Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Orthopaedic Surgery

Evaluation of Postoperative Outcome of Posterior Wall Acetabular Fracture in a Tertiary Level Hospital

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DOI: https://doi.org/10.36347/sjams.2025.v13i02.020 | **Received:** 28.12.2024 | **Accepted:** 03.02.2025 | **Published:** 15.02.2025

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Abstract **Original Research Article**

Background: Acetabular fractures are one of the most serious injuries treated by orthopedic surgeons. Among various types, posterior wall fracture is the most common. Open reduction and internal fixation is considered the best surgical treatment method for acetabular fractures and several studies shows satisfactory outcome following surgery. ***Objectives***: The objective of the study was to evaluate the functional and radiological outcome of surgically treated acetabular fractures. ***Methods***: 32 patients of posterior wall acetabular fracture were enrolled in this study, from January 2016 to September 2017 through non randomized purposive sampling. All the patients were between 18 to 60 years of age and operated within 21days of fracture. Postoperative functional outcome was assessed both clinically by modified Merle D' Aubigne and Postel criteria and radiologically by Matta criteria. Postoperative follow up was conducted at 2nd, 6th, 12th and 24th weeks. ***Results***: Excellent results were obtained in 19(59.4%) patients, good in 8 (25%), fair in 2 (6.3%) and poor results in 3 (9.3%) patients after functional evaluation. Radiological assessment revealed 26 (81.3%) hips had excellent radiographic view, 2 (6.3%) hips with good, 1 (3.1%) had fair and 3 (9.3%) had poor hip condition. Postoperative complications included avascular necrosis of femoral head in 3 (9.3%), iatrogenic sciatic nerve injury in 3 (9.3%) and wound infection in 2 (6.3%) patients. ***Conclusion***: The study showed surgery in posterior wall acetabular fractures leads good to excellent outcome in majority of the patients.

Keywords: acetabulum, posterior wall, fracture pelvis, AVN of Femoral head, hook plate, posterior dislocation of hip.

INTRODUCTION

Acetabular fractures, comprise considerable morbidity especially if not treated accordingly. The incidence of acetabular and pelvic fractures is approximately 2% to 7% of all fractures (Mucha and Farnell, 1984; Gänsslen, *et al*., 1996; Laird and Keating, 2005). Posterior wall fractures are the most common acetabular fractures and account for approximately 21% of acetabular fractures (Matta, 1994).

The most common injury mechanisms producing acetabular fractures are motor vehicle accidents (primarily dashboard injury) and fall from height. The associated injuries are common, sometimes even low-energy trauma, especially in the elderly, can lead to displacement of the joint surfaces of the acetabulum requiring operative treatment (Moed and Reilly, 2015).

From a historical perspective, Knight and Smith (1958) observed conflicting recommendations regarding the optimal care for a fracture of the acetabulum between 1950 and 1960. Both non-operative and operative treatment regimens were assumed to be useful. A number of studies has been done regarding outcome of surgical intervention in last 50 to 60 years. Among recent studies, Borrelli, *et al*., (2002) evaluated the effectiveness of surgical management of displaced acetabular fractures

on fifteen patients treated with a 2 Kocher-Langenbeck approach. At an average follow-up of 24 months, he evaluated patients both clinically and radiologically. These radiographic grades were given in contrast to achieving an anatomic reduction, and majority of the patients were graded as excellent to good.

The surgery is challenging and demanding even for the experienced surgeon, and has the potential for many serious complications. Many factors, including the patient's age, general medical condition and associated injuries, must be considered before making definitive management decisions (Parker and copeland, 1997).

Posterior wall is the most commonly and easily fractured and the most important for stability (Vailas, Hurwitz and Wiesel, 1989). It is a massive construction that can withstand great forces. But if the energy transmitted through the pelvis exceeds the holding power a fracture or disruption of the pelvic ring or an acetabulum fracture may result. Posterior dislocation of the hip is common with a posterior wall fracture. Complicating factors are sciatic nerve injuries, femoral head damage, impaction of joint surfaces as well as intraarticular joint fragments, etc. Avascular necrosis of the femoral head can be seen as an early as well as a late complication (Alonso, Kellam and Tile, 2015)

Untreated fracture can lead to several unacceptable conditions like pain, mal-union and joint incongruity, leading to rapid destruction of articular cartilage and ultimately to joint failure. Acetabular injuries are reconstructed with the goal of achieving a realigned and stable situation allowing bone and soft-tissues to heal properly, so the patient in the future will be able to bear weight on the lower extremities without pelvic pain or limp due to shortening (James and Edward, 2013).

Judet, Judet and Letournel (1964) set out to describe the radiographic findings in acetabular fracture patients and to outline plan of treatment. Their recommendation for operative treatment was based on 10 years of study and resulted from their disappointment with the results of conservative methods.

Further studies showed that to attain the best results, hip joint congruity and stability must be accompanied by an anatomic reduction of the displaced articular surface (Matta, 1996; Letournel and Judet, 1993). So, accurate reduction of the intra-articular fracture fragments is critical for a successful outcome. It has been stressed that in a displaced fracture this anatomic reduction is very difficult to obtain by closed means (Matta, 1994; Matta, Anderson and Epstein, 1986).

Thus, open anatomic reduction and internal fixation continue to serve as the mainstay in the treatment of displaced fractures of the acetabulum. No matter what the method, obtaining an excellent long-term result in the treatment of a fracture of the acetabulum is dependent on restoring a congruent and stable hip joint with an anatomically reduced articular surface. As has been noted, these treatment objectives have been well recognized for more than half a century. The achievement of these objectives are to minimize pain, prevent post-traumatic osteoarthritis and improve long-term functional outcome (Berton, Moed and Reilly, 2015).

It has generally been perceived that isolated fractures of the posterior wall have a good outcome. Moed, WillsonCarr and Watson (2002) had the best clinical results with a poor outcome in only 11% of patients with simple fracture of the posterior wall of acetabulum. 4 Kocher-Langenbeck is the recommended surgical approach for posterior wall fracture of acetabulum. This approach is used to obtain access to posterior structures directly, while anterior structures are addressed indirectly (Olson and Zlowodzki, 2015).

Clinical outcome and the post traumatic complications like arthritis or AVN have been shown to correlate with the accuracy of articular reduction and various other factors (Bhandari, Matta and Ferguson, 2006). Fracture reduction is easier and the results are superior when operative fixation is performed within 3 weeks of injury (Judet, Judet and Letournel, 1964; Johnson *et al*., 1994). A study conducted in National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, 15 patients with posterior column combined with posterior wall fracture and found 74% patients with good to excellent outcome. Further study with larger sample size was recommended (Ahmed, 2013). There is few data in our country regarding outcome following surgical intervention in posterior wall acetabular fracture.

MATERIALS AND METHODS

This was a descriptive analytical study. The study was conducted in the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), a tertiary level hospital situated in Sher -e-Bangla Nagar, Dhaka. The study was carried out during the period from January 2016 to September 2017. Radiologically proven cases of fracture of posterior wall of acetabulum were the study population. Purposive sampling (nonrandomized) according to availability of the patients and strictly considering the inclusion and exclusion criteria. Patients with following characteristics were included in the study: I. Between 18 to 60 years of age II. All sexes III. Fracture involving posterior wall of acetabulum. IV. Operated within 3 weeks of injury. Patients with following characteristics were excluded from the study: I. Open fractures. II. Pathological fractures. III. Fracture is more than 21 days old. IV. Patients with existing infection due to any other disease. In general, the surgical treatment of an acetabular fracture is not an emergency. A delay of 3

to 5 days is commonly allowed for evaluation of any underlying medical problems or associated injuries and for preoperative planning. Follow up was given at 2,6,12, 24 weeks after operation and after each follow up, necessary data were recorded in a structured follow up sheet for each patient. Postoperative assessment was done by plain x-rays, CTs, and 3-D CTs. However, we used x ray as main tool for radiological evaluation during each follow up according to Matta's reduction criteria and radiological scoring system for each patient. Functional evaluation was done by Modified Merle D' Aubigne and Postel scoring system.

RESULTS

The present study was carried out between January 2016 and September 2017 at NITOR, Dhaka. Total 32 patients of posterior wall acetabular fracture were selected. All the patients, after proper resuscitation and investigation, were treated by open reduction and internal fixation by reconstruction plate and screws and followed up. After an average of 6th month follow up for each patient, the following findings were compiled. All the relevant findings obtained from data analysis are presented in tables and figures.

Table I: Percentage distribution of the study population by age (n=32).

Age (in year)	Number of patients	Percentage (%)
11-20	2	6.3
21-30	13	40.6
31-40	8	25.0
41-50	2	6.3
51-60	7	21.9

Mean ± SD: 36.75±12.09 Range (Min-Max): (18-60)

Table shows distribution of patients by age. The highest number of patients was 13 (40.6%) were observed in 3rd decade. The lowest, 2 (63.6%) were observed in 2nd and 5th decade. The mean age was 36.75±12.09 years with range from 18 to 60 years.

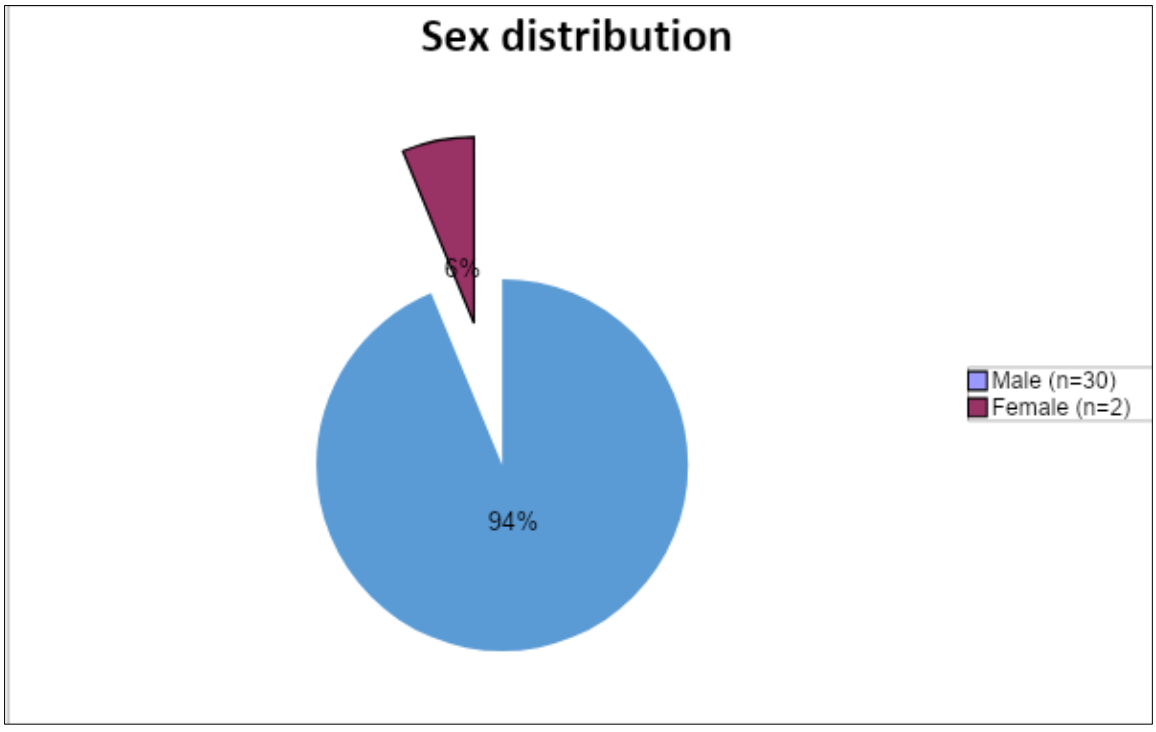

Figure I: Percentage distribution of the study population by sex (n=32)

Pie diagram showing the number of male patients were 30 (94.0%) and females were 2(6.0%).

In our study, out of 32 patients, 8 (25.0%) were service holder, 14 were businessman (43.8%), 1 (3.1%) housewife, 1 (3.1%) driver and 8 (25%) others.

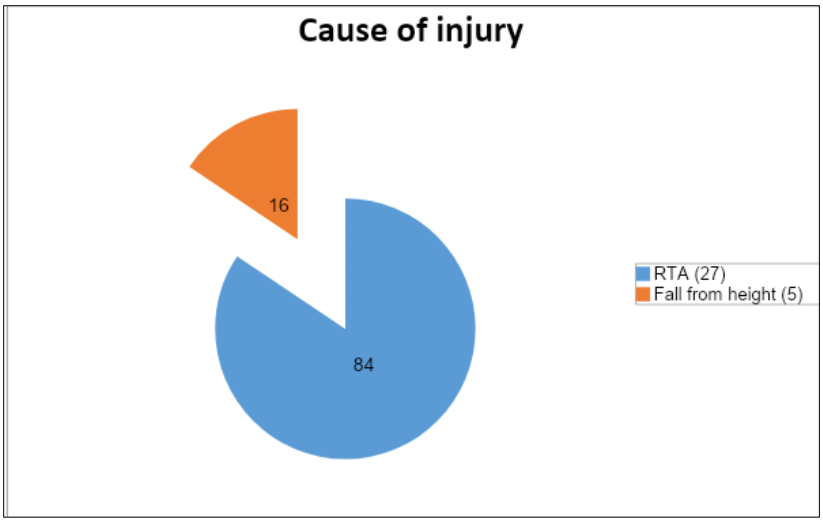

Figure II: Percentage distribution of study population by cause of injury (n=32)

Pie chart showing 27 (84.4%) fractures were caused by RTA and the rest 5 (15.4%) were due to fall from height.

Table II: Percentage distribution of the study population by associated injury (n=32).

Associated injury	Percentage (%)	Percentage (%)
Lower limb fracture	2	6.3
Upper limb fracture	1	3.1
Femoral head dislocation	8	25.0
None	21	65.6

Table shows that 8 (25%) patient presented with femoral head dislocation, 2 (16.7%) with femur fracture, 1 (8.3%) with upper limb fracture and 21 (65.6%) didn't have any associated injury.

Regarding the time interval between injury, 10 (31.3%) patients were operated within 7 days of injury, 18 (56.3) patients were within 8 to 14 days and 4 (12.5%) patients were operated between 15-21 days of injury. In our study, mean duration of hospital stay was 23.3±7.4 days with range from 12 to 35 days and most of the patients stay at hospital 22 to 28 days (50%).

Table III: Percentage distribution of the study population by post-operative complications (n=32).

Complication	Frequency	Percentage (%)
None	24	75.0
Sciatic nerve injury	3	9.3
Wound infection	2	6.3
AVN	3	9.3
Total	32	100.0

Table showing 24 (75.0%) patients had no complications, 3 (9.3%) had AVN of femoral head, 3 (9.3%) had sciatic nerve injury, 2 (6.3%) had wound infection.

Regarding the radiological assessment of hip joint 27 (8.4.4%) patients were normal, 2 (6.3%) had moderate, 3 (9.3%) had severe changes in affected hip joint.

Table IV: Percentage distribution of the study population by radiological score (n=32)

Radiographic score	Number of patients	Percentage (%)
Excellent	22	68.7
Good	5	15.6
Fair	2	6.3
Poor	3	9.3

Regarding the radiological scoring, excellent condition was present in 22 (68.7%), good in 5 (15.6%), fair in 2 (6.3%), poor in 3 (9.3%) patients.

Table V: Percentage distribution of the study population by functional outcome (pain), (n=32)

Pain	Number of patients	Percentage (%)
None	20	62.5
Slight/Intermittent	5	15.6
After walking but resolves	2	6.3
Moderately severe but patient can walk	0	0
Severe, with ambulation	1	3.1
Severe, prevents walking	2	3.3

This table demonstrates that most (62.5%) of the patients no pain, Slight pain present in 5 (15.6%), after walking but resolves in 2 (6.3%), severe pain with ambulation in 1 (8.3%), severe pain prevents walking in 2 (6.3%) patients. According to functional assessment of gait, it was observed that 21 (65.6%) of the patients had normal gait, 7 (21.9%) had limping but didn't use cane, 2 (6.3%) patients can walk long distance with crutch and 2 (6.3%) had limited movement even with support. According to functional assessment of range of movement 14 (43.8%) patients had 80- 94% movement, 4 (12.5%) had 70-79%, 3 (9.4%) had 60-59% range of hip movement. 11 (34.4%) patient had full range of hip movement.

Table VI: Percentage distribution of the study population by functional score (n=32)

Reduction	Frequency	Percentage (%)
Excellent	19	59.4
Good	8	25
Fair	2	6.3
Poor	3	0

Table above shows functionally 'excellent' patients are 19 (59.4%) in number. 8 (25%) patients were good, 2 (6.3%) patients were scored fair and 3 (9.3%) had poor functional status.

Table VII: Correlation between posterior dislocation of femoral head as an associated injury with AVN among the study population (n=32)

	Present	Absent
Posterior dislocation	8	24
AVN	3	29

Relative risk (RR): 2.67

Table above showing association of pre-operative posterior dislocation of hip and development of AVN later. It shows all 3 cases of AVN had posterior dislocation of hip during trauma. The calculated RR is 2.67, indicating higher chance of developing AVN in patients with posterior hip dislocation.

DISCUSSION

Acetabular fractures have the potential for a poor outcome regardless of the treatment method. The contributing factors may include an imperfect reduction, osteochondral defects in either the acetabulum or the femur at the time of injury, osteoarthritis, AVN of the femoral head, heterotrophic ossification, sciatic nerve injury and infection. (Briffa, *et al*., 2011)

The longterm results of any surgery are influenced by number of factors like fracture type, femoral-head status, injury duration, local complications associated with surgical approach and additional injuries and local soft tissue complications (Matta, 1996). Other factors which influence functional outcome include advanced age and delay in operative treatment (Merle d'Aubigne and Postel, 1954) and Brueton (1993). Deo, *et al*., (2001) pointed out that poor outcome is related to the use of extensile approaches and co-morbidity, such as obesity, osteopenia and a history of medical disorders. Our results were evaluated on the basis of both clinical and radiologic criteria and majority of the patients had a better outcome post-operatively.

In our study, 32 patients were included and majority of our patients were male (30), 93.8 %. This is due to the fact that most of these fractures result from high velocity trauma (RTA) thus males are more prone to these kinds of injuries in our setting.

In this study, the main mechanism of injury was road traffic accident (84 .4%) which was more often related to occupation and activities of young males. This was higher than other studies (about 56%) done by Matta (1996) and Giannoudis, *et al*., (2005).

In present study, the youngest patients were 18 years old, and the oldest was 60 years old. Geriatric age group (>60 years old) was excluded from this study as there is growing direction in the literatures to deal with this group as individual entity specifically. Mean age of our study was 36.3 years with most sample (40.6%)

within 21-30 years of age range. And age range 31-40 contains 25% of total sample. It is observed that active age group was mostly affected, probably due to being exposed to the environment filled with traffic and motor vehicles.

18 patients, which were 56% of the operated patient, were operated within 8-14 days of injury and 10 cases (31.3%) were operated within 7 days. In relation with complications, only 2 patients developed complication whom were operated within 7 days. 6 patients developed complications when operated after 7 days (75 % of total). Delay in reduction and definitive fixation of these fractures results in an increase in the formation of scar tissue between bony fragments and the formation of early callus at the fracture site. In these circumstances the surgeon will be faced with a more difficult exposure of less mobile fracture fragments which are more difficult to reduce (Mucha and Farnell, 1984). Delay in fixation may also be detrimental to the viability of the femoral head in cases of persistent subluxation. There is an increase in the incidence of both chondrolysis and osteonecrosis of the head with delayed reconstruction (Letournel and Judet, 1993).

Mean hospital stay of our study was 23.3±7.4 with range in between 12-35 days. Compared with other studies, Munshi, *et al*., (2015) showed mean hospital stay of 8.2 days with a range of 5- 12 days where Srestha, *et al*., (2014) showed average hospital stay 21 days with range of 2 to 42 days. There was no obvious data in previous studies regarding relation of hospital stay and clinical outcome of any patient. Duration of stay depends on patient load of the center as well as availability of resources.

The incidence of iatrogenic sciatic nerve palsy was found in 3 of our patients, which was 9.4% of total and all were gradually improving. There was no post traumatic nerve injury in any cases. Previous studies showed the incidence increased to about 40% to 60% when there was posterior dislocation of the femoral head this has been reported to occur. (Giannoudis, *et al*., 2005; Qadir and Bukhari, 2015). However, Helfet and Schmeling (1994) described in their study high incidence of sciatic nerve injury following acetabular fractures, to be around 29% and iatrogenic injury was around 5%. To avoid iatrogenic injury, Magu, *et al*., (2014) advised careful sciatic nerve retraction using fingers of free hand, not retractors. Thus expertise and being gentle to the soft tissue is the mainstay to avoid iatrogenic sciatic nerve injury.

Another complication was wound infection, which occurred in 2 patients representing 6.3% data of study population. All the patients had an extra articular infection, culture sensitivity was done and anti-microbial agents were used appropriately. Infection rate in present study was slightly higher than the 0-3% infection rate reported in studies of (Johnson, Matta and Mast, 1994; Liebergall *et al*., 1999). Kaempffe, Bone and Border (1991) described that Infection rate was lower where a simple approach and was higher when an extensive approach was used in acetabular fracture. We used Kocher- Langenbeck approach which is simple thus giving more or less similar statistical scenario comparing with previous studies. Although the incidence of infection has been reduced due to modern theatre facilities and aseptic measures, in developing countries its prevalence is still high and this may lead to increased antibiotic use, prolonged hospital stay, repeated debridement, change of infected implant, prolong rehabilitation, morbidity and mortality (Hickok and Shapiro, 2012).

Postoperative radiographs are important for evaluating the initial degree of articular congruency and to anticipate osteoarthritis, which may occur later on (Deo, *et al*., 2001; Giannoudis, *et al*., 2005). In the present study, 25 (78.1%) had excellent radiographic outcome at final follow-up. Matta, *et al*., (1986) reported 77% excellent or good radiographic outcome in a series of case study. We feel that the length of follow-up is critical for identifying some other complications like osteoarthritis.

In this study, 3 (9.4 %) patients developed early features of AVN. All of these case are associated with posterior dislocation of the femoral head. The rate of AVN has been reported to be between 3 and 10% (Matta 2011). Moed, WillsonCarr and Watson (2002) also showed nearly similar results in their study. Magu, *et al*., (2014) observed a series of patients for post-operative complication and found AVN in 11.53% patients. Yu, *et al*., (2004) evaluated the results of open reduction and internal fixation of displaced posterior wall and posterior column fractures of the acetabulum in 11 patients. All but the patient with AVN of femoral head had anatomic radiological reduction and good to excellent functional results. However, the pathophysiology of AVN has not been fully defined yet (Yue, *et al*., 2001). Vascular stretching and twisting during dislocation may contribute as well as local thrombosis and scarring leading to vascular compromise in femoral head (Shim and Shiku, 1979).

Heterotopic ossification was not seen in any of our samples. The rates of heterotopic ossification reported by various authors in acetabular fractures surpass 50% in some series (Bosse, *et al*., 1988; Routt and Swiontkowski, 1990). In a case series of 262 patients where no prophylaxis against heterotopic ossification was administered, reports a rate of heterotopic ossification as high as 82% (Matta, 1993). We administered indomethacin to all of our patients which is believed to decrease the rate of this complication. As our study has the limitation of up to 6 months follow up so we can't evaluate development of heterotrophic ossification in long term basis.

The quality of reduction is a critical factor which is dependent on the surgeon's expertise. So post-operative and the subsequent follow-up radiographs are important to assess degree of articular congruency and the hip joint appearance. Satisfactory reduction is dependent on the fracture type as well. (Routt and Swiontkowski, 1990; Matta, 1996). Mears, Velyvis and Chang (2003) described in their study that simple fractures could be reduced anatomically in 87% patients, while associated fractures had satisfactory reduction in only 59% of patients. Matta (2011) also observed similar results with satisfactory reduction in 96% of simple fractures and 64% in associated fractures. Qadir and Bukhari (2015) showed only 6% patients of posterior wall acetabular fractures had imperfect reduction. In present study, 2 (6.3%) patients had imperfect reductions and 30 (93.7%) patients had anatomical reduction. In case of posterior wall acetabular fractures, anatomical reduction is very much possible during ORIF as the column remains intact and only fragments of wall are to be realigned. So meticulous reduction technique and experienced surgical team is a factor.

In present study, all the samples were radiologically evaluated by Matta radiological criteria based on four factors- changes in the hip, narrowing of hip, presence of osteophytes and sclerosis. The overall results were expressed in final radiological score.

In this study, 22 (68.7%) patients had excellent radiological score, 5 (14.7%) good, 2 (6.3%) fair and 3 (9.6%) poor score. Nearly similar result was obtained by Qadir and Bukhari (2015), 94% of their study population had good to excellent results. Matta (1994) showed 77% good to excellent radiographic outcome. A Spanish study by Estrems-Diaz *et al*., (2012) showed no radiographic change in 52% cases yielding excellent result. Remaining 48 % had imperfect or poorly reduced radiographic outcome.

In this study, Clinical evaluation was done based on modified Merle D' Aubigne and Postel clinical criteria and evaluation of all three components (Pain, Gait and ROM) are accumulated to final scoring system. Outcome was excellent in 59.4%, good in 25%, fair in 6.3% and poor in 9.3%. Other studies had several outcome depending on different types of acetabular fractures. Most of the authors have reported overall good to excellent results in the range of 74-76%, (Chiu, *et al*., 2000; Deo, *et al*., 2001; Kumar, *et al*., 2005; Matta, 2011). Several studies found higher rates of poor outcomes and surgical complications for posterior wall fracture of the acetabulum when a surgeon only occasionally performed acetabular fracture surgery. For experienced surgeons, the incidence of fair or poor long-term results has ranged from 19% to 25%, while this was 55- 56% for inexperienced surgeons (Letournel and Judet, 1993; Mayo, 1994). Kaempffe, Bone and Border, (1991) and Wright, *et al*., (1994) believed that the severity of the fractures, the time required to become proficient at the surgery and experience of the surgeon were the main reasons for higher incidence of our good to excellent.

Several statistical tests were done to find out the relations among variables. Chi squire test and Fischer's exact test between functional and radiological outcome showed significant association. Several studies done in different timeframe by Matta (1994, 1996 and 2011) showed similar radiological outcome in comparison with clinical outcome. Our functional and radiological outcome had a strong association with associated injury during trauma as we did Chi Square test and Fisher's exact test and results were significant for both. The studies done by Moed, WillsonCarr and Watson (2002) also found strong association between posterior dislocation of femoral head and subsequent post-operative AVN. We found positive RR in between these two variables thus indicating strong relation of developing AVN among those who are being exposed or suffered posterior dislocation during trauma. Association between associated injury and as a whole all complication also revealed significant result by Chi Square test and Fischer's exact test, probably due to strong relation between AVN and associated injury discussed just above.

CONCLUSION

It is concluded that operative treatment of the posterior wall acetabular fracture leads good to excellent results in majority of the cases. So post-surgical outcome in this type of fracture is quite satisfactory.

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