



## To Study the Clinical and Radiological Result of Per-Cutaneous Fixation of Pelvic and Acetabular Fractures: A Minimally Invasive Internal Fixation Technique

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### Abstract

**Introduction:** The pelvic ring fractures and acetabular fractures are among the major orthopedic injuries associated with high rates of morbidity and mortality. Open surgical stabilization is the standard treatment for the majority of these complications. Percutaneous minimally invasive surgical stabilization of the fractures has become an accepted treatment method for the past several years. This study investigated the outcomes of percutaneous fixation of pelvic and acetabular fractures.

**Aims and objectives:** To evaluate the efficacy of Percutaneous Fixation of Pelvic and Acetabular Fractures by analyzing clinical and radiological outcomes using Merle's hip score and Matta's criteria respectively and also assess the pre and post operative complications of Percutaneous fixation.

**Method:** In this Ambispective observational study, we included 8 patients with pelvis and acetabular injuries who needed percutaneous fixation as per the Indications. The patients were selected according to the inclusion and exclusion criteria. The patients were operated between 2022 and 2023 at Yashoda Superspeciality Hospital, Nehru Nagar, Ghaziabad.

**Result:** Follow up of total 8 patients was done. The patients were assessed clinically according to the Merle's Hip Score and radiologically according to Matta's criteria.

Out of the 8 patients included in this study, 2 patients had excellent result, 5 patients had good result and 1 patient had fair result who developed paresthesia (treated with percutaneous screw removal), as per Merle's Hip score. And 5 patients had excellent result, 2 patients had good result and 1 patient had fair result and anatomical reduction was achieved in 7 patients and imperfect reduction was achieved in 1 patient as per Matta's criteria.

**Conclusion:** Closed reduction and percutaneous minimally invasive screw fixation for a pelvic or acetabular Fractures is a useful surgical treatment option with low complication rates.

**Keywords:** Pelvis; Acetabulum; Fracture; Percutaneous Fixation; Merle's Hip Score; Matta's Criteria

### Introduction

Pelvic ring and acetabular fractures are associated with a high rate of morbidity and mortality due to themajor hemorrhage and injury to the internal organs [1,2]. These fractures remain difficult to treat and are a major challenge for most orthopedic surgeons. Epidemiological data on these injuries are rare in cases. The incidence of acetabular fracture (AF) varies between 0.5% and 8% [3].

Early treatment of Pelvic ring fractures and acetabular fractures have been shown to be the preferred treatment because of their many advantages such as early ambulation, and reduced morbidity as well as mortality [4,5]. However, the most preferred method of fixation, especially in unstable fractures, remainscontroversial [1]. Open reduction internal fixation (ORIF) requires great exposure with a high risk of several intra- and postoperative complications, including massive hemorrhage, deep venous thrombosis, neurovascular injuries, heterotopic ossification (HO), and infection [6-8].

After the introduction of closed reduction using percutaneous screw fixation by Routt, *et al.* [9] several authors have used this percutaneous fixation technique for the treatment of patients with Pelvic Ring Fracture and Acetabular Fracture [10-17]. The advantages of percutaneous screw fixation noted in these studies of pelvic and acetabular fractures includes less soft tissue injury, less blood loss, and a lower rate of infection.

Also, early weight bearing ambulation will be possible with this type of fixation [12,18]. However, the technique may be associated with few complications, such as the increased neurovascular injuries, internal organ injuries, misplacement of screw, and screw fracture [5,13,14,17,19-23].

**Aim**

- Primary aim- To evaluate the efficacy of Percutaneous Fixation of Pelvic and Acetabular Fractures by analyzing clinical and radiological outcomes.
- Secondary aim- To assess intraoperative and postoperative complications of fracture treated by percutaneous fixation.

**Objective**

- To evaluate clinical outcomes of Percutaneous Fixation of Pelvic and Acetabular Fractures by using Merle d'Aubigne hip score.
- To evaluate the radiological reduction quality of Percutaneous Fixation of Pelvic and Acetabular Fractures by using the criteria of Matta.
- To assess complications of Percutaneous Fixation of Pelvic and Acetabular Fractures.

**Matta's Criteria**

Grade	Osteophytes	Joint-space narrowing	Sclerosis	Other factors
Excellent	None	Normal	None	-
Good	Small	>1 mm	Minimal	-
Fair	Moderate	<50%	Moderate	Femoral head
Poor	Large	>50%	Severe	Collapse

**Figure 2**

**Merle's Hip score**

Score	Pain	Mobility	Ability to walk
0	Pain is intense and permanent	Ankylosis in abnormal position	Impossible
1	Pain is severe, disturbing sleep	Ankylosis in normal position or in a very slight abnormal position	Only with crutches
2	Pain is severe when walking, prevents any activity	Flexion < 40° (abduction = 0°) or very light joint deformity	Only with two canes
3	Pain is severe but may be tolerated with limited activity	Flexion < 40° - 60°	Limited with one cane (less than one hour). Very difficult without a cane
4	Pain only after walking and disappearing with rest	Flexion > 60° - 80° (can tie shoelaces)	Prolonged with one cane; limited without a cane (limp)
5	Very little pain and intermittent, does not preclude normal activity	Flexion > 80° - 90°. Limited abduction (>25°)	Without a cane but slight limp
6	No pain at all	Normal. Flexion > 90°, Abduction > 25°	Normal

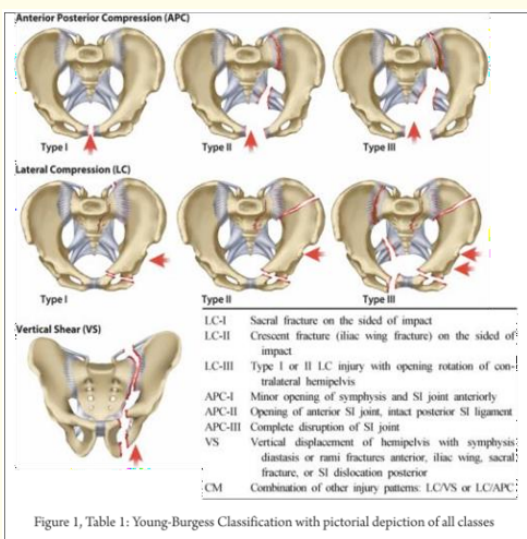
**Figure 3**

**Method and Materials**

- **Type of study:** Ambispective observational study.
- **Place of study:** Study was done at Yashoda hospital and Research centre, Nehru Nagar Ghaziabad, Uttar Pradesh.
- **Period of study:** From 2022 till 2023.

**Investigations**

- **Pre operative:** X ray pelvis with both hips AP and 3D CT
- **Post operative:** Pelvic inlet and outlet views and Obturator views.



**Figure a**

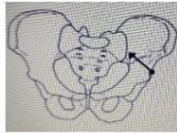
**PARTICIPANTS:**

**Criteria for inclusion**

1. Fractures of the superior ramus: use of an antegrade and retrograde medullary screw.



2. Fractures of the ilium: managed by a medullary screw in the pelvic brim.



3. Sacral fractures.



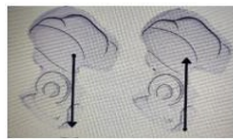
4. Sacroiliac joint disruptions.



5. Fractures of the anterior column.



6. Fractures of the posterior column.



7. Fractures of both columns.

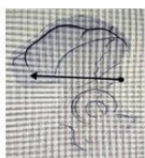
8. Transverse fractures.



9. Fractures high in the anterior column.



10. Lateral compression type-II fractures.



11. Magic screw (for reduction of quadrilateral plate)



**Criteria for exclusion**

1. Fractures of the posterior wall of the acetabulum.
2. Displaced fractures which are irreducible by closed means.
3. Sacral dysmorphism.
4. Other unusual pelvic anatomical variations.
5. Open injuries
6. Pelvic acetabular and ring fractures.
7. Severely osteoporotic bones.

**Figure 4**

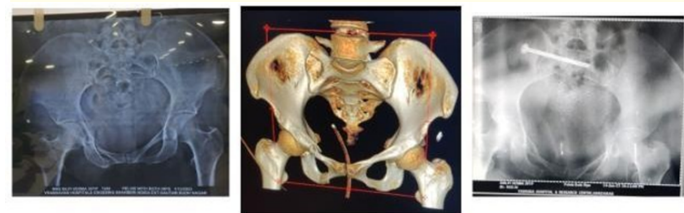
**Sample size of the study 8**



**Figure 5: Case No. 1.**



**Figure 6: Case No. 2.**



**Figure 7: Case No. 3.**



**Figure 8: Case No. 4.**



Figure 9: Case No. 5.

Demographical characteristics

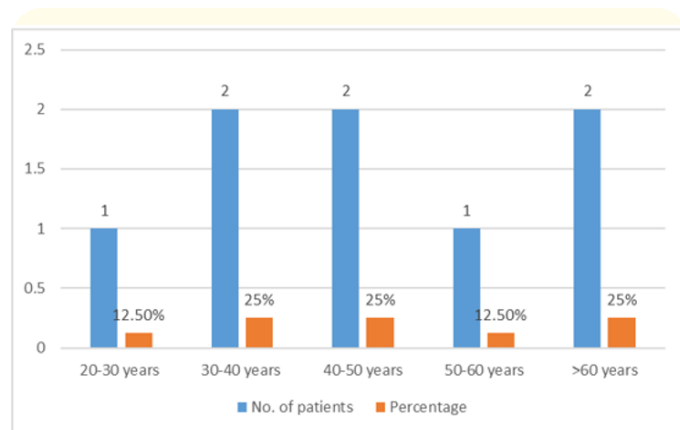


Figure 10: Age group, 20-30 years- 1 (12.5%); 30-40 years -2 (25%); 40-50 years- 2 (25%); 50-60 years-1 (12.5%); >60 years-2 (25%).

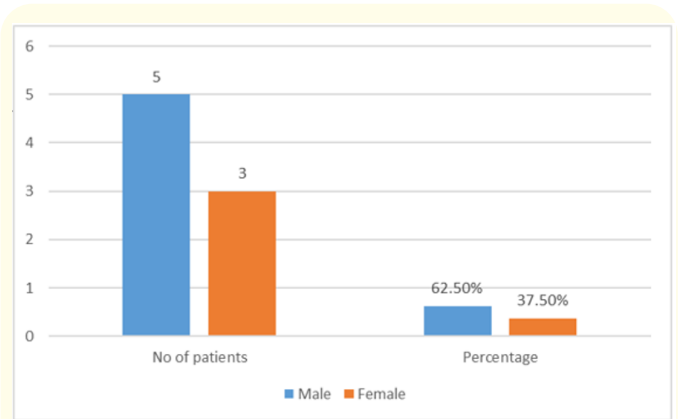


Figure 11: Gender- Male- 5 (62.5%) Female-3 (37.5%).

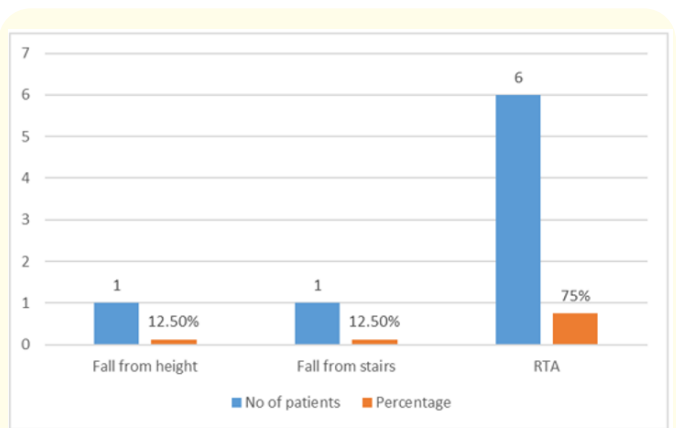


Figure 12: Mode of injury Fall from height-1 (12.5%) Fall from stairs-1(12.5%) RTA-6 (75%).

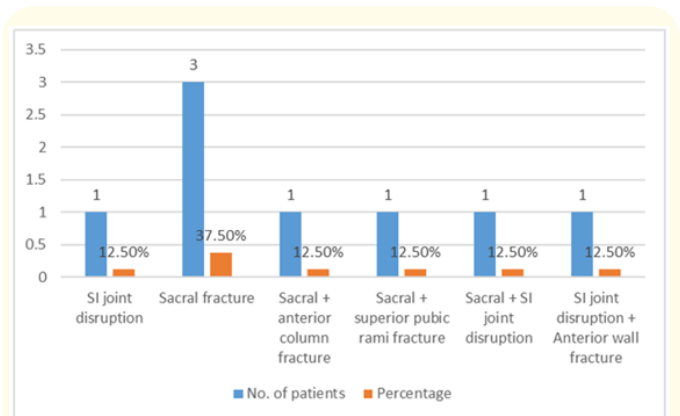
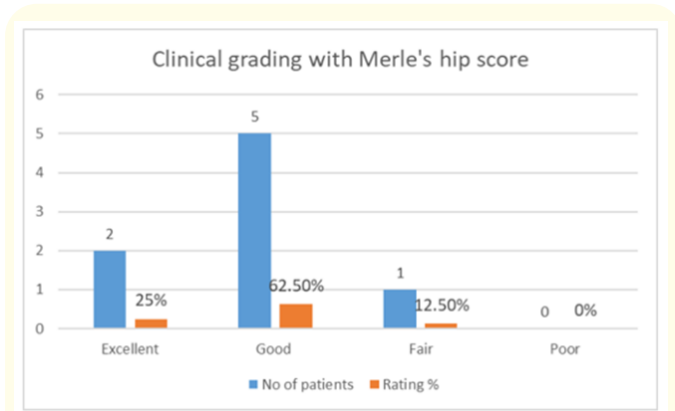


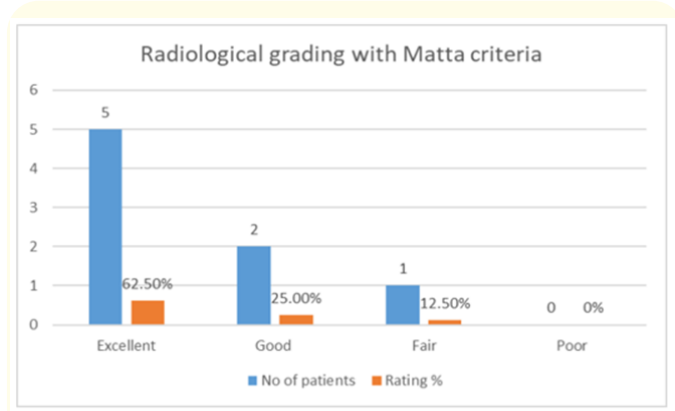
Figure 13: Type of fracture. SI joint disruption-1 (12.5%) Sacral fracture-3 (37.5%); Sacral + anterior column fracture-1 (12.5%); Sacral + superior pubic rami fracture-1 (12.5%); Sacral + SI joint disruption-1 (12.5%); SI joint disruption + Anterior wall fracture-1 (12.5%).

**Results**

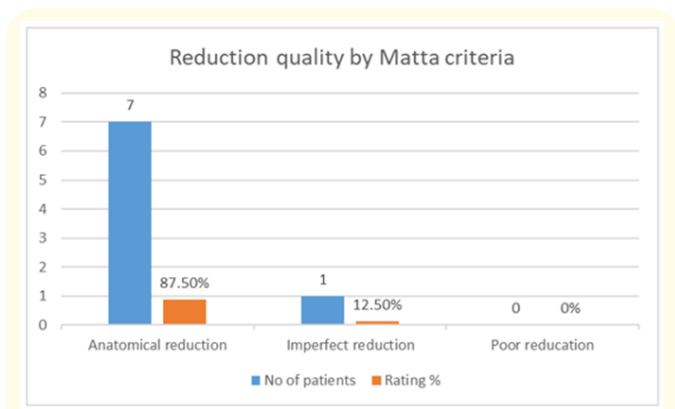
Clinico-radiological variables with results



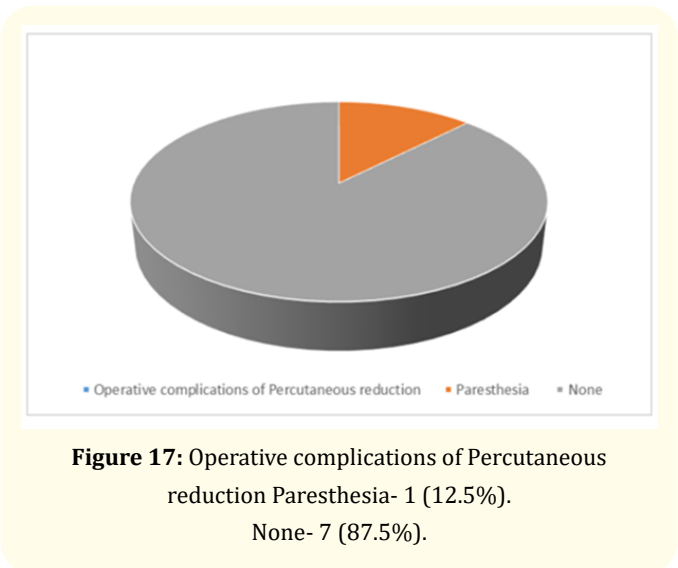
**Figure 14:** Clinical grading with Merles hip score Excellent-2 (25%). Good -5 (62.5%) Fair-1 (12.5%) Poor-0



**Figure 15:** Radiological grading with Matta criteria Excellent- 5 (62.5%). Good-2 (25%) Fair-1 (12.5%) Poor-0



**Figure 16:** Reduction quality by Matta criteria Anatomical reduction- 7 (87.5%) Imperfect reduction-1 (12.5%). Poor reduction-0.



**Figure 17:** Operative complications of Percutaneous reduction Paresthesia- 1 (12.5%). None- 7 (87.5%).

**Discussion**

The most important finding of the current study is the significant impact of percutaneous screw fixation and treatment of different types of Pelvic ring fractures and/or Acetabular Fractures on clinical and radiographic quality without the risk of neurovascular injury.

There are several surgical techniques for Pelvic ring Fractures and Acetabular fractures (ORIF) including anterior and posterior plating, trans-sacral bars, and tension band plating is considered as the standard approach. However, high risk of intra- and postoperative complications, such as excessive blood loss, sepsis and HO remains concerned.

These problems propelled surgeons to look for minimally invasive techniques leading to decreased soft tissue trauma and blood loss, as well as some other advantages. Percutaneous screw fixation of PRF was originally described by Routt, *et al.* in 1993.

Currently, percutaneous screw fixation of Pelvic ring fractures and Acetabular fractures is increasingly used worldwide with better outcomes.

Considering that intramedullary screw is used in this procedure, the rigidity of fixation is very high and the patient can bear full weight on next days after the procedure. This is a major advantage of this method, with respect to open methods and plate fixation, which usually needs a longer duration of partial weight bearing. In a recent analysis, Lee, *et al.* demonstrated that the use of posterior iliac screws to repair sacroiliac joint injuries is more stable than sacral rods or locking compression plates and reduces the risk of implants and Pelvic fractures.

In the current study, partial weight bearing was initiated on the first postoperative day in 65% of the patients and all of the patients were able to ambulate with partial weight bearing on the third postoperative day.

However, percutaneous screw fixation has its own problems. The positioning of screw is technically challenging due to the complicated anatomical structure of the pelvis and acetabulum and narrow osseous corridors.

Furthermore, several complications, such as osteoarthritis of hip joint, neurovascular injuries such as (radiculopathy, lateral femoral cutaneous nerve injury, injury to sciatic nerve and femoral nerve), misplacement of screws, and screw loosening were reported when percutaneous screw fixation was done. For example, iatrogenic nerve injury and hardware failure rates were reported as 0-7.2% and 0-2.9%, respectively, using different methods, modalities and techniques.

Schweritz, *et al.* reported the results of percutaneous iliosacral screw insertion in 71 patients with unstable pelvic fractures. After 31 months of follow-up, 61 patients (86%) could return to their pre-operative activities and work. They also reported positive results in the last follow-up of 66 patients. However, postoperative neurologic deficit and sacroiliac osteoarthritis occurred in 2 (2.8%) and 15 (21.1%) patients, respectively, regarding long-term follow-up.

In a study conducted by Tempelaere, *et al.* the results of 11 Pelvic ring fractures was evaluated 4 years after percutaneous fixation. The radiological and functional results were good to excellent with no intraoperative complications.

In the current study, all of the fractures were healed within the first three postoperative months. Also, most of the patients could return to their pre-operative work (93%). Also there was no thromboembolic event, and /or neurovascular injury in this current study. The total rate of postoperative complications was 12.5%. Plus, no screw fracture was noted in the current study. The obtained results are promising and demonstrate that minimally invasive percutaneous screw fixation is a safe method and can be efficiently used for patients with pelvic ring Fractures and/or Acetabular fractures.

Mean pain intensity score was about 2.7 after 6 months in a study conducted by Chui, *et al.* [13] which was same with the findings of this study also, in which the mean VAS was 2.2 after one year. In the study conducted by Fang, *et al.* 10.3% of the patients suffered from chronic pain post operation [23]. However, in the current study 16.8% of the patients reported a mild to moderate pain

at the fracture site, and 4.9% of cases required NSAIDS consumption.

The volume of intraoperative blood loss was insignificant and there was no need of blood transfusion in this study. The mean values of blood loss volume and operation time were 29 cc and 32 min, respectively, in the present study. Clearly, less blood loss is directly proportional to the better general and mental condition of the patients after the operation and decreases the complications and costs of the blood transfusion. Also changes of infection are decreased due to shorter operative time.

According to a study by Chui, *et al.* a larger amount of blood loss (179 ml) and longer operative time (141 min) was reported, with respect to those in this study. It seems remarkable since they employed a 3D.

Navigation system for the operations. The mean operation time was 63 min in the study by Eckardt, *et al.* and, the mean operation time in the study performed by Tempelaere, *et al.* was 45 min which was closer to the findings in the current study.

The inconsistencies in some measures in the abovementioned studies result from differences in age of the patients and patient selection, especially the type of fractures. Furthermore, the utilization of different techniques and modalities can affect the measures significantly. It should be noted that percutaneous screw placement is technically demanding and has a learning curve. With more expertise, the surgeon will be able to place the screws more precisely and quickly. As shown in this current study, there was no neurovascular injury using advanced modalities due to the surgeon's skill and expertise.

Although this study paved the way on the utilization of percutaneous fixation on pelvic and acetabular fractures, it suffers from some limitations. The current study was a case series and the results and outcomes were not compared with those of ORIF. All of the patients with pelvic and acetabular fractures amenable to this method of fixation were included in the current study. Furthermore, the reduction of the fracture was evaluated using plain radiography rather than CT scanning. Also, long-term follow-ups are necessary to find more reliable results. So, it was not possible to find the presence of degenerative changes in the current study due to the short-term follow-up [24-28].

## Conclusion

Closed reduction and percutaneous minimally invasive screw fixation turns out to be a safe and reliable treatment option for the

pelvic ring and acetabular fractures with minimal morbidity and complication rate. This intramedullary fixation is the most rigid fixation method in the pelvic ring that helps the patient bear early postoperative weight.

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