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Operative Management of Displaced Acetabular Fractures: an Institutional Experience with a Midterm Follow-up

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SUMMARY

Background. Operative management is considered to be the treatment of choice in acetabular fractures as this is the unique way of achieving precise anatomical reduction, stable internal fixation, and early mobilization of joint. With this background in mind we undertook a prospective study with an aim to assess the outcome of surgery in displaced acetabular fractures at our general orthopedic centre as a first experience.

Material and methods. This study was conducted on 59 patients (45 Males, 14 Females) with mean age of 38.35 years (range 18-60 years) with displaced acetabular fractures who were admitted consecutively at our centre from May 2008 through November 2011. Nine patients (7 Male, 2 Female) were lost during follow up. The average follow up was 3.5 years (range 2-5years). Prophylaxis for deep venous thrombosis and heterotopic ossification was used routinely in all patients.

Results. Clinical evaluation was based on modified Merle-d'Aubigne and Postel scoring system. Radiological evaluation was done according to criteria developed by Matta. It was graded as excellent in 16% hips, good in 54% hips, fair in 20% hips and poor in 10% hips. Good to excellent results were achieved in 42 cases (70%). The complications included were implant backout, postoperative dislocation, iatrogenic nerve palsy, superficial wound infection, intraoperative bleeding and osteoarthritis. There is a positive relationship between quality of reduction and functional outcome. In our series, radiographic congruity (75%) correlated well with the function (70%).

Conclusions. 1. We conclude that operative treatment is a safe and effective method of managing displaced acetabular fractures even in general orthopedic centres. 2. Time spent on a thorough study of the radiographs/CT scan for a proper preoperative plan is worthwhile and helps to outline an appropriate surgical approach and avoid complications.

Key words: acetabular fractures, functional outcome, operative management

BACKGROUND

The treatment of displaced acetabular fractures is a complex subject. Nonoperative management, although traditionally used in the past, has been shown to give inferior results because of inability to restore joint congruity, hence increased incidence of early hip osteoarthritis.[1-3] Operative management is considered to be the treatment of choice in acetabular fractures as this is the unique way of achieving precise anatomical reduction, stable internal fixation, and early mobilization of joint [4,5]. However, acetabular surgery is not an easy undertaking because of complex operative anatomy. Also the outcome is dependent on many variables, including energy of injury, radiographic fracture pattern, residual intraarticular step, lost vascularity to femoral head, time of open reduction and internal fixation and choice of corrective approach [6-8].

The surgical management of these fractures involves a definite learning curve, best documented in a report by Matta and Meritt of first 100 acetabular fractures treated operatively by Meritt [9]. Long term result is directly related to the quality of fracture reduction achieved irrespective of which operative approach is used or fracture type is involved [2]. Pioneering work was done by Letournel and Judet in 1964 to develop a logical line of thinking regarding management of these fractures by systematically classifying the acetabular fractures [10].

At our general orthopedic centre, we started a prospective study on operative management of displaced acetabular fractures in 2008. During this period we saw all types of acetabular fractures. The purpose of this study is to assess results of operatively treated displaced acetabular fractures at our centre.

MATERIAL AND METHODS

We operated all displaced acetabular fractures admitted consecutively in our institution from May 2008 through November 2011. All fractures were operated by a Single Surgeon. The study group consisted of 38 male and 12 female patients with a mean age of 38.5 years. The criteria for inclusion in our study included age between 18 to 60 years, fracture displacement of >2mm, intraarticular fragment, posterior joint instability and independent ambulation before the injury. During the same period, many patients with acetabular and hip fractures were admitted at the authors' institutions. From these patients, 59 patients met these criteria and were included in this study. Nine patients were lost during follow-up. The remaining patients who were excluded from the study had bilateral acetabular fractures, acetabular fractures associated with proximal femur fractures, pathological acetabular fractures, previous ipsilateral hip fracture or hip surgery and significant co-morbidities. All patients gave written informed consent to be included in this study and the study was approved by local ethical committee of the institution. The study was conducted in accordance with the World Medical Association Declaration of Helsinki. Demographic profile of patients, Mechanism of injury, side involvement, associated injuries and type of fracture is given in Table 1.

After admission all patients were stabilized by advanced trauma life support protocol (ATLS).[11] Anteroposterior and Judet views of pelvis along with 3-D CT scans were performed in all patients. The fractures were classified according to Letournel and Judet classification [10]. The indications for surgery were assessed on the basis of Judet views and CT

Tab. 1. Details of patients included in the study

Mean Age(Years)	38.5
Gender(M/F)	38/12
Side involved (Right/left)	34/16
Type of Fracture	
Posterior wall	18
Posterior column	08
Posterior column +Posterior wall	NIL
Anterior wall	03
Anterior column	05
Transverse	05
T shaped	05
Transverse + Posterior wall	03
Anterior Column + Posterior hemitransverse	02
Both column fracture	01
Mechanism of injury	
Fall from height	32
Road Traffic Accident	18
Associated Injuries	
Chest Trauma	08
Fractures of Extremities other than Acetabular	24

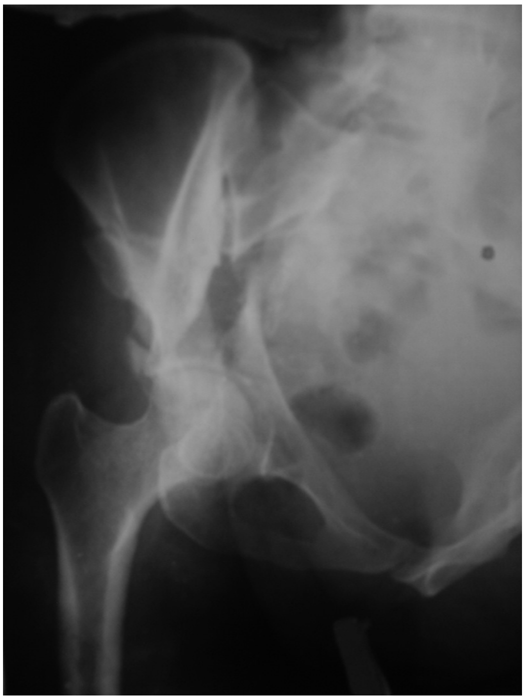

Fig. 1 Pre-operative anteroposterior radiograph of hip showing bicolumnar fracture

scan (Fig. 1). The surgery was performed through single or combined standard approaches, as per the fracture pattern and pre-operative plan. Prophylactic antibiotic (cefazolin) was given at the time of induction of anesthesia and repeated in the perioperative period if surgical time extended beyond 2 hours. Postoperatively indomethacin 75 mg in 3 divided doses daily was given for 6 weeks for prophylaxis

Tab. 2. Clinical grade criteria – Matta et al. 1996

A	**Pain**	**Grade**
	No pain	6
	Slight or intermittent	5
	After ambulation but disappears	4
	Moderately severe, permits ambulation	3
	Severe with ambulation	2
	Severe, prevents ambulation	1
B	**Ambulation**	
	Normal	6
	No cane but slight limp	5
	Long distance with cane/crutches	4
	Limited even with support	3
	Very limited	2
	Bedridden	1
C	**Range of Motion**^{P}	
	95-100%	6
	80-94%	5
	70-79%	4
	60-69%	3
	50-59%	2
	<50%	1

P :- expressed as percentage of the value obtained from the normal contralateral hip

Results were graded as:

Excellent	18 points
Good	15 - 17 points
Fair	13 or 14 points
Poor	<13

against heterotopic ossification [12]. Prophylaxis for thromboembolism was started once contraindication to the agent was ruled out and was continued post-operatively for 35 days. Ankle pumps, static quadriceps and static gluteal exercises were started on day one. Touch-down ambulation with support was started on 3rd to 4th day after surgery and full weight bearing was individualized.

The patients were followed up clinically and radiographically with all the three views at 6 weeks, 3 months, 6 months, 1 year and then yearly thereafter for 3 years and at final follow-up for the purpose of this study. X-rays were checked for implant position and heterotopic ossification formation. The functional results were evaluated by modified Merle – d'Aubigne and Postel scoring system (Tab. 2) [5]. This system has been generally accepted as the clinical grading system to evaluate results of acetabular fractures. Statistical evaluation was done by unpaired t test and p value of < 0.05 was considered statistically significant.

RESULTS

The mean follow up in our study was 3.5 years (Range 2 -5 years). The mean injury surgery interval was 7.8 days (range 3- 20 days). The majority of our patients were operated within 2 weeks of injury. The average surgical time was 160.25 minutes (range 90-330 minutes). The hospital stay averaged 14.95 days. Union time ranged from 3-5 months with an average of 3.92 months. There was no non-union reported in our study. The clinical results in patients with associated injuries were reported to be similar to those with isolated acetabular fractures in our study. The functional results of the displaced acetabular fractures correlate well with the quality of reduction in our study (Fig. 2,3). In our series, radiographic congruity 37 (75%) correlated well with the function 36 (70%) (Tab. 3,4).

The quality of reduction in our study decreased with the increase in the complexity of the acetabular fracture. Radiologically 90% i.e. 31 out of 34 of simple fractures and 37% i.e. 6 out of 16 of complex

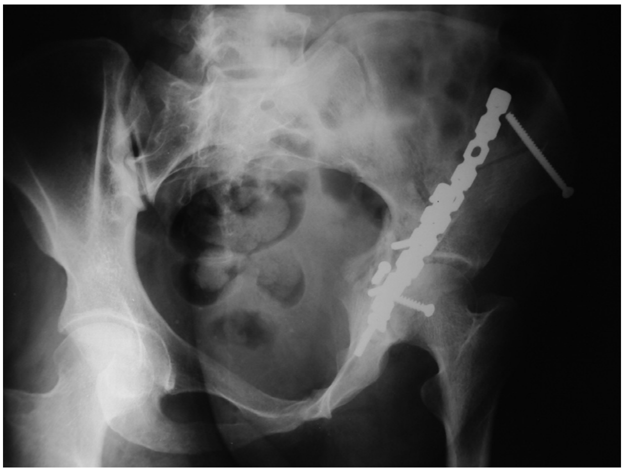

Fig. 2. Iliac oblique view showing fracture union after bicolumnar fixation

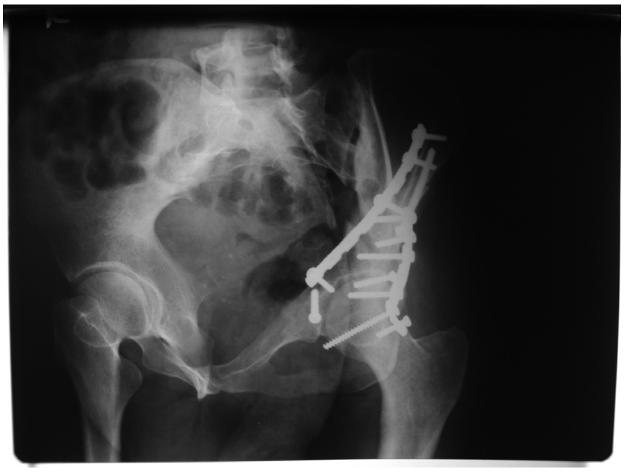

Fig. 3. Obturator oblique view showing fracture union after bicolumnar fixation

Tab. 3. Radiological Results

Results	PW 18	PC 8	AW 3	AC 5	TR 5	T 5	TR+PW 3	AC+PHT 2	BC 1	TOTAL 50
Congruent	15	8	3	5	3	0	0	2	1	37
Non-Congruent	3	0	0	0	2	5	3	0	0	13

Tab. 4. Functional Results

Results	PW (18)	PC (8)	AW (3)	AC (5)	TR (5)	T (5)	TR+PW (3)	AC+PHT (2)	BC (1)	TOTAL 50
Excellent	3	3	0	0	0	0	0	2	0	8
Good	11	5	3	3	5	0	0	0	1	28
Fair	4	0	0	0	0	3	3	0	0	10
Poor	0	0	0	2	0	2	0	0	0	4

fractures had congruent reduction. Correlating well with the congruity 90% of simple fractures and 37% of complex fractures had excellent/good function. Overall, 72% i.e, 36 out of 50 of our patients had excellent/good results (Matta Score ≥15). The mean functional score in patients with radiographic congruity was 16.22 as compared to 12.46 in patients with radiographic incongruity which was statistically significant with a p value of < 0.0001 (Tab. 5).

Six patients had sciatic nerve palsy preoperatively. Four patients recovered partially, two patients did not recover at final follow-up. Later they required foot drop splint during mobilization. Two patients got iatrogenic nerve palsy (lateral cutaneous nerve of thigh) in an anterior ilioinguinal approach. Intra-articular penetration of screw was reported in one patient in our series. The patient was not able to bear weight after 8 weeks of follow up and a CT scan was advised which showed intra-articular penetration of screws. The patient was lost to follow-up and did not report for further intervention.

One patient had implant backout. There was hardware backout from the anterior column about 3 months after fracture achieved union. The patient was having mild hip pain and was managing her activities of daily living. Four patients developed superficial wound infection which was managed with antibiotics and daily dressing without further problems. One patient developed intra-operative bleeding which was managed with compressive sponges and multi-

Tab. 5. Statistical correlation of functional outcome in congruent and incongruent reduction groups

Group	Congruent Reduction Group	Incongruent Reduction Group	P Value
Mean Functional Score	16.22	12.46	< 0.05 (statistically significant)
SD	1.53	1.45	
SEM	0.25	0.40	
N	37	13	

SD= standard deviation; SEM=standard error of mean; N = Number.

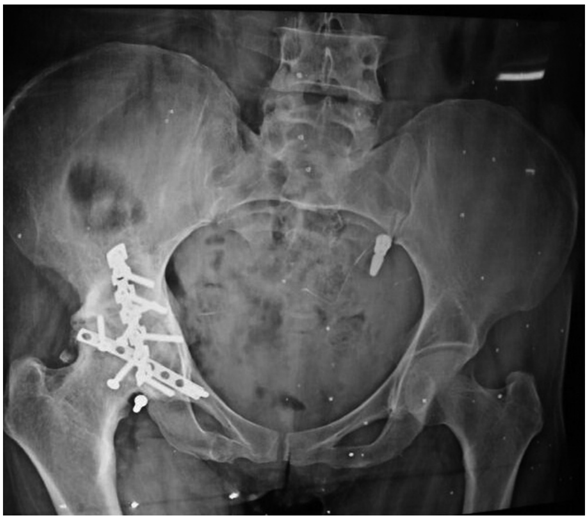

Fig. 4. Anteroposterior radiograph of pelvis showing osteoarthritis of hip with implant backout three and half years after fracture union

ple transfusions. AVN was seen in none of the cases. Eighteen patients had post-traumatic osteoarthrosis of the hip (Fig. 4), 13 had incongruent reduction on postoperative radiographs with poor reduction as per Matta's grading. Two of them developed shortening of 1 to 1.5 cm. Two patients developed post-operative dislocation which was managed with supplementary traction for 4 weeks. None of our patients had any associated bladder or urethral injuries.

The post-operative radiographs were assessed for adequacy of reduction. It was graded as excellent in 16% hips, good in 54% hips, fair in 20% hips and poor in 10% hips. Good to excellent results were achieved in 42 cases (70%). At the final follow-up, 42 patients were walking independently of any walking aid, 8 were walking full weight bearing with the help of a walking stick.

DISCUSSION

The management of displaced acetabular fractures is a challenging task for the general orthopedic surgeon. Being relatively uncommon, the average orthopedic surgeon never gains wide experience with them. Also, lack of technical expertise and inadequate infrastructure in the developing world further complicates the management. This work was unique in that acetabular fractures were managed mostly conservatively (with the exception of posterior wall fractures) in our hospital irrespective of fracture configuration. Hence, this is our first experience with operative treatment of all displaced acetabular fractures. Also, the experience in this series confirms the learning curve of Matta i.e. accuracy of fracture reduction is dependent on the experience of operating surgeon [9].

Operative reduction and internal fixation will lead to better functional outcome in displaced acetabular fractures [13,14]. It is an accepted fact that functional results of displaced acetabular fractures correlate well with the quality of reduction and that open reduction is the best method to achieve congruity [2-3,5,13,14-16]. Overall, 72% of our patients had excellent/good results. Matta reported good to excellent outcome in 76% in a series of 262 displaced fractures [5]. They also concluded that good to excellent outcome was related to anatomical reduction demonstrated radiographically. In our series also, radiographic congruity (74%) correlated well with the function (72%). Non-congruent reduction was shown to be the main cause of unsatisfactory results as was seen in a series by Rahimi H et al [17].

Fall from height as a mechanism of injury contributed to 64% of fractures in our series in contrast to other series [5,18] as most of our patients were from rural areas.

The posterior wall and posterior column constituted a major portion of acetabular fractures, which includes 26 cases (52%) which is comparable to other studies [19-20].

In our study all the patients achieved union of fracture by 5 months. Union time ranged from 3-5 months with an average of 3.92 months. There was no non-union reported in our study; our study is thus consistent with the study of Helfet and Schmeling (1994) who also reported no non-union in their series of 127 surgically treated acetabular fractures [21]. Matta (1986) also did not find any non-union in his series of 259 acetabular fractures [2].

The quality of reduction in our study decreased with the increase in the complexity of the acetabular fracture. Radiologically 90% i.e. 31 out of 34 of simple fractures and 37% i.e. 6 out of 16 of complex fractures had congruent reduction. This is because of the reason that we had a gradual learning curve in approaching complex fractures and used a single approach during the initial phase of our study to reduce complex fractures. Although no approach is ideal, as Letournel stated, combined approaches provide better exposure and allow the surgeon to reduce fragments of both the columns accurately and accomplish more rigid fixation [19]. Patients with complex fractures had good to excellent function correlating well with the congruity in our series; however, overall clinical results were inferior in complex fractures as compared to simple fractures in our series as also demonstrated by Gupta et al [22].

We did not report any avascular necrosis of femoral head in our series and we believe that exact assessment of aseptic necrosis could only be done after a longer follow up. We had iatrogenic lateral cutaneous nerve palsy in two patients but none of the patients had permanent dysesthesia in the distribution of the lateral femoral cutaneous nerve at the time of final follow-up.

18 patients had arthrosis at the time of final follow-up. Most of them were functionally good at final follow-up. 13 of them had incongruent reduction in the postoperative radiographs. Gradual decrease of clinical function may occur with appearance or progression of arthritic changes in some more groups of patients over a longer period of follow up. We presume that radiographs are inadequate for assessment of postoperative reduction although functional outcome may correlate with radiographic assessment over a short period of follow-up. Moreover computed tomography may be advisable to assess the exact amount of congruent reduction in the postoperative

period and may predict long term function of the hip. However, secondary procedures in these hips must be delayed [19].

The Kocher-Langenbeck approach was used for posterior wall and/or column fractures and the ilioinguinal approach was used for anterior wall and/or column fractures. However, both column displaced fractures were approached by an extended iliofemoral approach in few of our patients and a combination of the Kocher-Langenbeck and ilioinguinal approach in single stage in most of our patients. We found that combining the anterior (ilioinguinal) and posterior Kocher-Langenbeck approaches for complex acetabular fractures provides better fracture exposure and less postoperative morbidity as compared to extended iliofemoral approach as was also concluded by Harris et al [23].

In our series, we did not report any heterotopic ossification even in patients in whom extended illofemoral approach or Kocher Langenbeck approach was used. The incidence is much higher in patients treated operatively and has been reported between 18 and 90% [24-27]. However, when heterotopic ossification is defined as significant bone formation that limits motion by greater than 20%, the overall incidence is 7% [24]. We routinely used indomethacin for 6 weeks as a prophylaxis in our patients.

Traumatic nerve injury has been reported to occur in 10-13% of the cases, most frequently involving the peroneal division in our series, traumatic sciatic nerve palsy was found in six patients (12%) of posterior wall fractures [4]. All had perioperatively intact sciatic nerve and four had partial recovery at the end of 2 years. Two of them did not recover at all. We did not report any significant iatrogenic sciatic nerve palsy because the nerve was always exposed from sciatic notch to gluteus maximus insertion besides taking all other recommended precautions [8].

CONCLUSIONS

1. We conclude that operative treatment is a safe and effective method of managing displaced acetabular fractures even in general orthopedic and less established centres.
2. Our series of operatively treated acetabular fractures showed that adequate reduction can be achieved in a good percentage of fractures. This illustrates the high rate of success possible even in less established centres and confirms the place of operative management of displaced acetabular fractures, though the surgical approaches of this region are complicated and fracture configuration is often complex, satisfactory result is achievable in the majority of cases.
3. The quality of reduction is significantly affected by surgical lag. The aim should be to achieve anatomical reduction for the best possible functional outcome for the patient. The surgeon should prepare well for the problems such as prolonged operating time and increased blood loss.
4. Time spent on a thorough study of the radiographs and a proper preoperative plan is worthwhile and helps to outline an appropriate surgical approach and avoid complications.

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