

ORIGINAL RESEARCH

A prospective study of functional and radiological outcomes of treating acetabular fractures with open reduction and internal fixation

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ABSTRACT

Background: Acetabulum plays a vital role in weight-bearing in lower extremity. The fractures of acetabulum are complex and are difficult to treat. Thus, this study was planned with an aim to evaluate the functional and radiological outcomes following open reduction and internal fixation (ORIF) for acetabular fractures.

Methods: A prospective study was carried out in the orthopaedics department for a duration of one year after ethical approval. Patients aged between 18 to 65 years having closed acetabular fractures with more than 2 mm displacements and less than 3 weeks duration were recruited for the study. These patients were initially evaluated for other associated injuries and were provided with Bohler Braun splint and skin traction for a period of 3 to 4 days. Three X-rays were performed in AP view, Judet obturator oblique view and Judet iliac oblique view. CT scan was also done pre-operatively to determine the type of fracture. Three surgical approaches were used depending on the type of fracture: anterior iliofemoral approach, anterior modified stoppa approach and posterior Kocher – Langenbeck approach. Post-operative antibiotics and analgesics were prescribed. Follow-up was done at 4 weeks, 6 weeks, 3 months, 6 months and 1 year. Post-operative assessment for functional and radiological outcomes was done using Modified Merle d'Aubigné and Postel score and Matta's criteria, respectively.

Results: A total of 14 patients were recruited in the study. The mean age was 37.6 ± 3.4 years. Out of 14 patients, 78.57% (n = 11) were males. Out of 14, five patients had associated bony injuries, the most common of which was femur fracture which occurred in three patients. The most common type of fracture pattern was the posterior column and combined posterior wall and column fractures which were present in three patients each. Post-operative complication rate was 28.57% (n = 4). Modified Merle d'Aubigné and Postel functional score average was 14.2. 42% patients (n = 6) had fair post-operative functional outcomes at one year evaluation. Matta's criteria classified half of the cases as imperfect reduction.

Conclusion: ORIF can be an effective approach in the management of acetabular fractures. Proper preoperative planning, anatomical reduction, adequate fixation and early mobilization are essential to achieve good functional outcomes.

Key words: Acetabular fractures, open reduction, internal fixation

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Introduction

The Acetabulum is one of the largest joints in the body for weight bearing. The incidence of acetabulum fractures is approximately 3 per 100,000 persons per year.^[1] Acetabulum fractures are mostly caused by high-speed motor vehicle accident and fall from height. Young patients are generally involved in high-velocity injuries with other concomitant injuries and

in elderly patients most frequent cause of injury is a fall and is an isolated injury. Meta-analysis by Ginnoudis et al using midline search data following 3670 acetabular fractures over the period of 40 years found that acetabular fractures occur most commonly in young active male population (69%).^[2] Acetabulum fractures were previously treated non-operatively which had led to high morbidity causing

secondary osteoarthritis, limping, instability and chronic pain.^[3] Development in treatment strategies has decreased the morbidity and mortality of the patients. Congruent articular surface is extremely important for stable and painless mobilization. It was later observed that anatomic reduction of internal articular fragments and maintaining the reduction by internal fixation achieved excellent results.^[4] Hence, open reduction and internal fixation (ORIF) is consistently performed for acetabular fractures. Sometimes acetabular fractures are involved with concomitant fractures or dislocations of the hip in a polytrauma patient in that situation pre-operative planning and positioning becomes crucial for a successful outcome. The post-surgical outcomes depend on multiple factors such as patient factors, severity of injury and operative factors. Patient factors include age, bone quality, comorbid conditions and level of activity before the accident.^[5]

Treatment of acetabular fractures is challenging as it has complex anatomy with a steep learning curve for surgical management. The Acetabulum has intricate anatomy with difficult fracture patterns and requires a properly planned approach and two - column fractures requiring a dual approach to fix the fracture. The severity of injury includes hip dislocations, neck of femur fracture, head of the femur fracture and other associated fractures which worsen the prognosis. Operative factors include the experience of the surgeon, duration of surgery, quality of fixation and sterility maintained during surgery.^[6] The purpose of the treatment is to mobilize the patient early by providing a congruent articular surface and anatomically fixing the fracture. Thus, this study was planned to evaluate the functional and radiological outcomes following a ORIF for acetabular fractures.

Materials and Methods

This was a prospective study which was conducted in the Department of Orthopaedics at a tertiary care hospital in India for a duration of one year. The study was commenced after the approval was granted by Institutional Ethics Committee. The inclusion and exclusion criteria were defined to recruit the study participants –

Inclusion criteria

- Patients of either gender and aged between 18 and 65 years.
- Patients with closed acetabular fractures displaced more than 2 mm and less than three weeks in duration.
- Patients with or without hip dislocation in addition to the acetabular fracture.
- Patients willing to give written informed consent for the procedure and study.

Exclusion criteria

- Patients with open acetabular fractures, pathological fractures or local soft tissue damage.

- Fractures of more than three weeks duration and pre-existing hip joint arthritis.
- Patients with inflammatory disorders such as rheumatoid arthritis or ankylosing spondylitis.
- Patients having medical contraindications to surgical procedures.

Initial pre-operative evaluation: The patients were examined in emergency department. After collecting the demographic details and details regarding the cause of injury, all systems were examined to rule out injuries of other systems. If there was any systemic injury present, it was treated accordingly. Neurological and vascular status was assessed by sensations and digital pulsations in peripheral extremities, respectively. Patient was assessed for other associated fractures and was placed on Bohler Braun splint and skin traction for a period of 3 to 4 days. Once the patient was stabilised, three X-rays were performed in AP view, Judet obturator oblique view and Judet iliac oblique view. Judet oblique views helps to visualise interior and posterior borders of ilium as well as anterior and posterior walls of acetabulum. To plan the surgical approach and reduction, all patients underwent a preoperative CT scan to classify the type of fracture.

All the patients were started on 40 mg low molecular weight heparin (LMWH) once daily subcutaneously for deep vein thrombosis prophylaxis after admission. It was stopped 12 hours prior to surgery and restarted 48 hours after surgery.

Surgical approach: Choosing the correct surgical exposure is of great importance. In our study. The primary approaches used were:

1. Anterior ileofemoral approach
2. Anterior modified stoppa approach
3. Posterior kocher – langenbeck approach

These approaches were used alone or in combination depending on the condition of the patient, type of fracture and associated injuries.

Post-operative care: All the patients were started on post-operative antibiotics which were continued till post-operative day 10. They were also started on indomethacin 25mg 8 hourly from post-operative day 1. 1st post-operative dressing was done and drain was removed on post-operative day 2 and static quadricep and ankle pump exercises were also initiated. 2nd postoperative dressing was done on post-operative day 5 and passive bending was initiated. Sutures were removed on post-operative day 12.

Follow-up: Patients were called for follow-up on 4 weeks, 6 weeks, 3 months, 6 months, 1-year post-operation. Partial weightbearing with crutches or walker was allowed after 6 weeks depending upon the fracture type, fracture pattern and radiological union on X-ray. Full weightbearing was allowed on 3rd or 4th month after assessing the radiological images. Post-operative assessment for functional outcomes was done using Modified Merle d'Aubigné and Postel

score^[7] which evaluates pain, gait and range of motion. The obtained scores are combined to assess the final outcomes into: Excellent (17-18), Good (15-16), Fair (13-14) and Poor (< 13). The post-operative radiological outcome assessment was carried out using Matta's criteria.^[7] According to this, X-rays with less than 1 mm of fracture displacement after fixation are termed anatomical reduction, displacement of 1-3 mm are termed imperfect reduction and with displacement > 3 mm after fracture fixation were termed poor reduction. Statistical analysis: The data was analysed using Microsoft Excel 365. The results were described using

descriptive statistics of mean, standard deviation and percentages.

Results

A total of 14 patients were recruited for the study based on the inclusion criteria defined in methodology. The average age of the patients was 37.6 ± 3.4 years (range: 19 to 56 years). Figure 1 depicts the age distribution of patients in the study. Out of 14 patients, majority were males (78.57%, n = 11). The male to female ratio was 3.7: 1.

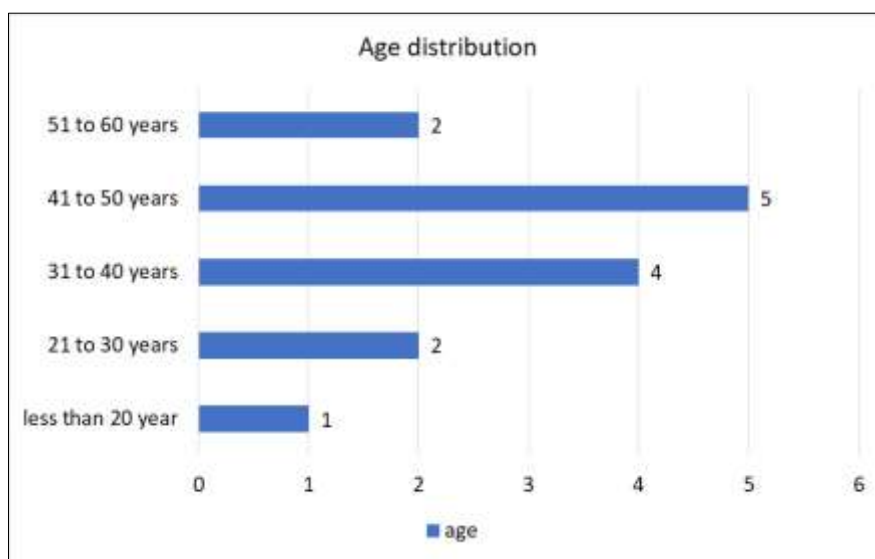


Fig1. Age distribution of study participants

Out of 14, five patients had associated bony injuries, the most common of which was femur fracture which occurred in three patients. One patient each had associated radius fracture and tibia + fibula fracture.

The most common type of fracture pattern was the posterior column and posterior wall fractures which were present in three patients each. Table 1 gives the different types of fractures encountered in the study.

Table 1. Different types of fractures

| Type of fracture | No. of patients | Percentage |
|--------------------------------|-----------------|------------|
| Posterior wall | 2 | 14% |
| Posterior column | 3 | 22% |
| Transverse | 2 | 14% |
| T type | 2 | 14% |
| Posterior column and wall | 3 | 22% |
| Transverse with posterior wall | 2 | 14% |

The average interim between injury and surgery was 4.3 days with minimum of 3 days and a maximum of 9 days. The average surgery time was 173 minutes with a minimum of 110 minutes and a maximum of 240 minutes.

Four patients had post-operative complications. The frequency of complications is mentioned in table 2. All the complications were managed appropriately with fair outcomes. None of the patients had pubic diastasis or sacroiliac disruption injuries. No patient had avascular necrosis or deep vein thrombosis.

Table 2. Post-operative complications

| Complication | No. of cases (%) |
|----------------------------------|------------------|
| superficial wound infection | 1 (7.14%) |
| sciatic nerve injury – foot drop | 1 (7.14%) |
| dislocation | 1 (7.14%) |
| heterotrophic ossification | 1 (7.14%) |

The evaluation of functional outcomes using Modified Merle d'Aubigné and Postel score is given in the following figure. Majority of the patients (42%, n = 6) had fair post-operative functional outcomes at one

year evaluation. Two patients had poor outcomes. They had restricted range of movement and pain on walking after one year of surgery. Average functional outcome score was 14.2 ranging from 5 to 18.

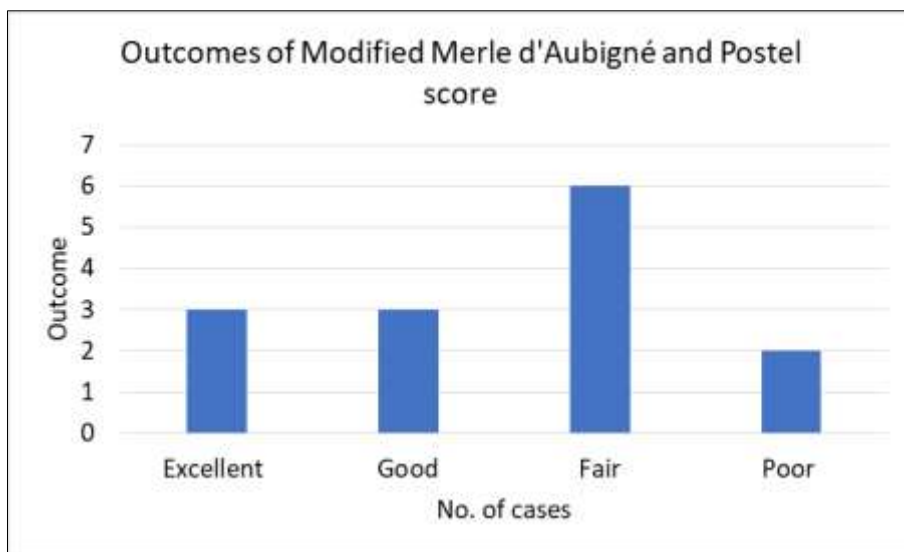


Fig 2: Functional Outcomes of open reduction and internal fixation.

The standard of fracture reduction as evaluated by Matta's criteria on a post-operative X-ray is given in table 3. The mean score in the anatomically reduced fracture was 16.4in, imperfectly reduced was 14.4 and

poorly reduced is 8. The more comminuted the fracture, the more difficult to achieve anatomical reduction.

Table 3. Radiological outcomes using Matta's criteria

| Radiological outcome | No. of cases |
|----------------------|--------------|
| Anatomic reduction | 5 (35.71%) |
| Imperfect reduction | 7 (50%) |
| Poor reduction | 2 (14.29%) |

Discussion

There is constant advancement in the area of acetabulum fractures. The patient should be treated as a whole. Road traffic accidents are the most common cause of acetabulum fractures and it additionally involves other systemic injuries. The concepts of damage control orthopedics should be applied and the patient should be treated accordingly. Knowing the mechanism of trauma is an important factor in detecting possible injuries. The principles of acetabulum fracture management are the same and have not changed much over the decades. The anatomical articular reduction will keep the joint congruent and functional. The treatment of simple acetabulum fractures is straightforward and have not been changed much over the decades. Approach to treatment of complex acetabulum fracture is still a challenge requiring bi columnar reduction with a single or dual approach. Hence, the aim of this study was to evaluate the functional and radiological outcomes of ORIF in patients with closed acetabular fractures.

The mean age of the study participants was 37.6 years. Males were higher in number. This is consistent with the general observation that males usually drive more for work and are involved in road traffic accidents more often. This is similar to the findings of few other studies where more number of study participants belonged to the age groups of 35-45 years with male preponderance.^[8-10]

The most common type of fracture encountered was posterior wall. This was similar to the findings of a study carried out retrospectively among 699 participants which reported 23% fractures of isolated posterior wall fractures.^[11] These fractures are more common as the posterior wall is thinner compared to anterior and superior walls. It is a part of weight-bearing area with limited bony support. This makes it prone and vulnerable to fracture more compared to other walls.^[12]

The complications encountered in the study were common as seen in previous studies. Using LMWH in all patients prevented deep vein thrombosis in all patients. Heterotrophic ossification occurring in one patient affected functional outcome of that patient.

Foot drop occurred due to sciatic nerve injury which improved in four months. A recently published study reported high complication rate with 21% re-operation post ORIF for acetabulum fractures.^[13] The most common complication requiring re-operation was reported to be arthrosis in 7.4% patients followed by infection in 3.9% patients.^[13]

The key importance of open reduction and internal fixation is anatomic reduction, rigid fixation and early mobilization will keep the articular surface congruent, the joint freely mobile and pain free. The clinical result of the patient directly depends upon the quality of reduction that has been attained when open reduction and internal fixation were performed. Anatomic reduction was achieved in 35.71% patients which is significantly lesser compared to other studies. A recently published study by Tannast et al. reported anatomic reduction in 72% of patients using modified Stoppa approach.^[8] Another study reported anatomic reduction in 82% patients using modified Stoppa approach.^[9]

Majority of the patients had fair functional outcome post ORIF for acetabular fractures. The functional outcomes could be influenced by obesity, use of tobacco, post-traumatic arthroses, heterotopic ossification and comorbid diabetes.^[11]

The study had certain limitations. First of all, the included sample size was very small and hence the results may not be very precise or generalisable to wider population groups. Also, the follow-up period upto one year was difficult for the study participants to follow through and one participant was lost to follow-up after 6 months.

Conclusion

In conclusion, acetabular fractures treated with open reduction and internal fixation have good functional outcomes. Using a dual approach of two column fixation, morbidity can be reduced as it avoids extensive dissection. Proper preoperative planning, anatomical reduction, adequate fixation and early mobilization are essential to achieve good functional outcomes. Future research with modified ORIF approaches must be conducted to evaluate their functional and radiographical outcomes and achieve the best possible treatment approach.

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