

FUNCTIONAL OUTCOME OF SURGICAL MANAGEMENT OF ACETABULAR FRACTURES BY INTERNAL FIXATION

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ABSTRACT: BACKGROUND: The treatment of acetabular fractures has seen major advances in the field of orthopaedic traumatology. Conservative treatment of acetabular fractures leads to poor results. Newer diagnostic tools like the Computed Tomography (CT) scan help in analyzing the three dimensional disturbance in the normal anatomy and plan the surgical management accordingly. In recent years operative treatment has become the treatment of choice in the management of acetabular fractures as precise anatomical reduction with adequate internal fixation can be attained.

OBJECTIVES: To evaluate the functional outcome of operatively managed acetabular fractures, and assess the efficacy of operative fixation of acetabular fractures, and also study the complications of operative fixation of acetabular fractures.

MATERIALS AND METHODS: Fifty five patients (49 male & six female) admitted to Sanjay Gandhi Institute of Trauma and Orthopaedics with acetabular fractures underwent open reduction and internal fixation. All patients were evaluated with Matta et al score with a minimum of follow up of six months. **RESULTS:** There were 24 (43.6%) patients with bicolumnar fractures, 15(27.3%) had posterior column fractures, 10(18.1%) had posterior wall fractures, five (9.1%) had transverse fractures, and one (1.8%) patient had an anterior column fracture. Full weight bearing was attained in thirty five (63.6%) patients in 16 weeks and in twenty (36.4%) patients after 16 weeks. Forty five (81.8%) patients were free of complications. According to Matta et al score 27(49.1%) had excellent, 15(27.3%) had good, nine (16.4%) had fair, and four (7.3%) had poor results. **CONCLUSION:** Open reduction and internal fixation of acetabular fractures is a reliable technique, minimizes healing time and provides congruent joint reduction. Operative treatment of acetabular fractures results in predictable union and good clinical results with a low rate of complications.

KEYWORDS: Acetabular fracture, Operative fixation, Open reduction.

INTRODUCTION: One of the major advances in the field of orthopaedic traumatology is the treatment of acetabular fractures. Until recently all acetabular fractures were treated primarily by closed methods. Acetabular fractures are complex fractures, and achieving optimum result requires experience. Fractures of acetabulum are very difficult to treat because of the difficulty in understanding the fracture pattern, difficult surgical approach and difficulty in achieving anatomical reduction.

Acetabular fractures are often caused by high energy trauma and associated injuries are frequent.⁽¹⁾ Treatment should follow accepted ADVANCED TRAUMA LIFE SUPPORT (ATLS) protocol, with orthopaedic management of acetabular fracture appropriately integrated into the treatment plan.⁽¹⁾ Fractures of the acetabulum make up about 2% of all fractures but are associated with significant morbidity and mortality due to high energy transfer, other injuries, local visceral damage and neurovascular and joint trauma.⁽²⁾ The incidence of acetabular fractures is 3 per one lakh /

year.⁽³⁾ The mean age of occurrence of these fractures is 36 years with the male: female ratio being 6:1.5.

Conservative treatment of acetabular fractures has been criticized because of the inability to restore joint congruity, thereby causing increased incidence of osteoarthritis.^(4,5) In the earlier days, as the anatomy of the pelvis and acetabulum was poorly understood, the acetabular fractures were managed conservatively and hence the outcome was poor as the anatomical reduction could not be attained. As the medical science has advanced the newer diagnostic tools like the CT scan have helped us to analyse the three dimensional disturbance in the normal anatomy and plan the surgical management accordingly. Hence, the outcome of surgically managed acetabular fractures has been found to be excellent.

Operative treatment is the treatment of choice in the management of acetabular fractures as precise anatomical reduction with adequate internal fixation can be attained.⁽⁴⁾ In 1960, Judet first suggested that open reduction and internal fixation be done in all cases of displaced acetabular fractures to achieve accurate reduction.

The accuracy of reduction of an acetabular fracture is directly proportional to the number of surgeries performed by the surgeon. In short, experience of the surgeon has a vast role in attaining anatomical reduction of the fracture.^(1,4)

The morbidity in acetabular fractures is significantly high. Hemorrhage is the most immediate and perilous complication. The other causes of early morbidity are open and closed degloving injuries, superadded infection and thrombotic phenomenon.⁽⁶⁾

The late morbidity in pelvi- acetabular trauma is usually due to chronic pain, postural and gait disturbances or persistent neurological deficits in the lower extremities, and genitourinary or rectal dysfunctions.⁽⁶⁾ In acetabular arthritis, avascular necrosis and heterotopic ossification are commonly seen.⁽⁷⁾

In the past decade, the emergence of pelvic and acetabular trauma surgery as a specialty has led to increased experience and expertise with these fractures resulting in decreased technical difficulties and wider acceptance of standard techniques. A thorough understanding of normal pelvic anatomy, plain radiograph and CT is necessary to understand the fracture patterns. An understanding of the Letournel classification aids the surgeon in understanding the individual fracture pattern, in planning the surgical approach, and in understanding surgical reduction techniques for a given fracture.

The goal of open reduction and internal fixation of an acetabular fracture is a perfect reduction. The available outcome studies however are limited in their scope either due to lesser number of cases studied or due to the limited management methods used. So the present study is planned to know the functional outcome in these patients of acetabular trauma. The objectives of the current study are 1) To evaluate the functional outcome of operatively managed acetabular fractures, and 2) To assess the complications of operative fixation of acetabular fractures.

MATERIALS & METHODS: A prospective study was conducted at Sanjay Gandhi Institute of Trauma and Orthopaedics between October 2013 and December 2014. A Total of 55 (49 male and six female) patients with acetabular fracture who underwent open reduction and internal fixation were included in the study.

Inclusion criteria included adult patients of either sex, with a closed, displaced fracture (Confirmed by CT scan and X-Ray). All fracture types based on Letournel and Judet classification

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involving the anterior column, anterior wall, posterior column, and posterior wall, except the ones mentioned in the exclusion criteria, were included.

Exclusion criteria were patients younger than 18 years, open fractures, associated lower limb and femoral head fractures, pathological and peri prosthetic fractures, stable undisplaced and minimally displaced fractures, low anterior column, transverse and T-shaped fractures, both-column fracture with secondary congruence, and wall fracture not compromising hip stability. Pregnant females and those with associated comorbid conditions, less than one year history of suffering from Myocardial Infarction (MI), psychiatric illness, uncontrolled Diabetes mellitus (DM), Hypertension and associated major visceral injury were also excluded.

Selected individuals with acetabular fractures were explained about the study. After obtaining written informed consent the selected subjects were included in the study. Approval of the Institutional ethics committee was also obtained.

After routine investigations and once the patient were fit for surgery, patients were taken up for surgery for open reduction and internal fixation with recon plates or screws. One of the following four surgical approaches was used depending on the fracture pattern. They are the Kocher-Langen back approach, the Ilio-inguinal approach, the extended ilio-femoral approach and the tri-radiate approach. Anterior column fractures, Ilioinguinal approach was used; whereas the Posterior column fractures were fixed by the Kocher Langenbeck approach. In Bicolumnar fractures, one column was first fixed and assessed for the reduction of the other column (Which usually gets reduced). If it was not satisfactorily reduced then that column was also fixed with the appropriate approach.

Mobilization Protocol: Static quadriceps exercises are started were begun on Day one, followed by Continuous Passive Motion (CPM) from day two or three, limiting the range to about 60 degrees for the first three days, to avoid tension on the wound. Dynamic Quadriceps exercises were started from three to seven. Once the pain subsided, patient was encouraged to start gait training on a walker or axillary crutches. Toe touch weight bearing is permitted. Active flexion, extension and abduction exercises while standing were encouraged. Physical therapy was directed towards regaining muscle strength at the hip, especially in the abductors as this has been seen to correlate with final functional outcome.

Limitation of weight bearing was continued for 8–12 weeks post-operatively. After 12 weeks full weight bearing ambulation was permitted only after confirming fracture union. The walking aids were discarded gradually as tolerated. Patients were followed up regularly and were assessed clinically and radiologically at the interval of 1 month, 2 months, 3 months and 6 months.

Clinically patients were assessed for pain, ROM and ambulation and graded based on clinical grading system by Matta et al Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented in Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on data are made: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, and 3. Cases of the samples should be independent.

Chi-square/Fisher Exact test have been used to find the significance of study parameters on categorical scale between two or more groups.

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Significant Figures:

- + Suggestive significance (P value: $0.05 < P < 0.10$)
- * Moderately significant (P value: $0.01 < P < 0.05$)
- ** Strongly significant (P value: $P < 0.01$)

Statistical Software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, Med Calc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS: Most of the patients were in the 21–40 age group, and a majority of them had Excellent to Good Matta et al. clinical score.

Age in Years	Number of Patients	Matta et al. Clinical Score			
		Excellent	Good	Fair	Poor
≤20	5	4(80%)	1(20%)	0(0%)	0(0%)
21-30	18	11(61.1%)	3(16.7%)	3(16.7%)	1(5.6%)
31-40	18	9(50%)	5(27.8%)	3(16.7%)	1(5.6%)
41-50	5	1(20%)	3(60%)	0(0%)	1(20%)
>50	9	2(22.2%)	3(33.3%)	3(33.3%)	1(11.1%)
Total	55	27(49.1%)	15(27.3%)	9(16.4%)	4(7.3%)

Table 1: Age wise analysis of Matta et al. clinical score

P=0.455, not significant, Fisher Exact test

Distribution of cases based on age of the patients with respect to the clinical grading system as described by Matta et al. is enumerated in Table 1.

Type of Fracture	Number of Patients	Matta et al. Clinical Score			
		Excellent	Good	Fair	Poor
Anterior Column	1	0(0%)	0(0%)	1(100%)	0(0%)
Bicolumnar	24	11(45.8%)	8(33.2%)	2(8.3%)	3(12.5%)
Posterior column	25	16(64%)	5(20%)	4(16%)	0(0%)
Transverse	5	0(0%)	2(40%)	2(40%)	1(20%)
Total	55	27(49.1%)	15(27.3%)	9(16.4%)	4(7.3%)

Table 2. Analysis of Matta et al. score based on type of Acetabular fracture

P=0.019*, significant, Fisher Exact test

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The bicolunar fracture was the most common type of fracture, followed by the posterior column fracture. Excellent scores were obtained in 45.8% of bicolunar and 64% of posterior column fractures.

Approach	No. of Patients	%
Ilio inguinal	9	16.4
Ilio inguinal + Kocher langenbach	6	10.9
Kocher Langenback	40	72.7
Total	55	100.0

Table 3: Distribution of cases based on Surgical Approach used

In this study, out of the 55 cases operated, in 40 cases (72.7%) Kocher Langenbeck approach was used. In 9 cases (16.4%), Ilio-inguinal approach was used and in 6 cases (10.9%), both approaches (Ilio-inguinal and Kocher langenbeck) were used.

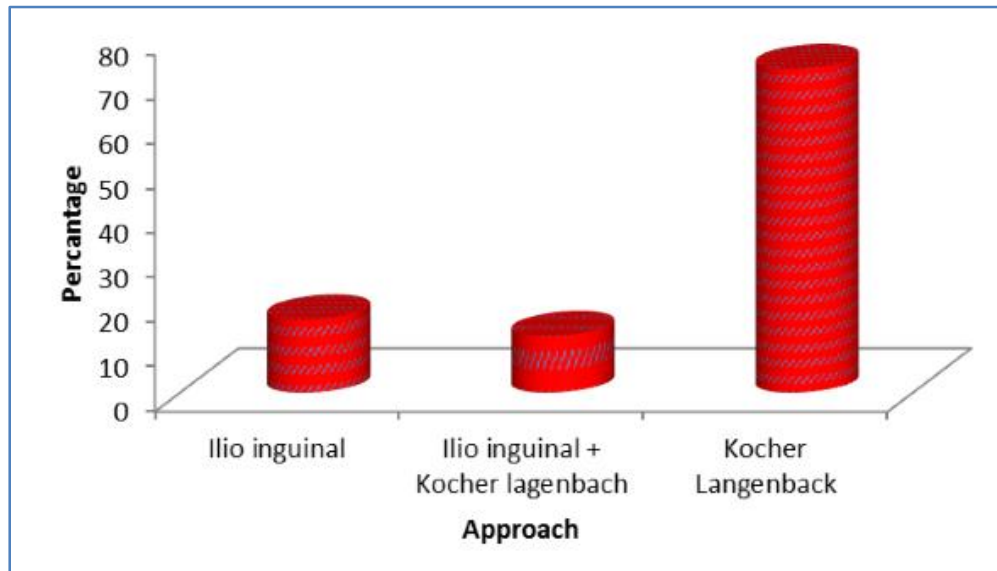


Fig. 1: Distribution of cases based on Surgical Approach used

Complications	Number of patients	Percentage
Nil	45	81.8
Avascular Necrosis	2	3.6
Sciatic nerve palsy	3	5.5
Urethral injury	1	1.8
Wound infection	4	7.3
Total	55	100.0

Table 4: Distribution of Cases based on Complications

Majority of the patients did not have any complications. However, a small percentage of patients developed known complications which have been enumerated in Table 4.

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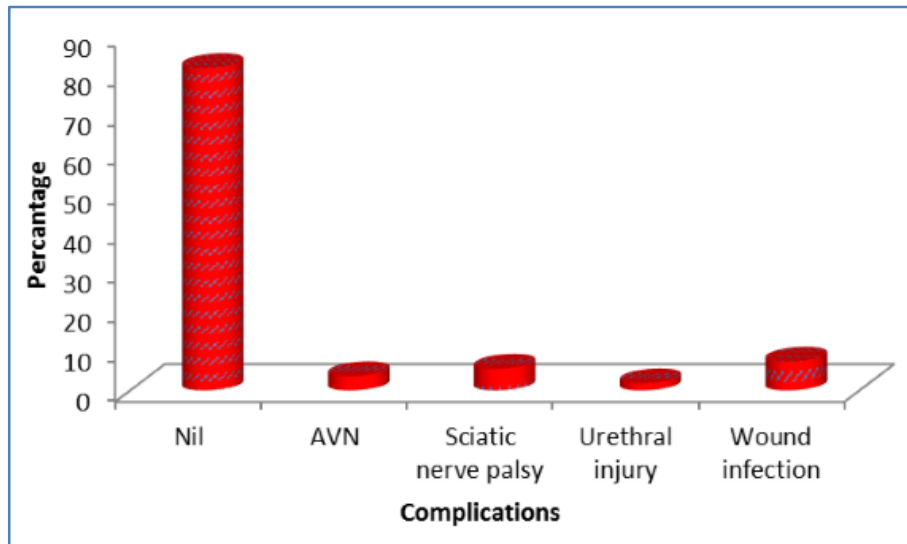


Fig. 2: Distribution of Cases based on Complication

Matta et al. Clinical Grading at Final Follow up	Number of Patients	Percentage
Excellent	27	49.1
Good	15	27.3
Fair	9	16.4
Poor	4	7.3
Total	55	100.0

Table 5: Distribution of cases based on Matta et al. clinical grading system

Overall, Excellent and good results as per the Matta et al. clinical scoring system were observed in 27 and 15 patients respectively.

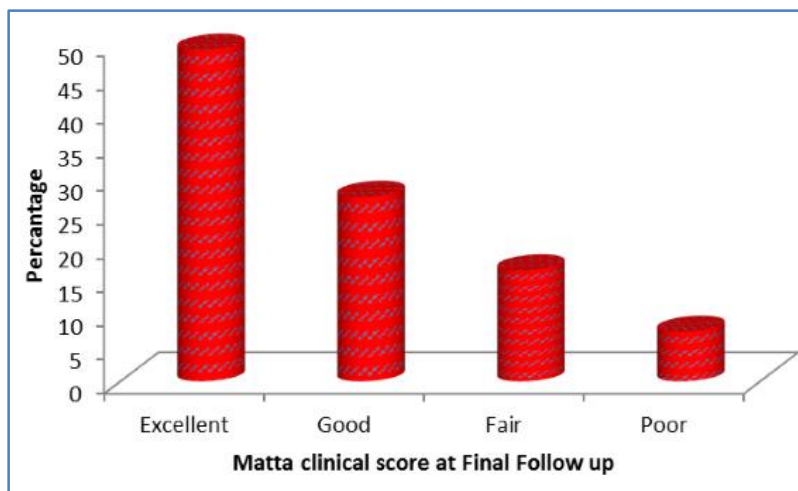


Fig 3: Distribution of cases based on Matta et al. clinical grading system

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DISCUSSION: Our study included 55 patients in the age group of 18–65 years. Each patient was followed up for a minimum period of 6 months and analysis of the results were made with respect to age, sex, mode of injury, laterality of the fracture, type of fracture, time taken for full weight bearing, and finally the Clinical outcome of the study was assessed through the CLINICAL GRADING SYSTEM by Matta et al.

The Mean age was 35.69 years and most of our patients were below 50 years. The distribution of acetabular fractures depending on age in different Studies is presented in the table below in comparison to our study. Majority of our patients were Males, i.e., 49 out of 55 cases (89.1%). Females constituted 6 cases (10.9%). Even in the other Studies taken into consideration for comparison, Males have outnumbered the Females. This may be attributed to the higher physical activity in in younger patients and males thereby predisposing them to the injury.

STUDY	Age of Patients (in yrs)	Mean Age (in yrs)
S. D. Deo et al ⁸	16 – 81	36
Vincenzo Giordano et al ⁹	18 – 79	35
M.L.Chip Routt et al ¹⁰	14 – 79	30
Albuquerque et al ¹⁰	23 – 68	40
A. Kumar et al ¹¹	15 -76	39.5
George Petsatodis ¹²	18 – 71	37.8
Chuan-Mu Chen ¹³	19 – 72	43
Joel M Matta ¹⁴	11 – 90	37
A.Moroni et al ^[15]	18 – 63	32
Our Study	18 – 65	35.69

Table 6: Comparison of the age wise distribution of the cases in our present study with the other studies

Majority of the fractures in our study were Bicolumnar i.e.,24 patients (43.6%), followed by posterior column fractures in 15 patients (27.3%), posterior wall fractures in 10 patients (18.1%), transverse fractures in 5 patients (9.1%) and anterior column fracture in one patient (1.8%). The comparison with other studies with regard to the type of fracture is shown in the table below.

Study	Anterior Column	Posterior Column	Bicolumnar	Transverse
Vincenzo Giordano et al ^[9]	11.76 %	29.41 %	41.18%	17.65%
Kumar A et al. ^[11]	8.11%	5.41%	72.97%	13.51%
Deo SD et al. ^[8]	12.5%	5%	50%	32.5%
Lim HH ^[16]	6.25%	87.5%	0 %	6.25%
Our Study	1.8%	27.3%	43.6%	9.1%

Table 7: Comparison of our study with other studies with respect to type of fracture

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In the present study, Kocher-Langenbeck approach was used in 40 cases (72.7%). Ilio-inguinal approach was used in 9 cases (16.4%). Both approaches were used to fix 6 patients with Bicolumnar fracture. Since posterior column and bicolumnar fractures constituted a majority of cases, the Kocher-Langenbeck approach was predominantly used. Comparison of the various studies with respect to the type of approach is shown in the table below.

STUDY	ILIO- INGUINAL	KOCHER- LANGENBECK	BOTH	EXTENDED FEMORAL	TRIRADIATE
S. D. Deo et al ⁸	24%	38%	15%	3%	20%
Vincenzo Giordano et al ⁹	15.85%	67.1%	15.85%	nil	1.2%
A. Kumar et al ¹¹	36.11%	56.94%	1.39%	nil	6.94%
Joel M Matta ¹⁴	33%	43%	2%	23%	nil
Our Study	16.4%	72.7%	10.9%	nil	Nil

Table 8: Distribution of the Acetabular fractures depending on the Surgical Approach used:

We encountered two complications-Osteonecrosis of the femoral head with secondary Osteoarthritis in two patients (3.6%). Sciatic Nerve palsy, which existed pre-operatively, was seen in three patients (5.5%). Urethral injury was observed in one patient (1.8%). Wound infection occurred in four cases (7.3%). We didn't encounter any other complication as enumerated in other studies shown in the table below.

STUDY	AVN With Sec. Osteoarthritis	SCIATIC NERVE PALSY	HETEROTROPIC OSSIFICATION	STIFFNESS	INFECTION	OTHERS	Morel. Iavalleskin lesion
S. D. Deo et al ⁸	8 %	Nil	9 %	3 %	nil	nil	nil
Vincenzo Giordano et al ⁹	4.8%	12.2 %	1.2 %	Nil	1.2 %	3.6%	nil
M.L.Chip Routt et al ¹⁰	2.8%	8.57 %	Nil	Nil	Nil	nil	nil
A. Kumar et al ¹¹	4.1%	Nil	27 %	Nil	4.16 %	nil	nil
Chuan-Mu Chen ¹³	Nil	Nil	9.3 %	Nil	5.7 %	nil	8.57 %
Our Study	3.6%	5.5 %	Nil	Nil	7.3%	1.8%	Nil

Table 9: Our results have been compared with those of the other studies in the table below Comparison of our study with the other studies with respect to Complications

As per Matta et al. scoring system, we had excellent outcome in 27 patients (49.1%), Good in 15 patients (27.3%), Fair in 9 patients (16.4%) and Poor in 4 patients (7.3%). Letournaul^[17] reported perfect reduction in 62% of bicolumnar fractures with a single approach. Matta and Merritt^[18]

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reported 81% good reduction by extended iliofemoral or ilioinguinal approaches occasionally by two separate approaches. A. Moroni et. al^[15] reported that good reduction was achieved by staged Combined Ilioinguinal and Kocher Langhenbeck approaches during the same Operation. The results of our study were on par with other studies. The poor outcome was due to the complications that we encountered.

The comparison of our Study with the other studies has been presented in the form of a table below.

Study	MATTA et al. Scoring System			
	Excellent	Good	Fair	Poor
Joel Matta et al ¹⁴	37%	47 %	14 %	2 %
Paul D Ruesch et al ¹⁹	51 %	30%	Nil	19%
V. A de Ridder et al ²⁰	42 %	33 %	25 %	Nil
Keith mayo et al ²¹	14%	61%	16%	9%
Our Study	49.1 %	27.3 %	16.4 %	7.3 %

Table 10: Comparison of Matta et al Score in present study with other studies

CONCLUSION: In earlier days because of poor understanding of the anatomy and fracture pattern, and lack of advanced imaging techniques and surgical expertise, the acetabular fractures were managed conservatively with a poor outcome and high morbidity. However, with the advent of CT scan with 3 D reconstruction, the fracture pattern is well understood and coupled with improvements in the surgical techniques and instrumentation, the management of these fractures has become standardized with good results.

Road traffic accidents are the commonest mode of injury with male predominance. Anterior column fractures are managed effectively by Ilioinguinal approach and the Posterior column fractures by the Kocher Langenbeck approach. In Bicolumnar fractures, one column is first fixed and assessed for the reduction of the other column (which usually gets reduced). If it is not reduced then that column is also fixed with the appropriate approach. Complications of acetabular fractures treated operatively are minimal. Good to excellent results were achieved in 76.4% patients.

We conclude that the management of fractures of acetabulum is best achieved by means of a surgical treatment. In order to achieve good to excellent results we recommend:

- Proper pre-operative evaluation - thorough analysis of nature of injury.
 - Care over morbidity factors.
 - Good radiological analysis of fracture pattern.
- Judicious Surgical Planning.
- The need for proper instrumentation and Implants.
- Surgical expertise.
- Tailored Post-operative protocol.

Case 1



Pre-op x ray

Post op Xray

Immediate Post-op Photos



At 6 weeks post-op follow up



Fracture united at the end of 6 months



Standing with support



Knee & ankle mobilization



Follow up movements at end of 6 months



Abduction



Adduction



Flexion



Extension



Internal rotation



External rotation



Cross legged sitting

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Case 2



Pre-op X- ray (Bicolunar fracture) Post-op X-ray (Anterior column fixed)

1st Post Op Day



Knee & ankle mobilization

Follow up movements after 8 weeks:



Flexion



Extension

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Abduction



Adduction



External rotation



Internal rotation



Sitting Cross-legged



Squatting



Full weight bearing



Old healed scar

X ray at the end of 6 months showing fracture union



Case 3



Posterior Dislocation of (R) hip with fracture of Posterior Column of Acetabulum



Dislocation reduced & placed in fixed traction over thomas splint as an emergency procedure



Posterior column fixed with recon plates (10 days after reduction)



Surgical scar after suture removal

Immediate Post-Op:



Complete bed rest (de-rotation boot applied)

Follow up after 2 months



knee and ankle mobilization walking with support

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