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Results of surgical management of displaced posterior wall fractures of acetabulum: A prospective study in terms of functional outcome & complications

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Abstract

Background: Treatment of patients with complex acetabular fractures, is one of the most difficult challenge for Orthopaedic surgeons. The purpose of this prospective study was to evaluate the results of surgical management of displaced posterior wall fractures of acetabulum and to determine the factors associated with an adverse outcome.

Materials and Methods: After obtaining approval from local ethics committee, 29 patients, with the displaced posterior wall fractures of acetabulum, were managed by open reduction and rigid internal fixation through Kocher-Langenbeck approach and as per standard protocol. The results of follow-ups were analyzed clinically and radiologically, using the “Merle d’Aubigne & Postel score” and the “radiologic criteria of Matta” respectively at 1, 2, 3, 6, 9, 12 months and at 2 years post-operatively.

Results: In our study, out of 29 patients, clinical results were very good in 41.4%, good in 20.7%, medium in 6.9%, fair in 10.3% and poor in 20.7% patients. Radiological results were excellent in 31%, good in 44.8%, fair in 6.9%, and poor in 17.3% patients. Heterotopic ossification (grade I in 10 patients, grade II in 4 patients, and grade III in 1 patient) and post-traumatic arthritis of the hip joint (3 patients) were the main complications observed during 2 years of follow-ups, which were treated accordingly.

Conclusion: Management of the patients with displaced posterior wall fractures of acetabulum is a surgically demanding procedure with a learning curve to new surgeons. The clinical and radiological results depend on early anatomic reduction of fractured fragments, articular congruency of hip joint and the deliberate approach to soft tissues during surgery.

Keywords: Kocher-Langenbeck approach, Merle d’Aubigne & Postel score, radiologic criteria of Matta, heterotopic ossification

1. Introduction

Due to its three-dimensionally complex anatomy, treatment of acetabular fractures are one of the most difficult challenge to the Orthopaedic surgeons. These fractures are caused by high-energy trauma, and occur more commonly in young active male population (69%). Acetabular fractures are usually associated with pelvic ring injuries, fractures of the extremities, head injuries, spine injuries, chest and intra-abdominal injuries^[1]. According to Judet- Letournal classification, posterior wall fractures are most frequent type and involve 23.6% of all acetabulum fractures^[2, 3]. It’s difficult to achieve anatomic reduction of posterior wall fractures and thus, these injuries are prone to joint failure.

For the management of posterior wall fractures of acetabulum, one can go for conservative maneuver only if hip joint stability and the joint congruency are maintained enough clinically and radiologically in relationship with the acetabular roof after the trauma^[4, 5].

In case of displaced posterior wall fractures of acetabulum, open anatomical reduction of the articular surface, and rigid internal fixation is the standard treatment protocol^[6, 7]. For an operating surgeon, the primary aim of surgical management of these fractures, is always to obtain a stable congruous hip joint with complete union of the fragments. The functional outcomes of these fractures involve various factors such as age, fracture pattern, superomedial acetabular dome impaction, fracture & dislocation of femoral head at the time of injury, associated injuries to vital structures, delay to the surgery, and quality of fracture reduction during surgery^[8, 9].

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The purpose of this study was to evaluate the results of the surgical management of displaced posterior wall fractures of acetabulum, in terms of functional outcome and complications.

2. Materials and Methods

This study was conducted during the years 2016 to 2019 in the department of Orthopaedics, SMS Medical College, Jaipur (Rajasthan). The approval of institution's ethical committee was obtained prior to initiation of the study. A prospective study was designed with sample size of 29 patients, met with inclusion criteria. The written informed consent was taken from every patient involved in our study.

Inclusion Criteria: all patients of age group >16 years or fused triradiate cartilage, with acute closed fractures of the posterior wall of acetabulum exclusively, with less than 3 weeks duration, and had readiness to take part in the study, were included.

Exclusion Criteria: fractures of the posterior wall of acetabulum in children with a visible triradiate cartilage, patients with old fractures > 3 weeks duration, previously operated cases, patients with compound fracture of pelvis, fractures with neural and vascular compromise and with severe soft tissue injury like Morel-Lavelle Lesion, pathological fractures, and fractures of the posterior wall of acetabulum with associated other fractures.

In this study, out of 29 patients, 23 were male and 6 were female, with mean age of 43.62 years (range 19- 68). The demographic variables are shown in table 1 and figure 1.

After initial evaluation and stabilization, anteroposterior views and Judet views and three dimensional CT scan of the pelvis was done in each case to understand the morphology of the fracture in detail.

2.1 Surgical Technique

All surgeries were performed under combined spinal epidural anaesthesia. A Kocher-Langenbeck approach [10] was used in all the patients. After exposing the fracture site, soft tissue-debris was removed between the fracture fragments and attached capsular soft tissues were preserved carefully. The hip joint was opened and intra-articular osteochondral free fragments were removed. Gentle traction at the hip joint was applied and the extent of marginal impaction was identified. The posterior wall fragments and their attached capsular ligaments were reduced and held with Kirshiner wires temporarily until definitive fixation was done. Two or three 3.5 mm cortical lag screws were used for firm fixation of the fragments. The smallest fragments were abandoned when they were separated from their soft tissues. After fixation, intra-articular reduction was confirmed with gentle traction at the hip joint and a stability test. Lag screws, close to the posterior rim, were placed extrarticular. The void resulting from the elevated marginal fracture was filled with a bone graft using autologous bone from the greater trochanter. The outer surfaces of the reduced fragments were buttressed with one or more reconstruction plates of appropriate size. The buttress plates were somewhat molded so as to provide compression to the posterior wall of acetabulum. A suction drain was used at the end and closure was done in layers.

2.2 Post-operative follow-up

Just after surgery, each patient was immobilized in a Thomas splint with or without skeletal traction for at least 6 weeks. Intravenous antibiotics were started for initial five post-operative days, and followed by oral antibiotics for next ten post-op days. Suction drain was removed after 48 hours and first dressing was done. Next dressings were applied on 5th and 8th post-op days,

respectively. On 15th post-operative day, the patient was discharged after suture removal. Indomethacin was given postoperatively to the patients with extensive dissection during surgery to prevent heterotopic ossification.

After 6 weeks, gentle hip ROM and non-weight bearing walking was started. After 12 weeks, partial weight bearing was started but the full weight bearing was not allowed until radiological evidence of complete union. Although, the immobilization protocol was flexible according to the patient age, compliance, fracture pattern, and radiological union.

For first three months each patient was followed up every monthly, and then after every three months for one year and finally at two years. Patients having any complication during hospital stay or during follow up were recorded. For radiological evaluation, X-rays of pelvis with both hips and Judet views were taken at each follow. The grade of reduction was considered as anatomical if post-op plane radiograph showed zero or 1mm displacement, satisfactory if 2-3mm displacement and unsatisfactory if > 3mm displacement. Once there was no pain on weight bearing position and radiologically good callus bridging the fracture site, then fracture was considered united. However, all patients were followed up even after fracture healing to identify development of any late complication.

2.3 Statistical analysis

Statistical analysis was performed using SPSS software version 16.0 and MS Excel 2013. All illustrative results were presented as the mean± SD. We used Fisher's exact test for the evaluation of categorical data. The dependent variables consisted of surgical site infection, neurological complications, avascular necrosis of the femoral head, and heterotopic ossification. Other related numerical data were considered simultaneously using multiple logistic regression analysis.

Table 1: Showing demographic variables of the study

Study design		Prospective study
Study period		2016-2019
Total number of the patients		29
Mean age (range) in years		43.62 (19- 68)
Male: Female ratio		23:6
Mechanism of injury	Road Traffic Accidents	16
	Fall from Height	9
	Slip on hard surface	2
	Heavy object injuries	2

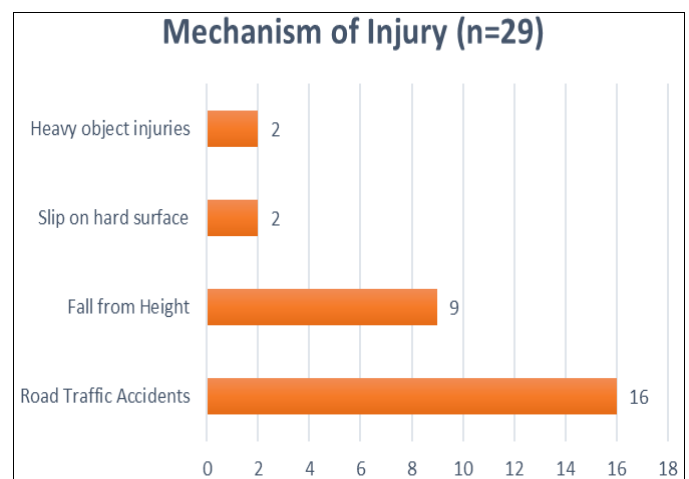


Fig 1: Showing Mechanism of injury of patients with acetabular posterior wall fractures involved in the study

3. Results

For radiological evaluation, X-rays of pelvis with both hips and Judet views were taken just post-operative and at each follow. The grade of reduction was considered as anatomical if post-op plane radiograph showed zero or 1mm displacement, satisfactory if 2-3 mm displacement and unsatisfactory if > 3 mm displacement (Table 2).

In this study, the clinical results were determined using the Merle d'Aubigne and Postel score¹¹ while the radiological results evaluated by the Joel Matta score⁸. Three parameters-pain, mobility, and ability to walk are included in the Merle d'Aubigne and Postel score. The worst condition rated as 0 point, while the best condition rated as 6 points. At each follow up, these scores were calculated and the final scores were taken at two years.

In our study, out of 29 patients, clinical results were very good in 12 patients, good in 6 patients, medium in 2 patients, fair in 3 patients and poor in 6 patients, as per Merle d'Aubigne and Postel score^[11] [Table 3]. Radiological results were excellent in 9 patients, good in 13 patients, fair in 2 patients, and poor in 5 patient, as per radiologic criteria of Matta^[8] [Table 4]. Pre-op and post-op radiological assessment of a patient with posterior wall fracture of acetabulum are shown in 'figures 3 -6'.

Table 2: Showing initial degree of articular congruency in the post-operative plane radiographs of patients with acetabular posterior wall fractures

Grade of Reduction	Post-op displacement criteria	Number of patients & Percentage (n=29)
Anatomical	Zero or 1 mm	25 (86.2%)
Satisfactory	2-3 mm	3 (10.3%)
Unsatisfactory	> 3 mm	1 (3.5%)

Table 3: Showing the clinical results of the study.

Clinical Results (based on the Merle d'Aubigne & Postel score)	Number of patients & Percentage (n=29)
Very good	12 (41.4%)
Good	6 (20.7%)
Medium	2 (6.9%)
Fair	3 (10.3%)
Poor	6 (20.7%)

Table 4: Showing the radiological results of the study

Radiological Results (based on radiologic criteria of Matta)	Number of patients & Percentage (n=29)
Excellent	9 (31%)
Good	13 (44.8%)
Fair	2 (6.9%)
Poor	5 (17.3%)

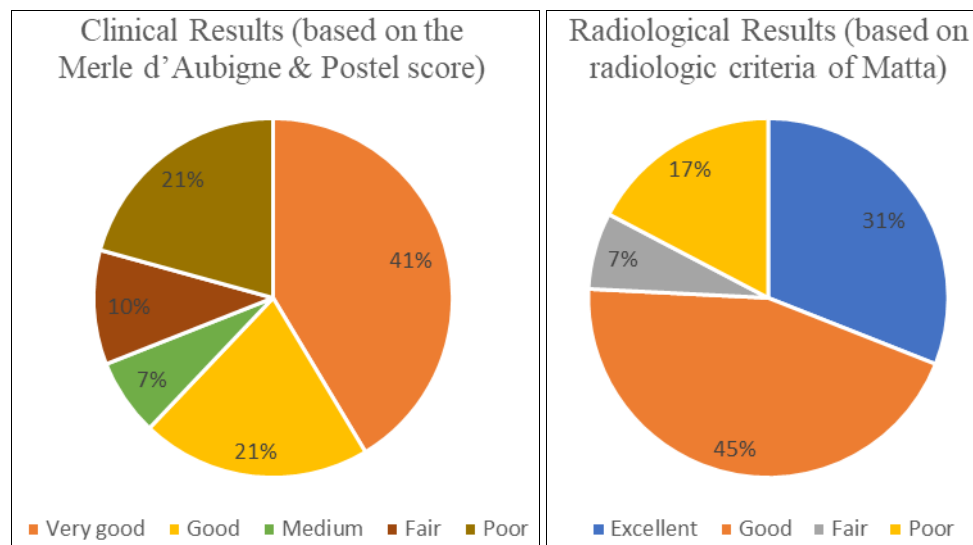


Fig 2: Pie charts showing the clinical and radiological results of the study.

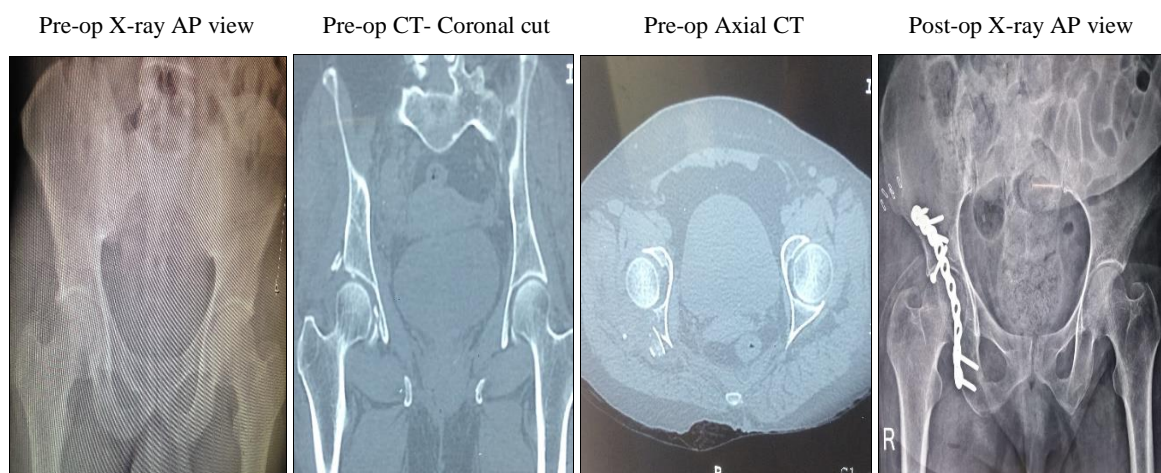


Fig 3-6: Showing the pre-op and post-op radiological assessment of a patient with posterior wall fracture of acetabulum

3.1 Complications

The early post-operative complications after surgery included

two cases of superficial surgical site infection, which were successfully treated with antibiotics and dressings. One case was

diagnosed as deep vein thrombosis, which was managed with anticoagulants and resolved completely. Out of four cases of sciatic nerve palsy, three cases were of traumatic origin and identified preoperatively, while one case was iatrogenic. All cases were conservatively managed with medications. Recovery was complete in two cases and partial in rest one case.

For the late complications, we had three patients with post-traumatic arthritis of the hip joint and two patients with AVN stage IV, at their one year follow-ups; all five cases underwent total hip arthroplasty. Ten patients had class I heterotopic ossification, four patients had class II heterotopic ossification and one patient had class III heterotopic ossification according to Brooker *et al.* grading [12]. All cases managed conservatively. (Table 3)

Table 3: Showing the complications of the study

Complications		Number of patients & Percentage (n=29)
Superficial surgical site infection		2 (6.9%)
DVT*		1 (3.5%)
Sciatic nerve Palsy	Traumatic	3 (10.3%)
	Iatrogenic	1 (3.5%)
Post-traumatic arthritis of the hip joint		3 (10.3%)
AVN** femoral head (grade IV)		2 (6.9%)
Heterotopic ossification (Brooker <i>et al.</i> grading)	Grade I	10 (34.5%)
	Grade II	4 (13.8%)
	Grade III	1 (3.5%)

*DVT: Deep Vein Thrombosis, **AVN: Avascular Necrosis.

4. Discussion

Functional outcomes and postoperative complications for posterior wall fractures of the acetabulum depend on several factors. Operating surgeon's experience is one of the factor. It's a demanding surgery with a long learning curve. Previous studies have reported that for inexperienced surgeons, the incidence of fair or poor long-term results was 55- 56% [13, 14] while this was 19- 25% [2, 3, 15], for experienced surgeons who regularly performed acetabular surgeries.

In this study, possibly the higher grade of fracture pattern and time gap between incidence of trauma to surgical management leads to lower number of good to excellent outcomes and the higher incidence of fair or poor results. Regarding the filling materials for a bone void, our first choice was autologous bone, either from the greater trochanter or the posterior iliac crest, although a freeze-dried cancellous allograft [16] or other bone graft substitutes can be used as bone-void filler.

In our study, 86.2% patients with acetabular posterior wall fractures showed anatomical reduction on post-operative radiographs [Table 2]. Although, at 2 years follow-up, we had total 62.1% good to very good clinical results according to the Merle d'Aubigne & Postel score [11] and 75.8% good to excellent radiological results according to radiological criteria of Matta [8]. Any subsequent osteoarthritis depends on initial degree of articular congruency, which can be predicted by a good quality post-operative plane radiograph. Our results were comparable with results of previous studies mentioned in the literature [17, 18, 19].

According to previous studies [15, 20, 21] the incidence of infection rate after acetabular surgery was about 0-3% when a simple approach was used and even higher when an extensive approach was used. In our study, we noticed two patients (6.9%) with superficial surgical site infection. Methicillin-resistant staphylococcus aureus was identified in pus culture and sensitivity reports of both patients. This infection was resolved

completely with vancomycin therapy in both the patients. We didn't observe deep infection post-operatively in any patient of our study group. One case (3.5%) was diagnosed with DVT, managed conservatively with anticoagulant therapy and was recovered completely.

According to literature, acetabular fractures with posterior dislocation of femoral head, have approximately 16-40% incidence of traumatic sciatic nerve palsy and about 2-6% incidence of iatrogenic sciatic nerve palsy [15, 18]. In this study, we noticed three cases (10.3%) of traumatic sciatic nerve palsy preoperatively, and one case (3.5%) of iatrogenic sciatic nerve palsy. All four cases managed conservatively with medications. Two of them showed fully recovery and one case showed partial recovery over the successive monthly follow-ups.

In our study, three patients (10.3%) had post-traumatic osteoarthritis of hip. In all these cases, there was inadequate reduction of the fracture at the time of surgery or delayed reduction of the fracture fragments. In delayed surgery due to any reason, it was arduous to achieve anatomic reduction of the smaller fractured fragments. Later On all these patients underwent total hip arthroplasty. Previous studies [1, 22, 23] had reported 20-50% incidence of post-traumatic osteoarthritis of hip after acetabular surgery.

In our study, two patients (6.9%) developed AVN grade IV. In both cases, there was history of posterior dislocation of the femoral head along with delayed reduction of the dislocated femoral head. These patients subsequently underwent total hip replacement. Previous studies [1, 15] had reported 3-10% complication rate of AVN of femoral head in patients with acetabular posterior wall fractures.

Giannoudis PV *et al.* (2005) reported in their study that the rate of heterotopic ossification following acetabular surgery is about 25.6% [18]. In our study, most of the patients developed grade I (34.5%) or grade II (13.8%) heterotopic ossification post-operatively without significant functional impairment of the hip joint. Only one case (3.5%) developed grade III heterotopic ossification. We found satisfactory improvement with successive follow-ups in all these patients. We believe that early surgical management of fractured fragments with deliberate approach to soft tissues during surgery can reduce the incidence of heterotopic ossification. All these cases were managed conservatively. Surgical resection was not required in any case even with grade III heterotopic ossification. We found satisfactory improvement with successive follow-ups in all these patients.

4.1 Limitations of our study

Small sample size of study group and short duration of follow-ups are the major limitations in this study to conclude more significant results and complication rates.

5. Conclusion

The most effective method for the management of displaced posterior wall fractures of acetabulum is open reduction and internal fixation as earliest through Kocher Langenbeck approach. The clinical and radiological results depend on an anatomic reduction of fractured fragments, articular congruency of hip joint and the deliberate approach to soft tissues during surgery. The sciatic nerve should be properly exposed and preserved during the surgery. The operating surgeon's competence and familiarity with the procedure remain one of the major Factor to achieve these determinations.

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7. Declarations

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Conflict of interest: None.

Ethical approval: This study was approved by the local ethics committee.

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