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Outcome of the surgical management of single versus comminuted fractures of the posterior wall of the acetabulum

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Abstract
Introduction- Posterior wall fractures of the acetabulum account for 1/3rd of all acetabulum fractures. The comminuted fractures managed surgically have poor outcomes in 30% patients even after anatomical reduction and fixation. The choice of fixation, anatomical reduction and stable fixation are important for better outcomes.
Materials And Methods- A total of 27 patients with a minimum age of 18 years were included in the study and managed surgically by fixation by buttress plates and screws in all patients by the Kocher Langenback approach. They were followed up for a minimum follow up of 1 year for their clinical and radiological outcomes. The outcome was assessed at the final follow up as per the Merle de'Aubigne score.
Results- The post-operative reduction was anatomical in 18 patients, good in 7 and poor in 2. The clinical outcome as per the modified Merle de'Aubigne score at the final follow up was found to be excellent in 12 (44.4%), good in 8 (29.6%), fair in 3 (11.1%) and poor in 4 (14.8%). The radiological outcome was evaluated as per Matta's criteria and was found to be excellent in 13 (48.1%), good in 5 (18.5%), fair in 4 (14.8%) and poor in 5 (18.5%).
Conclusion- Supplementing the screw fixation of the posterior wall by plates allow for early mobilization of the patients leads to more favorable results in isolated single posterior wall fragment as compared to comminuted posterior wall fragment.

Keywords: Posterior wall acetabulum, buttress plate

Introduction
Acetabulum fractures are complex fractures that are difficult to approach and treat. Almost one third of acetabular fractures is accounted for by posterior wall fractures in different series [1, 2]. Posterior wall fractures are relatively easy to access and fix as the approach is familiar to most surgeons. The displaced variety require open reduction and fixation to provide a painless, mobile and functional hip. Even after accurate reduction, nearly 30% are reported to have a poor outcome which are influenced by various factors like fracture type, chondral injury associated dislocation, femoral head status, intra articular fragments, duration of injury and associated injuries [3, 4, 5].
Comminuted fractures of the posterior wall have been reported to have a poor outcome as compared to a single large fragment due to a higher chance of osteoarthritis of the hip joint, AVN of the femoral head and heterotopic ossification even after satisfactory reduction.[3, 5] Depending on the fracture pattern, the choice of fixation has also varied from using only screws to spring or buttress plates in different studies [6, 7]. This study was conceptualized to depict the radiological and functional outcome of single fragment and comminuted posterior wall fractures fixed by open reduction and fixation by buttress plate and screws.

Materials and Methods
This study is a retrospective analysis of the patients with posterior wall acetabular fractures treated between Jun 2011 to Feb 2017 done at King George Medical University, Lucknow.

These fractures were classified as per the Judet and Letournel classification based on X-rays and CT images [8]. A total of 32 patients with posterior wall acetabular fractures were operated in this period. 27 patients were available having a follow up of at least one year with the inclusion criteria of an isolated posterior wall fracture of the acetabulum, age more than 18 years and who gave consent. Patients with other associated fractures of the acetabulum, open fractures and undisplaced fractures were excluded from the study.

Those patients associated with dislocation of hip were treated by closed reduction under General anaesthesia and were given above knee skin traction until surgery. Routine investigations and imaging including X ray–AP and Judet views and CT scan with 3D reconstruction was obtained for all patients.

These patients were divided into two groups–one with a single large fragment and the other with comminution. All patients were operated within 2 weeks of injury and were managed by ORIF by screws and buttress plate. The Kocher Langenback approach was used in all cases. No osteotomy of the greater trochanter was done for any patient.

Surgical Steps

A standard Kocher Langenback approach was used in all patients and the Pyriformis and Obturator tendons were identified and cut 2.5 cms from the point of insertion to avoid vascular insult.

The sciatic nerve was identified and protected by careful retraction and placing retractors under the obturator internus while maintaining the hip in extension and knee in flexion.

Fracture was identified and care was taken to preserve soft tissue attachments of the displaced fragments. Using a bone hook at the pyriformis fossa, longitudinal traction was applied and the hip joint was distracted and irrigated to look for intra-articular fragments. If found, they were removed using a blunt tipped curved Kocher's forceps. The quadratus femoris muscle was preserved in all cases by doing a sub muscular plating.

Any marginal impaction was elevated and the defect filled with bone graft from the greater trochanter. Posterior wall fractures were reduced anatomically with ball pushers and clamps and stabilized temporarily with Kirsches wires. This was followed by definitive fixation by inter fragmentary screws if needed and supplemented with recon buttress plates in all cases.

Closure done in layers in standard fashion and post-operative IV antibiotics were continued for 5 days followed by oral antibiotics till stitch removal. Post-operative above knee skin traction was given for 6 weeks only in patients with comminuted fractures. No prophylaxis was given for DVT or heterotrophic ossification.

All patients were encouraged to perform intermittent in-bed static quadriceps and ankle pump exercises starting on the second postoperative day. Hip and knee flexion exercises were also started by second post-operative day but were delayed for 4 weeks in patients with comminuted fractures. Toe touch weight bearing was allowed after 6 weeks and gradually progressed to full weight bearing at 12 weeks according to radiological union. All patients were followed up for a minimum of 1 year post operatively.

The reduction was evaluated using Matta's criteria based on Antero-posterior and Judet views on digital X rays and graded as anatomical (0–1 mm of displacement), imperfect (2- to 3-mm of displacement) or poor ([3-mm displacement).[9]

The radiological outcome at the final follow up was based on Matta's criteria–Excellent (Normal appearing hip joint), Good (Mild changes with minimal sclerosis and joint narrowing less than 1 mm), fair (intermediate changes with moderate sclerosis and joint narrowing less than 50%) and poor (advanced changes) [8].

At the final follow-up, functional outcome was evaluated using a modification of the clinical grading system developed by de'Aubigne´ and Postel [9, 10]. Avascular necrosis of the femoral head was classified according to Ficat and Arlet classification [11]. Heterotopic ossification was graded according to the classification by Brooker *et al* [12].

Statistical Analysis – The statistical analysis was done using SPSS version 21 and the results are expressed using averages and means. Spearman's coefficient and P value was used to assess the significance of the results.

Results

Of a total of 27 patients, the right acetabulum was involved in 15 patients and the left in 12 patients. The mean age of the patients was 37.7 years (18 – 70 years). There were 20 male patients and 7 females in our study. Road traffic accidents was the most common mode of injury in 21 patients (77.7%), followed by fall from height 5 (18.5%). Seventeen patients had comminuted fracture of the posterior wall while 10 patients had a single large chunk. Sixteen patients had an associated posterior dislocation of the femoral head at the time of presentation. Of these, 14 were reduced within the first 12 hours while 2 were reduced between 12 to 24 hours.

The associated injuries were present in eleven patients. Four patients had ipsilateral fracture shaft femur and 2 had fracture shaft tibia, 3 patients had associated head injury and 2 patients had rib fractures. The average time between time of injury and operation was found to be 6.2 days (3-14 days).

The average operative time was 73.2 mins (50 mins-120 mins). Intra-articular fragments were seen in 9 patients. The post-operative reduction was anatomical in 18 patients, good in 7 and poor in 2. The clinical outcome as per the modified Merle de'Aubigne score at the final follow up was found to be excellent in 12 (44.4%), good in 8 (29.6%), fair in 3 (11.1%) and poor in 4 (14.8%). The radiological outcome was evaluated as per Matta's criteria and was found to be excellent in 13 (48.1%), good in 5 (18.5%), fair in 4 (14.8%) and poor in 5 (18.5%).

Anatomical reduction was attained in 90% of the patients with a single large fragment and 64.7% in those with comminuted fractures. Sixteen patients (80%) of the patients with anatomical reduction had excellent or good outcome by the final follow up. Four patients, of which three had comminuted fractures had a poor outcome. (Table 1)

Table 1: Clinical outcome with respect to postoperative reduction achieved

	Reduction post op (as per Matta's)	**Clinical Outcome (As per Merle de'Aubigne Scoring)**			
		Excellent	**Good**	**Fair**	**Poor**
Single Large Fragment - 10	Anatomic (9)	7	1	1	-
	Good (1)	-	-	-	1
	Poor	-	-	-	-
Comminuted – 17	Anatomic (11)	5	3	2	1
	Good (5)	2	2	-	1
	Poor (1)	-	-	-	1

All patients with a single large fragment had an excellent or good radiological outcome by the final follow up. Six patients (41.2%) with comminuted fractures had fair or poor outcomes by the final follow up. (Table 2)

Five patients developed arthritis of the hip joint by the final follow up while one had superficial infection of the surgical site. No cases of post-operative sciatic nerve palsy were documented

Table 2: Radiological outcome with respect to postoperative reduction achieved

	Reduction post op (as per Matta's)	radiological Outcome (As per Matta's Scoring)			
		Excellent	Good	Fair	Poor
Single Large Fragment - 10	Anatomic (9)	8	1	-	-
	Good (1)	1	-	-	-
	Poor	-	-	-	-
Comminuted – 17	Anatomic (11)	4	2	2	1
	Good (4)	2	2	1	1
	Poor (1)	-	-	-	1

Table 3: Complications as noted by the final follow up

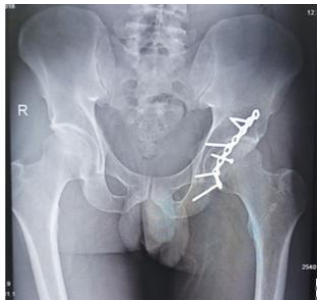
	No
Myositis ossificans (grade 1)	1
Avascular necrosis (grade 1 or 2)	3
Hip arthritis	5
Postoperative sciatic nerve palsy	0
Infection	1

Case 1

Fig 1: Pre-op

Fig 2: Post op

Fig 3: 6-month post op



Pic 4: 2.5 years follow up

Pic 6: Clinical photo at 1 year

Case 2

Fig 1: Pre-op

Pic 2: Post op

Pic 3: 6 months post op

Pic 4: 3 years follow up X-ray

Pic 5: Clinical photo at 3 years follow up

Discussion

Post-operative anatomical reduction was attained in all patients with single large fragments and in 91.3% of the patients over all. This was similar to the results of Magu *et al* and Ebraheim *et al* who reported anatomical reduction in 87% and 88% respectively. Gansslen *et al* [15] in their study on 137 patients achieved anatomical reduction in 96.3% of the patients. All patients in our study were managed by the same surgical unit regularly performing acetabulum fixations and it has been reported in literature that poor outcome and surgical complications are higher when performed by surgeons doing acetabulum surgeries occasionally. [9, 10, 5, 16, 17].

In our study, 16 patients (59.25%) had a concomitant fracture posterior dislocation of the hip which were all reduced within 24 hours and were given an above knee balanced skin traction after reduction till surgery. Magu and Ebraheim *et al* reported

associated dislocations in 72% and 62% of their patients respectively [3, 7] and QI Xin *et al* reported dislocations in 70.9% [13].

All patients in our study were managed by the Kocher-Langenback approach with minimum soft tissue dissection. Unlike Magu *et al* and Ebraheim *et al*, [3, 7] a trochanteric osteotomy was not required in any case of our study but still managed to achieve adequate reduction of fractures extending antero-superiorly by abducting the lower limb and allowing the gluteus medius muscle to relax.

All fractures in our study were fixed using a buttress plate and screws regardless of the type of fracture for better fixation and early post-operative rehabilitation, especially in single large fragments. Weight bearing was consequently delayed for patients with comminuted fractures. Supplementing screw fixation of single large fragments with buttress plate enabled earlier rehabilitation as compared to studies where only screws were used for fixation. [3, 7, 13, 14]

The functional outcome as per the modified Merle de'Aubigne score was excellent or good in 77% of the patients which included nine patients (90%) with a single large chunk and 12 patients (70%) with comminution. Letournel *et al* [2] reported excellent results in 82% of the patients with posterior wall fractures. Matta *et al* [9] had excellent results in 68% of their patient, while Ebraheim *et al* and Magu *et al* reported a satisfactory outcome in 74% and 77% of their patients respectively [3, 7]. As compared, Mistinois *et al* reported satisfactory outcome in almost 90% of patients with posterior dislocation of hip associated with posterior wall fracture of the acetabulum [6]. This variation in outcome is probably due to many factors including comminution of the fracture, associated dislocations and chondral injuries at the time of injury, other injuries and surgical specifics. Cases 1 and 2 as shown in the pictures are those with excellent clinical and radiological outcome by the final follow up.

The radiological outcome was assessed as per Matta's criteria and was satisfactory (excellent or good outcome) in 20 patients (72.5%) and fair or poor in 3 patients (11.7%). Our results were similar to those reported in literature with satisfactory results in 71% by Ebraheim *et al*, 72.7% by Hui Taek *et al* and 78% by Magu *et al* [3, 7, 18]. Mitsionis *et al* [7] found satisfactory radiological outcomes in almost 90% of their patients and concluded that the adequacy of reduction determines the long term surgical outcome in surgically managed posterior hip dislocations associated with posterior wall fractures. According to Spearman correlation analysis there is strong positive association between final radiological score and function results score. (p=<.05)

Amongst the 3 patients presenting with poor outcome, 2 patients had avascular necrosis of the hip and one had reported with severe early arthritis of the hip. Maintaining congruence of joint and stable fixation are paramount to preventing development of early arthritis. It was observed that five patients (18.5%) developed osteoarthritis in our study. By logistic regression analysis, post op reduction was identified as a prognostic factor for development of osteoarthritis. (pvalue<0.05). The reduction was not good in 4 out of 5 patients who eventually developed arthritis. Of these, three patients had features of early arthritis, while one had moderate and the other had severe arthritis as per the Kellgren and Lawrence classification. Magu *et al* [3] reported arthritis in 23% of the patients and also found association of arthritis to the presence of other associated injuries and a high BMI. We did not find any such co-relation in our study. In our study, the three patients who developed AVN of the femoral head also had posterior dislocation of the hip at the time of presentation. Two of these patients had comminuted fractures of the posterior wall. Even though reduction was done within 24 hours of presentation, they still went into avascular necrosis. Hence, delay in reduction and comminuted fractures, both hamper the blood supply of the femoral head increase the risk of AVN. The reported incidence of AVN in literature is around 10-15% [3]. Magu *et al* (11.3%) reported that these patients developed the complication within 3 years of surgery and thus should be followed very closely for a period of at least three years after surgery. Ebraheim *et al* [7] reported the incidence of Avascular necrosis of the femur head in one patient (3.1%) in his study whose reduction of the hip joint was done during surgery after 2 weeks. Case 3 shows a patient who presented with a comminuted fracture of the posterior wall and later developed avascular necrosis of the femoral head after 2 years

Giannoudis *et al* [9] reported that post-operative sciatic nerve palsies occur in approximately 27% of the patients with the peroneal component being involved most commonly. We, although, do not report any incidence of any nerve injury in our study. This was perhaps due to maintaining hip extension and knee flexion during surgery to identify and gently retract the nerve away from the operative field.

One patient was found to have superficial post-operative evidence of infection and was managed by debridement and IV antibiotic. No prophylaxis was given for heterotropic ossification and was eventually documented in 3 patients by the final follow up. This caused no limitations and therefore no treatment was given.

The strong points about our study are single surgical team, single institute and similar management protocol while the limitations are that it is a retrospective study with a limited sample size and follow up.

Conclusion

Open reduction and internal fixation with screw fixation along with neutralization plate is reliable method of treatment for single fragment as well as comminuted posterior wall acetabulum fracture and it allows early rehabilitation.

The post-operative reduction attained is directly related to the eventual clinical and radiological outcome and comminuted posterior wall fragment have less favorable result as compared to single posterior wall acetabular fracture.

Conflict of interest: none.

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