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A PROSPECTIVE STUDY ON RADIOLOGICAL AND FUNCTIONAL OUTCOME OF UNSTABLE DISPLACED ACETABULAR FRACTURES TREATED BY OPEN REDUCTION AND INTERNAL FIXATION

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Abstract

We reviewed the radiological and functional outcome of open reduction and internal fixation of 18 unstable acetabular fractures in our institution from July 2009 to November 2011. Pre operative evaluation was done with Letournel and Judet views, Axial CT scan and 3D reconstruction scans. The factors affecting the radiological and functional outcome of surgically treated patients were analyzed. The anatomical reduction is found to be the most important and consistent factor affecting the outcome.

The relationship between the factors such as age, initial displacement, associated injuries, and the time interval between injury and surgery were also evaluated. The radiological outcome was assessed using Matta's criteria while the functional outcome was assessed using Merle d' Aubign and Postel modified score. The post operative fracture reduction as measured on the three plain radiographs were graded as anatomical in 7(39%), imperfect in 6 (34%) and poor in 5(28%) cases. The functional outcome which was evaluated with Merle d' Aubigné' and Postel modified score was found to be excellent in 4 patients, good in 6 patients, fair in 4 patients and poor in 4 patients.

The radiological outcome was strongly associated with the functional outcome (p=0.0044) which strongly supports the point that achieving anatomical reduction is the most important aspect. The findings in our study

suggest that the achievement of anatomical reduction is the most important factor affecting the outcome. None of our patients had iatrogenic nerve injury. We encountered complications such as infection (3 out of 18), posterior dislocation of hip (1 out of 18) and plate breakage (1 out of 18).

To conclude, it involves a long learning curve and the treatment should be done in a specialized tertiary care centre which has a specialized team for managing the acetabular fractures. The goal of the surgical treatment should be to produce a functional mobile painless joint that continues to function till the rest of life for the patient.

Keywords: Acetabular fractures, anatomical reduction, Letournel and Judet views, Kocher Langenbeck, posterior wall.

Introduction

The incidence of acetabular fractures is on the rise with the increase in the high velocity road traffic accidents. Fractures of the acetabulum occur by impact of the femoral head with the acetabular articular surface. The pattern of the acetabular fractures depends on the position of the hip at the time of impact as well as the location and direction of originally applied force

Judet and Letournel recommended operative treatment for fractures that involved the weight bearing dome of the acetabulum as the results from conservative treatment were disappointing¹. The subsequent studies by Letournel and Judet and Matta² emphasized anatomical reduction (less than 2mm of displacement) of fracture fragments was necessary to attain best results with hip congruity and stability.

Aim

To assess the radiological and functional outcome of unstable displaced acetabular fractures treated by open reduction and internal fixation. The goal of the surgical management of acetabular fractures is pain free motion and stability to permit vocational and day to day activities without the propensity for future degenerative changes.

Materials & Methods

In our institution we have selected cases of unstable acetabular fractures. It is a prospective study done from July 2009 to November 2011. The age group varied between 18-60yrs among them 13 males and 5 females, right side was involved in 10 cases and left side in 8 patients. Mean follow up was done for 8 months. All fractures have been classified by Letournel and Judet classification^{1,3}. All the cases

were followed up and were analysed for radiological and functional outcome. The radiological outcome was evaluated with X-ray pelvis AP view, Obturator oblique view and Iliac oblique views². The functional outcome was evaluated with Merle d'Aubigne and Postel modified clinical grading system⁴.

Mode Of Injury

Road traffic Accidents: 17

Accidental fall from height: 1

Associated Injuries

Out of 18 cases 8 cases have associated injuries. Pelvic ring fractures were present in 4 patients. Extremity fractures were present in 4 patients. Bladder injury was present in one patient.

Most of the pelvic ring fractures were managed conservatively. Extremity fractures were managed open reduction and internal fixation mostly as staged procedures. One case of bladder rupture was managed with bladder repair and suprapubic cystostomy

Exclusion Criteria

- Age - < 18 yrs and > 60 yrs
- Non displaced & minimally displaced fractures (<2mm displacement in the weight bearing dome)
- Roof Arc angle >45°
- No femoral head subluxation on 3 views taken out of traction
- Secondary congruence in displaced both column fractures
- Highly comminuted fractures

Operative Treatment

Indications

- Fractures involving >50% of articular surface

- Displacement of >2mm in weight bearing dome
- Roof arc angle⁵ – Medial roof arc <45°
Anterior roof arc <50°
Posterior roof arc < 60 °

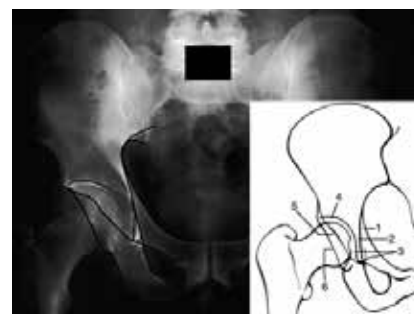
Timing of surgery

The surgery should be performed ideally in 5-7 days. The surgery must be performed within 3 wks to achieve a better result. Anatomical reduction becomes more difficult after that time because hematoma organization, soft tissue contracture, and subsequent early callus formation hinder the process of fracture reduction, especially if more limited Kocher Langenbeck or Ilio inguinal exposure is used⁶.

Pre-Operative Planning

X-ray Pelvis with both hips AP view, Obturator oblique view and Iliac Oblique view was taken in all the patients. The following to be taken into consideration in AP view⁷:

1. Superior channel, the arcuate [Iliopectineal line] – Anterior column
2. Ilioischial line – Posterior column
3. Roengenographic 'U'/Teardrop
4. Roof of the acetabulum
5. Anterior lip
6. Posterior lip



In CT Scan Axial view, the following should be assessed

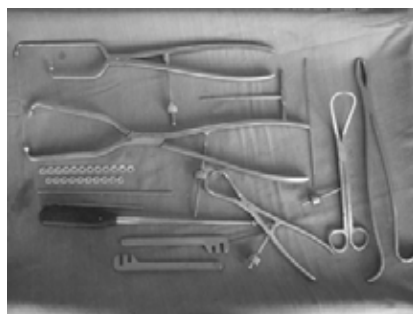
1. Extent and location of acetabular wall fractures
2. Presence of intra articular free fragments / injury to femoral head
3. Orientation of fractures lines
4. Identification of additional fracture lines
5. Rotation of the fracture fragments
6. Status of posterior pelvic ring
7. Marginal impaction (defined as the depression of articular surface of joint)

Time Interval Between Injury And Surgery

Total of four patients were operated between 3 to 7 days. Nine patients were operated between 7-14 days. Five patients were operated between 14-21 days.

Implants And Instruments

- 3.5 reconstruction plates
- 3.5mm cortical screws of various sizes
- 2.7mm long drill bit
- 3.5 mm screw driver
- 1.6mm k-wires
- Farabeuf clamp
- Pointed reduction clamps
- Ball tipped reduction spike
- 4mm Schanz Pin



Anaesthesia

Spinal anaesthesia was used in all

the patients

Position

Three positions were used for surgery. Twelve patients were operated in lateral position. Three patients were operated in prone position and three patients in floppy lateral position.



Prone position



Floppy lateral position



Lateral position

Surgical Approach

The choice of surgical approach is determined by the fracture pattern, the elapsed time from injury, the magnitude and location of maximal fracture displacement. A single surgical approach is generally selected with the expectation that the fracture reduction and fixation can be completely performed through the one approach and which was determined

by the amount of displacement of each column and the degree of superior articular surface involvement at each limb of the fracture^{3,5,8}. Also, as extensile/ two approaches result in higher morbidity like skin necrosis, infections and myositis ossificans, single approach is preferred^{5,9}.

Kocher Langenbeck approach was used in fifteen patients. Iliofemoral approach was used in three patients.

Surgical Technique

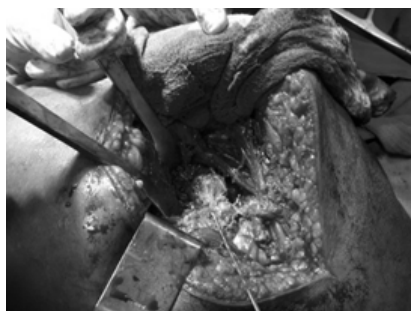
After exposing the fracture site, the fracture configuration was verified with C-arm. The fracture fragments were reduced using special clamps and Ball tipped spikes. K-wires (1.6mm) were passed to maintain the reduction. Lag screw fixation with 3.5mm cortical screws was done. Buttress plating was done using contoured 3.5mm reconstruction plate. If lag screw fixation was not possible, fracture was reduced and fixed with contoured 3.5mm Reconstruction plate.



Kocher Langenbeck approach



Posterior wall fragment exposed



Provisional Reduction and Fixation with K-wire

Image Intensifier

All but three cases were operated with the help of Image intensifier (due to technical snag).



C Arm Picture Showing Per Operative Reduction of Fragments



C Arm Picture Showing Per Operative Reduction and Plate fixation

Postoperative Care And Rehabilitation

Prophylactic intravenous antibiotics were used in all cases for 7 days. Closed suction drain was used in all cases. Suction drain was removed on Day 2 and EOT was done on Day 2.

Suture removal was done on 12th POD. Deep venous thrombosis prophylaxis was not used as a routine in our study. Indomethacin 25mg TDS from II POD to 6 weeks post operatively was given as a prophylaxis against Heterotrophic ossification¹⁰.

The patients were mobilised as soon as tolerated. They were made to sit up on first POD and they were

subsequently made to perform physical therapy for muscle strengthening and active range of motion exercises. Partial weight bearing in the form of toe touch walking with walker/crutches was started at 6 weeks and was maintained up to 12 weeks. This was also individualised as dictated by other injuries of the patients. Full weight bearing was started at 3 months time. Physical therapy was continued until range of motion and muscle strength was regained.

Post – Operative Follow Up

Post-operatively all the patients were assessed with plain X-rays AP view, obturator oblique view, and iliac oblique view to assess the fracture reduction. Serial radiographs [all the three standard views] were scheduled at two weeks, 3 months, 6 months, and one year.

Radiological Assessment

Intraarticular congruity (<2mm) remains the most clinically significant radiological parameter regarding the functional outcome & degenerative changes.

The radiographs were assessed by the criteria described by Matta². A grade of excellent indicates a normal appearing Hip joint; good denotes mild changes with minimal sclerosis and joint narrowing (<1 mm); fair indicates a intermediate changes moderate osteophytes moderate (less than 50%) narrowing of the joint and moderate sclerosis; and poor indicates advanced changes, large osteophytes, severe (more than 50%) narrowing of the of the joint, collapse or wear of the femoral head and acetabular wear.

The reduction of the fracture was evaluated by measuring the residual post operative displacements on the three plain radiographs. The reduction

was graded as anatomical (0-1mm displacement), imperfect (2-3mm of displacement), or poor (>3mm of displacement)

Reduction	Cases	
	No	%
Anatomical	7	38.9
Imperfect	6	33.3
Poor	5	27.8
Total	18	100

The reduction was anatomical in 38.9% of the cases. Imperfect and poor reductions were seen in 61.1% of cases.

Functional Outcome

The functional outcome was assessed with the Merle d' Aubigne' and Postel modified score which assessed the pain walking and the range of motion with each component carrying 6 points. The results were graded as Excellent (18), Very good (17), good (15 or 16) fair (13 or 14), Poor (<13)⁴.

Merle D' Aubigne and Postel Modified Score

Merle D' Aubigne and Postel Modified Score	Cases	
	No	%
Excellent	4	22.2
Good	6	33.3
Fair	4	22.2
Poor	4	22.2
Total	18	100

55.5% of the cases had excellent and good scores and the remaining 44.5% had fair and poor scores.

Additional factors which were taken into consideration to assess the possible associations with the functional outcome were age of the patient, fracture pattern, posterior dislocation, and time interval between injury and fracture fixation

Results

In our study 18 patients with unstable displaced acetabular fractures

were included and were treated with open reduction and internal fixation. The total number male and female patients were 13 and 5 respectively. The gender did not have any relationship with the radiological or functional outcome. The mean age in our study was 32.3 years. The age of the patient was not associated with accuracy of reduction in our study.

The post operative fracture reduction as measured on the three plain radiographs were graded as anatomical in 7(39%), imperfect in 6(34%) and poor in 5(28%) cases.

The mean initial displacement in our study was 17.9mm. The quality of fracture reduction was strongly related to the initial displacement which was statistically significant

The mean interval between injury and surgery in our study was 10.8 days. The accuracy of reduction was not found to be statistically related with the timing of surgery. This may be due to the fact that all the patients in our study were operated within 3 weeks of the injury.

The fracture pattern was simple in 11(61.1%) patients and associated fracture types were present in 7(38.9%) patients. The reduction and the fracture pattern were not found to be statistically significant.

The associated injuries were present in 8(44.5%) patients. The fractures of the extremities were present in 4 patients who were managed with interlocking intramedullary nailing. The intra abdominal injury (Bladder rupture) was present in one case for which bladder repair was done by urologists. The sciatic nerve injury was present in one case which is improving. The presence of associated injuries did not influence the outcome in our study.

None of our patients had iatrogenic

nerve injury. 3(16.6%) of our patients had infections. Two of them had superficial infection which responded well to Intravenous antibiotics. One of our patients had deep infection and he was treated with wound debridement and flap cover was done for the raw area. The patient who had deep infection also had post operative posterior dislocation which was reduced and was maintained in lower femoral pin traction for six weeks. One patient had implant failure which occurred after malunion of the acetabulum. The functional outcome in patients with superficial infections was good. But the patient who had deep infection and posterior dislocation had a poor functional outcome. None of the patients in our study developed heterotopic ossification after average follow up of 8 months

The posterior dislocation of hip was present in 4(22.2%) of the patients in our study. The presence of posterior dislocation was not statistically related to the achievement of anatomical reduction.

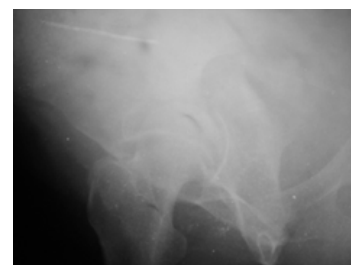
The functional outcome which was evaluated with Merle d' Aubigne' and Postel modified score was found to be excellent in 4 patients, good in 6 patients, fair in 4 patients and poor in 4 patients. The radiological outcome was strongly associated with the functional outcome which strongly supports the point that achieving anatomical reduction is the most important aspect.

The mean blood loss and time taken for surgery in Kocher Langenbeck approach were 1263 ml and 2.85 hours and the mean blood loss and time taken for surgery in Ilio Femoral approach was found to be 1700 ml and 3.47 hours.

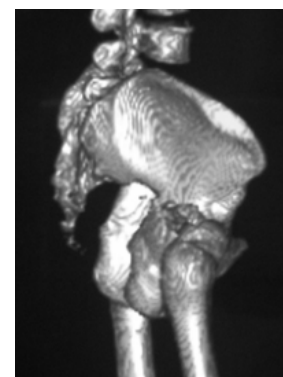
Case 1



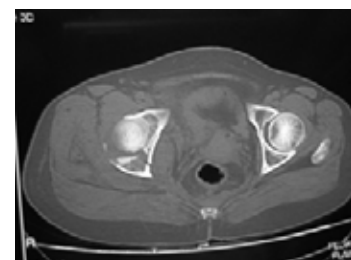
Pre Operative



Pre Operative



Pre operative 3D reconstruction



Pre Operative Axial CT



Post Operative AP view



Post Operative Obturator oblique view

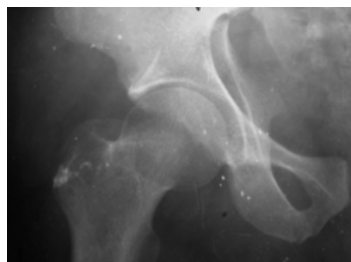


Post operative Iliac Oblique view



Post Operative Clinical

Case 2



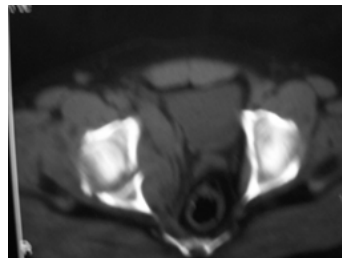
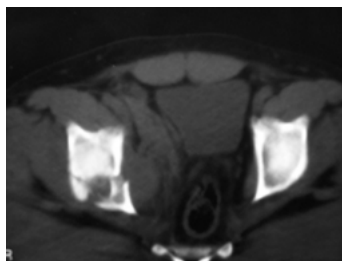
Pre operative AP



Pre operative obturator oblique view



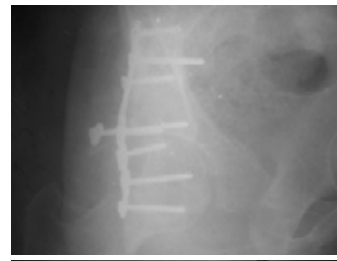
Pre operative iliac oblique view



Pre Operative Axial CT scan



Post operative Xray AP view



Post operative Xray obturator oblique view and iliac oblique view



Post operative follow up

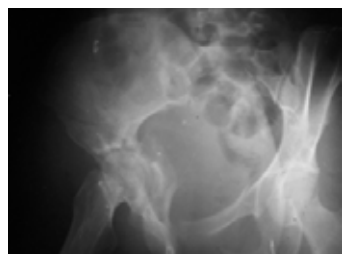
Case 3



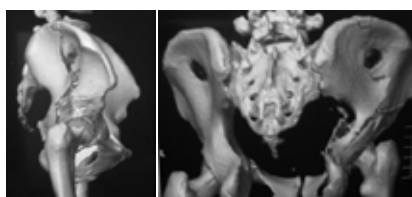
Pre operative AP view



Pre op Obturator oblique view



Pre op iliac oblique view



Pre Operative 3D Reconstruction



Post OP AP View



Post OP Obturator Oblique view and Iliac Oblique View



Post operative follow up



Post Operative follow up

Complications



Post Operative Picture Showing Broken Plate

Discussion

Fracture of the acetabulum still remains a Bermuda Triangle for the orthopaedic surgeons of developing country such as ours due to the lack of technical expertise and inadequate infrastructure¹¹. The variables such as initial injury to the articular surface, residual intra articular step, lost vascularity to the femoral head are also the important factors that determine the outcome, including the degenerative changes in the hip joint¹².

The anatomical reduction of the

fracture is the single most important factor which determines the functional outcome^{13,15}. In our study also radiographic congruity correlated well with the functional outcome. In our study 45.5% of the patients with simple fractures attained good anatomical reduction compared to 28.6% of patients with associated fracture types.

Matta et al, Letournel and Judet strongly suggested that the surgeons should be well trained and specialized in evaluating the radiological anatomy of the fracture, planning the optimal treatment strategy including the approach and attaining perfect anatomical reduction^{2,3,7}.

The infection rate in our study was 16.6% which was higher than that reported in other series 0-3%^{3,13,14}. The cause of may be due to delayed interval between injury and surgery, more soft tissue stripping and longer duration for surgery.

Another factor which closely correlated with the outcome was the time interval between injury and fracture fixation^{2,8}. 85.7% of the patients who had earlier surgery had good anatomical reduction and functional outcome.

The age of the patient which was strongly related to the outcome in Matta's² study did not have any effect on the outcome in our study. This may be due to reason that the number of patients in our study was much lower.

The other important factor, as suggested by Matta et al and other authors, which determines the radiological outcome, is the initial displacement of the fracture fragment. In our study also the amount of initial displacement correlated well with the outcome.

The use of single exposure for even both columns fracture with indirect

reduction of the opposite column is currently recommended as the morbidity associated with extensile approaches was found to very high. The opposite column fracture can be treated with the help of image intensifiers, traction and also with the help of Judet fracture tables.

In our study there were no Avascular necrosis of femoral head, secondary arthrosis of the hip joint or heterotopic ossification which may be due to the reason that the mean follow up was only 8 months in our study.

Conclusion

No doubt, it involves a long learning curve and the treatment should be done in a specialized tertiary care centre which has a specialized team for managing the acetabular fractures as even the most quoted authors of acetabular fractures such as Matta and Letournel had unsatisfactory results during their early days.

The surgical treatment of unstable displaced acetabular fractures is universally accepted as the conservative management of the complex unstable displaced fractures produced consistently poor results. The key to success in the surgical treatment of acetabular fractures is the understanding of the anatomy of the fracture, pre operative planning for the approach and type of reduction.

The surgical treatment of acetabular fractures if presented late is difficult, but possible. Even though poor results are more probable of late fixation the total hip replacement which may be needed subsequently in such cases will be easier¹⁷.

Though various factors such as age, initial displacement and the time interval between injury and surgery affect the outcome of the surgical treatment, the surgical treatment of

unstable acetabular fractures is the recommended treatment option in all patients otherwise contraindicated.

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