

Surgically Treated Isolated Posterior Wall Fractures of Acetabulum: A Short Term Outcome Study

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ABSTRACT:

BACKGROUND:

Isolated posterior wall fractures are common injuries of the acetabulum, anatomical reduction and stable fixation are the goals of operative treatment when indicated, outcomes of surgical treatment depend on many patient's and fracture's factors.

OBJECTIVE:

To evaluate the functional and radiological outcomes of surgically treated isolated posterior wall fractures of acetabulum and the effect of patient's and fracture's variables on the outcomes in a short term follow up.

MATERIALS AND METHODS:

Prospective study on twenty patient who met the inclusion criteria treated surgically for isolated posterior wall fractures of acetabulum at Baghdad Medical City Directorate from July 2014 to December 2016 with at least one year follow up. All patients were evaluated clinically with Modified Merle d'Aubigne score and Harris hip score, and radiologically with Matta's radiological outcome grading. The effect of gender, BMI, associated dislocation, timing of reduction of dislocation, timing of surgery, and quality of reduction on the outcomes were evaluated.

RESULTS:

The mean final Modified Merle d'Aubigne score was 15.65 (range, 8 to 18) with excellent and good results in 16 patient (80%), fair and poor results in 4 patients (20%). The mean final Harris hip score was 89.2 (range, 65 to 100), with excellent and good results in 16 patient (80%), fair and poor results in 4 patients (20%). The final radiological outcome results were excellent and good in 17 patient (85%), fair and poor in 3 patients (15%). The functional and radiological outcomes were significantly affected by the quality of fracture reduction ($p < 0.0001$, $p = 0.0009$) respectively. In addition, the functional outcome was significantly affected by the presence of dislocation ($p = 0.019$), delay in reduction of dislocation ($p = 0.0026$), and delay in surgery more than 2 weeks ($p < 0.0001$). However, gender, and BMI did not show clear effects on the functional outcome ($p = 0.938$, $p = 0.172$) respectively.

CONCLUSION:

Satisfactory outcomes can be obtained with open reduction and internal fixation of isolated posterior wall fractures of acetabulum in short term follow up. Anatomical reduction strictly correlated to both functional and radiological outcomes with favorable results. Early reduction of hip dislocation within 12 hours and early surgery within two weeks had favorable functional outcome while the presence of hip dislocation adversely affects the functional outcome. However differences in gender and body mass index did not clearly affected the functional outcome.

KEYWORDS: posterior wall acetabular fractures, Surgical treatment.

INTRODUCTION:

Acetabular fractures are infrequent⁽¹⁾, still isolated posterior wall fracture is the commonest among all it accounts for 20–35%⁽²⁾, they can result from high-energy trauma or even low-energy one in elderly⁽³⁻⁵⁾. The fracture anatomy

depends on the femoral head position during the injury as it works as a hammer for the acetabulum⁽⁶⁾.

Plain AP, Judet views and CT scan are all necessary imaging for assessment and classification of acetabular fractures and Judet and Letournel classification system is the commonly used one for these injuries⁽⁶⁾ (table 1).

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Table 1: Judet and Letournel classification of acetabular fractures

Elementary Fractures
Posterior wall
Posterior column
Anterior wall
Anterior column
Transverse
Associated Fractures
T - shaped
Posterior wall plus posterior column
Posterior wall with transverse
Anterior column or wall with transverse
Anterior column or wall with posterior hemitransverse
Both columns

Posterior wall fractures includes the posterior rim of acetabular and only the posterior articular surface, it is not seen on the medial articular surface⁽⁷⁾. Those fractures sometimes separate one or more segments and this comminution have an adverse effect on prognosis.

with posterior dislocation, fragments may be pushed into the underlying bone, this injury named as marginal impaction which adversely affects acetabular joint congruity during reduction and the fractures can superiorly extend and affect weight-bearing area⁽⁸⁾.

In general, nonoperative care is only indicated when the joint stability and congruency are acceptable⁽⁶⁾. While the goals of surgery if indicated are the restoration of articular cartilage and congruency, and rapid mobilization and painless hip function⁽⁹⁾.

Indications for operative treatment of posterior wall fractures includes displacement of more than 2 mm with affection of weight bearing region, femoral head instability, marginal impaction, fracture - dislocation which is irreducible and intra-articular fragments⁽¹⁰⁾. Usually the posterior Kocher-Langenbeck approach is used⁽⁶⁾.

A Modified Merle d'Aubigné score (MMDS) is a clinical hip score and currently is the most accepted clinical grading system for evaluating the outcome after an acetabular fracture, the score range is (4 to 18 points), the final grading regarded excellent if it's (18), good if it's (15-17), fair if it's (13-14), or poor if it's less than (13) points⁽¹¹⁾.

The Harris Hip Score (HHS) also used to assess results of hip surgery⁽¹²⁾, The domains covered are pain, function, absence of deformity, and range of motion. The score has a maximum of 100 points (best possible outcome), the higher the HHS, the less the dysfunction. A total score of 70 is considered a poor result; 70–80 is considered fair, 80–90 is good, and 90–100 is an excellent result⁽¹³⁾.

Matta's radiological reduction and outcome score assesses the reduction of fracture by measurement of residual gap, reduction is graded according to displacement, it's anatomical if (0–1 mm), imperfect if (2 to 3 mm) or poor if (>3 mm)⁽⁵⁾.

AIM OF STUDY:

To evaluate the functional and radiological outcomes of surgically treated isolated posterior wall fractures of acetabulum and the effect of patient's and fracture's variable factors on the outcomes in a short term follow up.

PATIENTS AND METHODS:

This is a prospective case series study conducted at Baghdad Medical City Complex, The Fracture and Orthopedic Surgery Department. Twenty patient surgically treated for isolated posterior wall fractures of acetabulum were included in this study over a period from July 2014 till December 2016. Last case included was followed for one year. A written informed consent provided to the patients willing to participate after being informed about the study.

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Inclusion criteria were; Patients with isolated posterior wall fracture or fracture dislocation indicated for surgery.

Exclusion criteria includes associated patterns fractures of acetabulum, patients with pelvic ring injuries, patients with open fractures, polytrauma patients, preexisting hip arthritis, femoral head fractures and patients operated after 3 weeks from initial trauma.

A total of 20 patients with isolated posterior wall fractures of acetabulum who fits the inclusion criteria and indications underwent open reduction and internal fixation by the same team, all patients had unilateral fractures.

In this study we considered variables including patient's factors as age, gender and body mass index, as well as fracture's factors as mechanism of injury, injury side, associated dislocation, time to reduction of dislocation, injury to surgery time interval, and postoperative quality of reduction. All those factors were documented during the work aiming at assessment of the results of the surgical treatment. Mean follow up period was (16.5) months (12-30 months) after index surgery. The last one included in this study was followed for one year after operation.

Patients in the study were either received from the emergency department of our center or referred from other centers, after assessment and stabilization, the sciatic nerve function was screened by physical examination and included patients sent for Anteroposterior and Judet 45° views of conventional x-ray in order to evaluate and classify the fracture type (according to Judet and Letournel classification) and document the associated dislocation if present and all patients were admitted to the hospital.

Patients with hip dislocation admitted immediately to the operating room and closed reduction of dislocation was done under general anesthesia. Skeletal traction with Steinmann pin in distal femur was applied (5-7.5 kg) for all patients.

CT scan with 3D reconstruction was performed for all patients and the percentage of posterior wall fracture was calculated and indication for surgery was documented.

Fractures involving 25%-50% of posterior wall, the stability was determined by dynamic stress fluoroscopic examination under general

anesthesia (EUA), the hip was flexed to 90°, rotated internally for 20°, and adducted maximally to determine the stability, if it was stable we proceed with conservative treatment and exclude the patient, if not open reduction with internal fixation was performed.

All patients received subcutaneous LMWH (Enoxaparin) 40 mg daily from the time of admission and stopped prior to surgery, prophylactic antibiotics in form of (ceftriaxone) 1g twice daily were used as well preoperatively, surgery was performed as soon as patients conditions permit, it's usually done within 5 days to 2 weeks except for patients with delayed presentation, but no surgery done after 3 weeks from injury.

Posterior Kocher-Langenbeck exposure was adopted in prone position for most of the patients and lateral decubitus position was used when trochantric osteotomy is indicated (fractures involving the dome of acetabulum). The sciatic nerve was identified and protected.

Posterior wall fractures were anatomically reduced and stabilized provisionally by K-wires, followed by definitive fixation with 3.5 mm cancellous lag screws and was buttressed with a 3.5-mm reconstruction plate, loose intraarticular bony fragments were removed under direct vision, when marginal impaction was present, the impacted cartilage was elevated and reduced to its anatomical position and cancellous bone grafting was used if necessary. For osteochondral fragments a lag screw or spring plate were used. Closed suction surgical drains were used for 24-48 hrs. Subcutaneous LMWH started again 8 hours after surgery and continued for 3 weeks, IV antibiotics continued for 3 days, then 5 days of oral antibiotics. Prophylaxis for heterotopic ossification used after surgery in a form of (Naproxen) 500mg twice daily for 3 weeks.

AP, Judet oblique radiographic views and CT scan with 3D reconstruction are requested to assess the quality of reduction according to Matta's radiographic criteria and postoperative reduction was graded.

One day after operation, the patients gradually encouraged to sit up in bed and passive range of motion exercises were started for quadriceps and hamstrings muscles, patients usually discharged

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home in the third day after surgery and informed to come back two weeks later.

Follow up:

After two weeks surgical stitches were removed, wound inspected for possible local signs of infection and patients encouraged to do passive and active muscles exercise and walking with aids without weight bearing.

Functional and radiological outcomes assessment were obtained at 3, 6, 9, and 12 months after surgery.

The final functional and radiological outcomes scores were reported for all patients and our results were obtained according to the final scores.

Outcome assessment :

At final follow up functional outcome of each patient was evaluated using the clinical scoring systems of Modified Merle d Aubigne Score (MMDS) and Harris Hip Score (HHS). The final follow-up radiographs of each patient were grade according to matta`s radiological outcome grading.

Statistical analysis:

The data of total 20 patient were collected and analyzed using the statistical package for social sciences (SPSS) Windows version 21. The values were expressed as average, mean, standard deviation (mean \pm SD), numbers and proportions (%), the effect of the variables on the functional outcome and inter-group differences were compared by using student t-test and p-value of less than 0.05 considered statistically significant, effect of reduction quality on radiological outcome was evaluated by using the Fishers exact test and p-value of less than 0.05 considered statistically significant, correlation between the scoring systems was found by using Spearman Rho correlation, the findings and results were

presented in figures and tables with an explanatory paragraphs.

RESULTS:

The 20 patient included in the current study were 18 (90%) males, and 2 (10%) females, age ranged from 20 to 55 years with a mean of (37.7 years). 12 patients (60%) had right side fractures and 8 patients (40%) had left side fractures. The mechanism of injury was motor vehicle accident (MVA) in 12 (60%), motor cycle accident (MCA) in 5 (25%) and 3 (15%) with fall from height (FFH).

BMI of the patients ranged from 20.8 to 34.2 kg/m² with mean (25.52 kg/m²), in 12 patient (60%) the BMI was < 25, and in 8 patients (40%) the BMI was > 25.

Posterior hip dislocation was found in 14 patients (70%), among those with dislocation 4 patients were delayed (>12 hours) till reduction of dislocation.

Injury to surgery time interval ranged from 5 to 21 days with a mean of (10.35 days), surgery was delayed > 2 weeks in 4 patients (20%), and the other 16 patient (80%) surgery was performed within 2 weeks. Anatomical reduction was observed in 17 patient (85%) and imperfect in 3 patients (15%).

The final Functional outcome obtained by (MMDS) and (HHS) scoring systems.

The MMDS gave a mean of (15.65), excellent in 8 patients (40%), good in 8 patients (40%), fair in 2 patients (10%), and poor in 2 patients (10%). The HHS gave a mean of (89.2), excellent in 13 patient (65%), good in 3 patients (15%), fair in 2 patients (10%), and poor in 2 patients (10%) (table 2).

The final radiological outcome by Matta`s radiological outcome grading, showed excellent results in 15 patient (75%), good in 2 patient (10%), fair in 2 patients (10%), and poor in 1 patient (5%) (table 2).

Table 2: results of functional and radiological outcomes

Garden	MMDS	HHS	MROG
Excellent	8 (40%)	13 (65%)	15 (75%)
Good	8 (40%)	3 (15%)	2 (10%)
Fair	2 (10%)	2 (10%)	2 (10%)
Poor	2 (10%)	2 (10%)	1 (5%)
Total	20	20	20

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The spearman Rho correlation coefficient between the two functional scores (MMDS and HHS) was $R=0.88$ (p value= 0.11), indicating close correlation and no statistical significance , and the correlation coefficient between MMDS, HHS and the radiological outcome grading of Matta's (MROG) were ($R=0.7$, $R=0.83$), ($P=0.29$, $P=0.16$), respectively, which indicating the clinical results were related

closely to radiographic results, and no significant differences. In this study the male gender represented by 18 patient, with a mean MMDS of (15.67), and mean HHS of (89.44), while there were only 2 female patients, their MMDS was (15.5), and HHS was(87), P value was (0.938), so the functional outcome not affected by the difference in gender (table 3).

Table 3: variables with mean results of MMDS, HHS and P values

Variables	Scores		*P value
	MMDS	HHS	
1- Gender	Average		0.938
Male	15.67	89.44	
Female	15.5	87	
	16.19	92.75	
3- BMI			
<25	16.25	91.5	0.172
> 25	14.38	85	
4- Dislocation			
Absent	18	98.33	0.019
Present <12hrs	*(16.2) 14.79	(90.2) 85.29	*(0.0026)
Present>12hrs	*(11.25)	(73)	
5-Time to surgery			
<2weeks	16.88	94.19	< 0.0001
> 2 weeks	10.75	69.25	
6-Qualityof reduction			
Anatomical	16.65	93	<0.0001
Imperfect	10	68	

Regarding the BMI, the mean MMDS and HHS of those had BMI < 25 kg/m² (12 patient) were (16.25, 91.5) respectively, and of those with BMI > 25 kg/m² (8 patients) were (14.38, 85) respectively, with a P value was (0.17) showing no significant effect of BMI on the functional outcome (table 3).

Posterior hip dislocation was found in 14 patient, their mean MMDS was (14.79), and their mean HHS was (85.29). Absence of dislocation was found in 6 patients, their mean MMDS was (18), and mean HHS was (98.33), the P value

was (0.019) indicating that the presence of posterior hip dislocation had adverse effect on the functional outcome. On the other hand, time to reduction of hip dislocation of more than 12 hours was found in 4 patients with mean MMDS and HHS of (11.25, 73) respectively, and time to reduction < 12 hours was found in 16 patients with mean MMDS and HHS of (16.2, 90.2) respectively, the P value was (0.0026), so delayed reduction of more than 12 hours had adverse impact on functional outcome (table 3).

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Surgery was performed in < 2 weeks in 16 patient, mean MMDS was (16.88), mean HHS was (94.19), delayed time to surgery > 2 weeks was observed in 4 patients, mean MMDS was (10.75), and mean HHS was (69,25), P value was (<0.0001), this means the delayed time to surgery had significant adverse effect on the functional outcome (table 3).

Postoperative quality of reduction was assessed by Matta's radiological reduction criteria, anatomical reduction was obtained in 17 patient, mean MMDS was (16.65), and mean HHS was (93), while imperfect reduction was observed in 3 patients due to comminuted posterior wall fracture with delayed surgery, mean MMDS was (10), and mean HHS was (68), P value was (<0.0001) (table 3).

The final radiological outcome of patients was assessed by MROG, and the results of quality of reduction on radiological outcome were as follows, patients with anatomical reduction (17 patient) was excellent in 15 patient, and good results in 2 patient, no fair or poor results, and those patients with imperfect reduction (3 patients) the results were, fair in 2 patients, poor in 1 patient, and no excellent or good results. By using Fishers exact test to show the effect of imperfect reduction on radiological outcome, the P value was (0.0009), indicating highly significant effect (table 4).

Imperfect reduction had highly significant adverse impact on both short term functional and radiological outcomes.

Table 4: quality of reduction with functional and radiological outcomes

Quality of reduction	postoperative quality of reduction	Final radiological outcome score (MROG)		Final functional outcome (MMDS)	
		Excellent + Good	Fair + Poor	Excellent and Good	Fair and Poor
Anatomical	17(85%)	17 (100%)	-	15 (88.23%)	2 (11.76%)
Imperfect	3(15%)	-	3 (100%)	-	3 (100%)
Total	20	16	4	15	5

Complications found in this study were, sciatic nerve palsy in 2 patient (10%), one recovered completely after 8 weeks from surgery with excellent outcome, and the other partially recovered with good functional outcome, Heterotopic ossification (HO) observed in 1 patient (5%) with good functional and radiological outcomes, avascular necrosis (AVN) in 1 patients (5%), with poor functional and radiological outcomes, post traumatic arthritis in 3 patients (15%), including the patient with AVN, one with fair both functional and radiological outcomes and the other one with poor functional outcome and fair radiological outcome. No infection, venous Thromboembolism, delayed union, nonunion or hardware failure were reported.

DISCUSSION:

Posterior wall acetabular fractures are intra-articular fractures⁽¹⁴⁾, and whenever indicated must be treated surgically aiming at anatomical reduction, pain free stable mobile hip⁽¹⁵⁾.

The outcome of surgery depends on different variables that can be "surgeon dependent" like timing of surgery, quality of reduction and fixation and factors that are "non-surgeon dependent" like the mechanism of injury, femoral head and sciatic nerve injury, age, comorbidities and others⁽¹⁶⁾.

Comparing the clinical and radiological results of this study to a nearly similar published results as those of Kim and his co-workers (2011)⁽¹⁷⁾, Magu et al. (2014)⁽¹⁵⁾, and Pantazopoulos and his colleagues (1993)⁽¹⁸⁾ - comparison - shows nearly similar outcome (table 5).

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Table 5: outcomes comparison with other studies.

Study	No. of cases	Functional outcome (excellent and good)	Radiological outcome (excellent and good)
Kim et al	33	60.6%	72.6%
Magu et al	25	76.9%	70%
Pantazopoulos et al	52	90.3%	92.3%
Present study	20	80%	85%

The prediction of post-traumatic osteoarthritis in posterior acetabular wall fractures largely depends on the "restoration of articular congruity with stable fixation", other studies added the "quality of reduction depending on the size of the gap or step" as a factor for prediction of osteoarthritis⁽¹⁶⁾.

Bhandari and colleagues (2006), in their retrospective study of 109 patients with posterior wall fracture dislocation found that the quality of fracture reduction is the only significant factor that affects clinical and radiological outcome as well as possible later osteoarthritis⁽¹⁹⁾, similar conclusion stated by Li et al (2014) in a study of 57 patient⁽²⁰⁾.

In this series the quality of reduction had a significant effect on the final outcome as all patients (n=3, 15%) who had imperfect reduction had fair-to-poor clinical score, and all of them developed post traumatic arthritis at final follow up.

Kreder et al. (2006) reported that anatomical reduction by itself was not enough to get proper clinical outcome, they stated that pattern of fracture, marginal impaction and residual displacement are all associated with possible later arthritic hip which indicates arthroplasty⁽²¹⁾. Timing of surgery proved to be vital in prediction of the surgical outcome and poor results to be expected if surgery performed more than two weeks after injury^(16,17,22), and this fact is well shown in the results of this study.

Different studies skipped the effects of hip dislocation and delay in its reduction, development of AVN of femoral head and sciatic nerve palsy on the functional outcome^(16,18,23). This series showed that the presence of dislocation and delayed time to reduction of more than 12 hours adversely affects the functional outcome.

Moed and his colleagues (2002) found that a delay of greater than 12 hours in the time to reduction of hip dislocation was an important risk factor associated with unsatisfactory results⁽²³⁾. Nearly similar findings seen by Meena and co-workers (2013) who found that hip dislocation has adverse effect on the final functional outcome; it not only threatens vascularity of the femoral head but also makes the surgical reconstruction of the fractures more challenging⁽¹⁶⁾.

Gender difference seems to be of less important in relation to final outcome of surgery^(11,16), the small sample (20) with only (2) females in this work make it difficult to assess the effect of gender.

Obesity has been shown to increase the rate of complications. Magu et al. (2014) revealed that BMI > 25 adversely affects the functional outcome⁽¹⁵⁾. In this work most of the patients was normal or overweight with no morbid obesity, with satisfactory functional outcome.

In a meta-analysis published in 2005 the incidence of heterotopic bone formation after acetabular surgery was 25.6%, meta-analysis revealed no difference between prophylactic treatment of heterotopic bone formation compared with no treatment⁽¹⁵⁾. The prophylactic use of naproxen is associated with lower complication rate compared to other NSAIDs as compared to indomethacin⁽²⁴⁾ which is associated with high non-union rate of long bone⁽²⁵⁾.

conclusion: In order to get the best possible functional and radiological outcomes in surgically treated posterior wall acetabular fractures they must be operated best within 2 weeks of injury with the best possible anatomical reduction and stable fixation. If its associated with hip dislocation, this must be reduced as soon as possible within the first 12 hours of injury.

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