients experienced no pain while sitting or uncomfortable sitting without pain. Average sitting score was 8.6 [16].

Sexual intercourse criteria of majeed score

According to Sexual intercourse criteria in Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 10 patients (27.0%) had score of 0 to 1, out of them 5 patients were not indulged in sexual activities and were given score of zero, rest 5 were given score of 1 as they were having pain with sexual intercourse, all of them had associated urogenital injuries, 9 patients (24.3%) had score of 2 with pain on prolongation of sexual intercourse, most of them had associated long bone fractures or urogenital injuries, 7 patient (18.9%) with score of 3 had uncomfortable sexual intercourse, 11 patients (29.7%) had no problem in sexual intercourse. Mean sexual intercourse criteria score was 2.38 with minimum score of 0 and maximum score of 4 with standard deviation of 1.40.

Suzuki *et al*. in their study of 57 patients excluding the patients with other associated injuries showed that a sexual disturbance of fewer than 3 points was in 15 patients [5]. However Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that 15 patient managed operatively had mean sexual intercourse score of 3.00 with standard deviation of 1.00 (while 17 patients managed conservatively had sexual intercourse score 2.88±0.93, p value- 0.473). More than half (68%) of total patients in study reported discomfort regardless of whether they received surgical treatment and it was suppose that in most cases the discomfort was attributable to the pelvic injury [6]. Sullivan *et al*. in their study of functional outcome of posterior ring injuries treated with percutaneous screw fixation reported that most of the patients experienced uncomfortable sexual intercourse, but not painful. All of them had isolated pelvic fractures. Average sexual intercourse score was 3.3 [16].

Standing criteria of Majeed score

The standing criteria for functional outcome in Majeed score is sub divided in to three – walking aid score, gait unaided score and walking distance score. According to Walking aids score in standing criteria of Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 28 patients (75.7%) had score of 12 who were able to walk without any aid, 7 patients (18.9%) had score of 10 who required aid of 1 stick for walking, 2 patient (5.4%) with score of 6 required aid of walker for walking, both of them had multiple long bone fractures of lower extremities. No patient in our study was bed ridden or required two sticks or wheel chair for ambulation. Mean walking aid criteria score was 11.30 with minimum score of 6 and maximum score of 12 with standard deviation of 1.51. According to Gait unaided score in standing criteria of Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 19 patients (51.4%) with score of 12 had normal gait while walking unaided, 8 patients (21.6%) with score of 10 had slight limp while walking unaided, 8 patients (21.6%) with score of 8 had moderate limp while walking unaided, all of them had associated long bone fractures of lower extremities, 1 patient (2.7%) with score of 6 had gross limp while walking unaided, 1 patient (2.7%) with score of 4 had associated diffuse axonal injury and had gait with small shuffling steps. Mean gait unaided criteria score was 10.32 with minimum score of 4 and maximum score of 12 with standard deviation of 2.08. According to Walking distance score in standing criteria of Majeed functional outcome grading, out of 37 patients available for final follow up in the study, 13 patients (35.1%) with score of 12 had walking distance normal for age and general condition, 12 patients (32.4%) with score of 10 had slight limp or pain after walking for one hour unaided, 10 patients (27.0%) with score of 8 were able to walk for one hour with aid of one stick, 2 patients (5.4%) with score of 6 had limited walking with aid of walker only but were able to stand without any aid, both of them had associated long bone fractures of lower extremities. Mean walking distance criteria score was 9.95 with minimum score of 6 and maximum score of 12 with standard deviation of 1.86.

Henderson *et al*. investigated the correlation of the clinical outcome of different types of pelvic ring injuries to the method of treatment. Objective neurologic deficit (42%) and a limp (32%) were often detected on examination in case of patients managed conservatively. Walking capacity was proved to be significantly better in the groups of operative treatment compared to the non-operative group [17]. Chen *et al*. in their study of Outcome Analysis of Unstable Posterior Ring Injury of the pelvis reported that 15 patient managed operatively had mean standing score of 26.27 with standard deviation of 5.70 (while 17 patients managed conservatively had mean standing score 24.00±7.11, p value- 0.457) [6]. Sullivan *et al*. in their study on 16 patients with isolated pelvic injury reported that all of the patients were walking without assistance with average walking aid score of 11.8. Reliance of assistive devices and gait abnormality showed excellent outcomes across fracture patterns. Average gait score was 11.3. Most of the patients were able to walk continuously for one hour without assistance but experienced slight pain or limp. The average walking distance score was 9.8 [16].

Comparison of radiological and functional outcomes

Radiological outcome in our study - 3 patients (8.1%) had poor radiological outcome, 7 patients (18.9%) had fair radiological outcome, 11 patients (29.7%) had good radiological outcome, 16 patients (43.2%) had excellent radiological outcome. Functional outcome in our study - 15 patients (40.5%) had excellent score, 19 patients (51.4%) had good score, 1 patient (2.7%) had fair score and 2 patients (5.4%) had poor score. The difference between radiological and functional results in our study was found insignificant statistically (p value = 0.059).

Several reports described that the anatomical reduction was significantly associated with the functional outcome. However, some authors reported that there was no relationship between functional outcome and anatomical reduction. Mardanpor *et al*. in their study also reported that the difference between radiological and functional outcomes was found insignificant statistically (p>0.05). They concluded that although there is no statistical difference between radiological and functional results in the study, the clinical figures agreed with the hypothesis that radiological outcome is usually better than the functional outcome. The functional results are often affected by the associated skeletal or extra skeletal injuries as well as other variables. Simultaneous effects of these variables on the final outcome make it impossible to study each effect separately. A huge number of

cases are needed to accomplish this task by choosing patients with only one variable at a time [12]. Lindhal *et al*. in their study reported that the final radiographic results were excellent in 66 patients, good in 25 patients, and fair in 10 patients (none had a poor result). The functional score results were excellent in 68 patients, good in 16, fair in 16, and poor in 1 patient. They were positively affected by stable anatomic reduction. Most of the patients with an excellent or good radiographic result (78/91) had at least a good functional result. There was a significant association between the radiological and functional results (Odds ratio 4.0; 95% CI: 1–16) [18]. Kokubo *et al*. in their study of Functional outcome of patients with unstable pelvic ring fracture reported that the displacement within 20 mm had no influence to the long-term functional outcome. They believed that the disrupted pelvic ring alignment must be reconstructed surgically, but the strict anatomical reduction is not necessarily needed [19].

Table 1: Distribution of patients according to mode of injury

Mode of injury	No. of cases	Percentage
Road side accident	33	82.5%
Fall from height	5	12.5%
Fall from running bus	1	2.5%
Fall of heavy objects	3	7.5%
Total	40	100.0%

Table 2: Distribution of patients according to type of fracture (Tile classification)

Fracture classification (TILE'S)	No. of cases	Percentage
Total type B	19	47.5%
Type B1	6	15.0%
Type B2	9	22.5%
Type B3	4	10.0%
Total type C	21	52.5%
Type C1	7	17.5%
Type C2	10	25.0%
Type C3	4	10.0%
Total	40	100%

Table 3: Distribution of patients according to associated injuries

Associated Injuries	No. of cases	Percentage
Chest Injury	6	15.0%
Abdominal Injury	3	7.5%
Cns/Spine Injury	5	12.5%
Uro-Genital Injury	12	30.0%
Neurological Injury	2	5.0%
Morel Lavelle Lesion/Soft Tissue Injury	7	17.5%
Upper Extremity Fractures	4	10.0%
Lower Extremity Fractures	11	27.5%
Combined Upper & Lower Extremity Fractures	2	5.0%
Acetabular Fractures/Hip Dislocation	4	10.0%

Table 4: Distribution of patients according to initial stabilizing external fixator application and fracture type

Fracture type	Initial stabilization with Ex-fix	No. of cases	Percentage
Tile type B (n=24)	Yes	1	4.2%
	No	23	95.8%
Tile Type C (n=16)	Yes	8	50%
	No	8	50%

Table 5: Distribution of patients according to operative procedures

Operative procedures	No. of cases	Percentage
Anterior fixation only	8	21.1%
Posterior fixation only	11	28.9%
Anterior and posterior fixation	14	36.8%
Other procedures	5	13.2%

Table 6: Distribution of patients according to complications

Complications	No. of cases	Percentage
Intra-op		
Hypotension	4	10.0%
Post-op		
Superficial soft tissue infection	3	7.5%
Superficial pin site infection	3	7.5%
Loss of reduction	3	7.5%
Neurological complications	4	10.0%
UTI	4	10.0%
Skin necrosis	1	2.5%
Mortality- Multi-organ dysfunction	2	5.0%
Deep vein thrombosis	0	0%
Pulmonary embolism	0	0%
No	24	60.0%

Table 7: Distribution of patients according to Radiological results and fracture type

		Tile type				Total
		Type B	Type B	Type C	Type C	
Radiological results Total	Excellent	8	42.1%	8	44.4%	16
	Good	6	31.6%	5	27.8%	11
	Fair	4	21.1%	3	16.7%	7
	Poor	1	5.3%	2	11.1%	3
		19	100.0%	18	100.0%	37

Table 8: Distribution of patient according to Majeed score at 6 months follow up

Grade- Majeed score	No. of cases	Percentage
Excellent	15	40.5%
Good	19	51.4%
Fair	1	2.7%
Poor	2	5.4%
Total	37	100.0%

Table 9: Distribution of patient according to Pain criteria of Majeed score

Pain	No. of cases	Percentage
Intense continuous at rest (0-5)	0	0.0%
Intense with activity (10)	0	0.0%
Tolerable but limits activity (15)	2	5.4%
With moderate activity, abolished by rest (20)	9	24.3%
Mild, intermittent, normal activity (25)	24	64.9%
Slight, occasional or no pain (30)	4	10.8%
Total	37	100.0%

Table 10: Distribution of patient according to sitting criteria of Majeed score

Sitting	No. of cases	Percentage
Painful (0-4)	0	0.0%
Painful if prolonged or awkward (6)	1	2.7%
Uncomfortable (8)	16	43.2%
free (10)	20	54.1%
Total	37	100.0%

Table 11: Distribution of patient according to Sexual intercourse criteria of Majeed score

Sexual intercourse	No. of cases	Percentage
Painful (0-1)	10	27.0%
Painful if prolonged or awkward (2)	9	24.3%
Uncomfortable (3)	7	18.9%
Free (4)	11	29.7%
Total	37	100.0%

Table 12: Distribution of patient according to walking aid criteria of Majeed score

Walking aids	No. of cases	Percentage
Bedridden or almost (0-2)	0	0.0%
Wheelchair (4)	0	0.0%
Two crutches (6)	2	5.4%
Two sticks (8)	0	0.0%
One stick (10)	7	18.9%
No stick (12)	28	75.7%
Total	37	100.0%

Table 13: Distribution of patient according to gait unaided criteria of Majeed score

Gait unaided	No. of cases	Percentage
Cannot walk or almost (0-2)	0	0.0%
Shuffling small steps (4)	1	2.7%
Gross limp (6)	1	2.7%
Moderate limp (8)	8	21.6%
Slight limp(10)	8	21.6%
Normal (12)	19	51.4%
Total	37	100.0%

Table 14: Distribution of patient according to walking distance criteria of Majeed score

Walking distance	No. of cases	Percentage
Bedridden or few metres (0-2)	0	0.0%
Very limited time and distance (4)	0	0.0%
Limited with sticks, difficult without prolonged standing possible (6)	2	5.4%
One hour with a stick limited without (8)	10	27.0%
One hour without sticks slight pain or limp (10)	12	32.4%
Normal for age and general condition (12)	13	35.1%
Total	37	100.0%

Comparison of radiological and functional outcomes

Table 15: Distribution of patient according to correlation between radiological and functional outcome

		Majeed score				Total 16	p-value 0.059
		Excellent	Fair	Good	Poor		
Radiological result Total	Excellent	10	0	6	0		
	Fair	0	0	6	1	7	
	Good	4	1	6	0	11	
	Poor	1	0	1	1	3	
		15	1	19	2	37	

Conclusion

For high energy pelvic injuries are often seen in motor vehicle accidents, operative management results in good clinical and radiographic results. Pelvic injuries are potentially life threatening. Concomitant injuries add on to morbidity and mortality, so have deleterious effect on the functional outcome. Tile type C injuries are more devastating than type B pelvic injuries. We recommend that these lethal injuries require timely and highly dedicated emergency management and resuscitative measures including multidisciplinary approach for initial management and subsequent fixation using various methods used in our study. The study had limitation as it neither had randomization nor had a control group for comparison. Our cohort is small in size. Effectiveness of various methods of treatment had not been evaluated. A large, randomized, controlled multi-centre study shall be necessary to make a meaningful conclusion.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Ertel W, Keel M, Eid K, Platz A, Trentz O. Control of severe hemorrhage using C-clamp and pelvic packing in multiply injured patients with pelvic ring disruption. J Orthop Trauma. 2001;15:468-74.
2. Katsoulis E, Giannoudis PV. Impact of timing of pelvic fixation on functional outcome. Injury. 2006;37:1133-42.
3. Demetriades D, Karaiskakis M, Toutouzas K, Alo K, Velmahos G, Chan L. Pelvic fractures: Epidemiology and predictors of associated abdominal injuries and outcomes. J Am Coll Surg. 2002;195:1-10.
4. Pohlemann T, Gansslen A, Schellwald O, Culemann U, Tscherne H. Outcome after pelvic ring injuries. Injury.1996;27:B31-8.
5. Suzuki T, Shindo M, Soma K, Minehara H, Nakamura K, Uchino M, *et al*. Long-term functional outcome after unstable pelvic ring fracture. Journal of Trauma and Acute Care Surgery. 2007;63:884-8.
6. Chen PH, Hsu WH, Li YY, Huang TW, Huang TJ, Peng KT. Outcome analysis of unstable posterior ring injury of the pelvis: comparison between percutaneous iliosacral screw fixation and conservative treatment. Biomedical Journal. 2013;36:289-94.
7. Mardanpour K, Rahbar M. The outcome of surgically treated traumatic unstable pelvic fractures by open reduction and internal fixation. J Inj Violence Res. 2013;5(2):77-83.
8. Miranda MA, Riemer BL, Butterfield SL, Burke III CJ. Pelvic Ring Injuries: A Long Term Functional Outcome Study. Clinical Orthopaedics and Related Research (1976-2007). 1996;329:152-9.
9. Tornetta P, Matta JM. Outcome of operatively treated unstable posterior pelvic ring disruptions. Clinical Orthopaedics and Related Research. 1996;329:186-93.
10. Gruen GS, Leit ME, Gruen RJ, Garrison HG, Auble TE, Peitzman AB. Functional outcome of patients with unstable pelvic ring fractures stabilized with open reduction and internal fixation. J Trauma. 1995;39(5):838-44.
11. Kabak S, Halici M, Tuncil M, Avsarogullari L, Baktir A, Basturk M. Functional outcome of open reduction and internal fixation for completely unstable pelvic ring fractures (type c): a report of 40 cases. J Orthop Trauma. 2003;17(8):555-62.
12. Majeed SA. External fixation of the injured pelvis. The

functional outcome. J Bone Joint Surg. 1990;72:612-4.
13. Rommens PM, Hessmann MH. Staged reconstruction of pelvic ring disruption: Differences in morbidity, mortality, radiologic results, and functional outcomes between B1, B2/B3, and C-type lesions. Journal of orthopaedic trauma. 2002;16:92-8.
14. Vallier HA, Cureton BA, Schubeck D, Wang XF. Functional Outcomes in Women after High-Energy Pelvic Ring Injury. J Orthop Trauma. 2012;26(5):296-301.
15. Tornetta P, Dickson K, Matta JM. Outcome of rotationally unstable pelvic ring injuries treated operatively. Clin Orthop Relat Res. 1996;147-51.
16. Sullivan MP, Scolaro JA, Milby AH, Mehta S. Isolated pelvic ring injuries: functional outcomes following percutaneous, posterior fixation. European Journal of Orthopaedic Surgery & Traumatology. 2015;25:1025-30.
17. Henderson RC. The long-term results of non-operatively treated major pelvic disruptions. Journal of orthopaedic trauma. 1989;3:41-7.
18. Lindahl J, Hirvensalo E. Outcome of operatively treated type-C injuries of the pelvic ring. Acta Orthop. 2005;76(5):667-78.
19. Kokubo Y, Oki H, Sugita D, Takeno K, Miyazaki T, Negoro K, *et al*. Functional outcome of patients with unstable pelvic ring fracture: Comparison of short-and long-term prognostic factors. Journal of Orthopaedic Surgery. 2017;25(1):1-6.
20. Lefaivre KA, Slobogean GP, Valeriote J, O'brien PJ, Macadam SM. Reporting and interpretation of the functional outcomes after the surgical treatment of disruptions of the pelvic ring. The Journal of Bone and Joint Surgery. 2012;94-B:549-55.

How to Cite This Article
Malhotra R, Yamin M, Verma P, Dogra A. Functional and radiological outcome of operative treatment for unstable pelvic ring fractures: A 2 year prospective observational study. International Journal of Orthopaedics Sciences. 2023;9(3):432-439.