A PROSPECTIVE STUDY ON FUNCTIONAL OUTCOME ANALYSIS OF OPEN REDUCTION AND INTERNAL FIXATION OF COMPLEX ACETABULAR FRACTURES

Dissertation submitted to

M.S. DEGREE-BRANCH II

ORTHOPAEDIC SURGERY

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

CHENNAI-TAMILNADU

APRIL 2013

CERTIFICATE

This is to certify that this dissertation titled **"Functional Outcome Analysis of Open reduction and internal fixation of complex Acetabular fractures"** is a bonafide record of work done by **DR.D.KAMALASEKARAN ,** during the period of his Post graduate study from June 2010 to May 2013 under guidance and supervision in the INSTITUTE OF ORTHOPAEDICS AND TRAUMATOLOGY, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai-600003, in partial fulfilment of the requirement for **M.S.ORTHOPAEDIC SURGERY** degree Examination of The Tamilnadu Dr. M.G.R. Medical University to be held in April 2013.

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DECLARATION

I declare that the dissertation entitled **"FUNCTIONAL OUTCOME ANALYSIS OF OPEN REDUCTION AND INTERNAL FIXATION OF COMPLEX ACETABULAR FRACTURES FRACTURES"** *submitted by me for the degree of M.S is the record work carried out by me during the period of* ***October 2010 to October 2012*** *under the guidance of* ***PROF.V.SINGARAVADIVELU*** **M.S.ORTHO.,D.Ortho.,** *Associate Professor of Orthopaedics, Institute of Orthopaedics and traumatology, Madras Medical College, Chennai. This dissertation is submitted to the Tamilnadu Dr.M.G.R. Medical University, Chennai, in partial fulfillment of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH-II) examination to be held in April 2013.*

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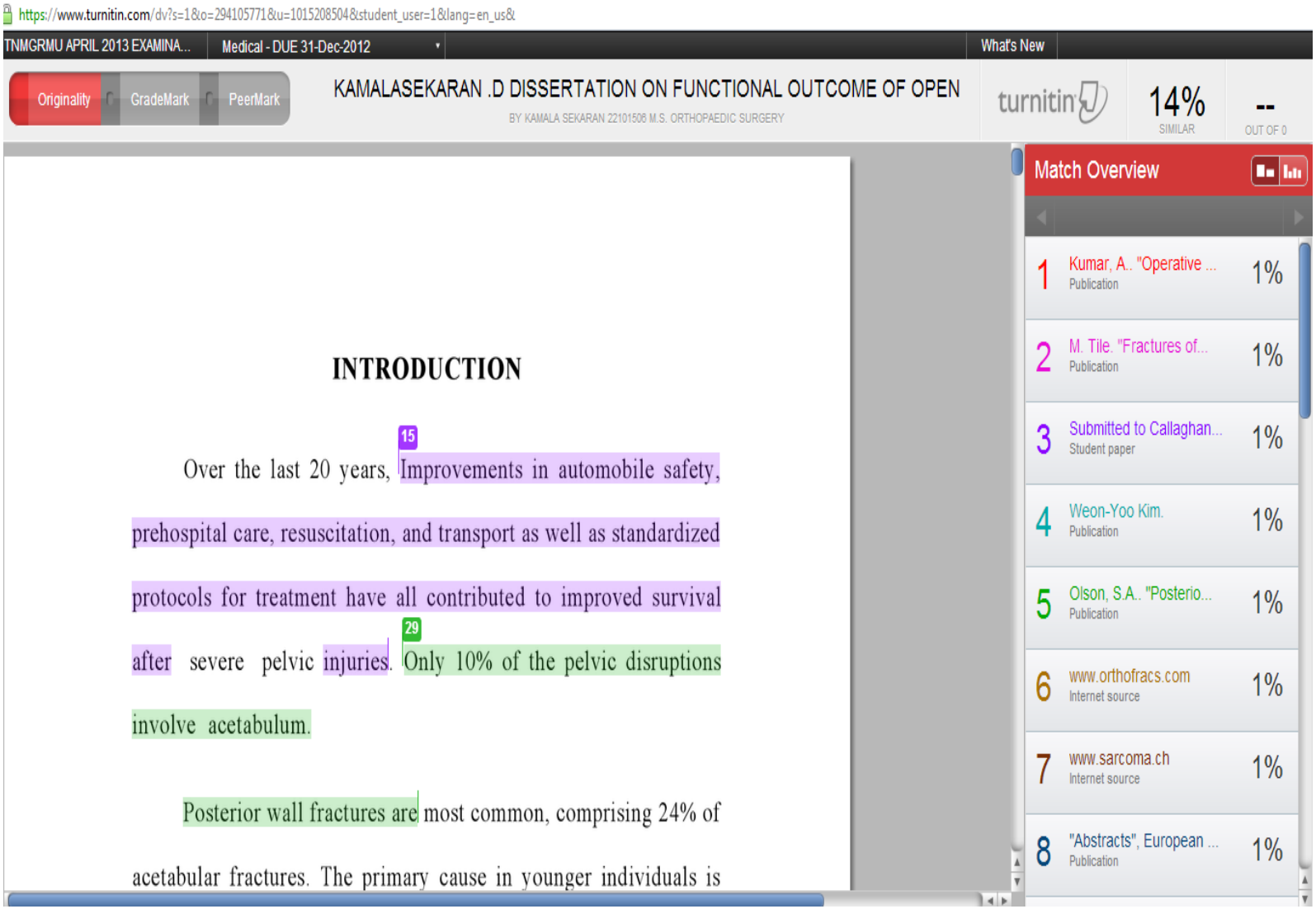
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INTRODUCTION
Over the last 20 years, Improvements in automobile safety, prehospital care, resuscitation, and transport as well as standardized protocols for treatment have all contributed to improved survival after severe pelvic injuries. Only 10% of the pelvic disruptions involve acetabulum.
Posterior wall fractures are most common, comprising 24% of acetabular fractures. The primary cause in younger individuals is
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INTRODUCTION

Over the last 20 years, Improvements in automobile safety, prehospital care, resuscitation, and transport as well as standardized protocols for treatment have all contributed to improved survival after severe pelvic injuries. Only 10% of the pelvic disruptions involve acetabulum.

Posterior wall fractures are most common, comprising 24% of acetabular fractures. The primary cause in younger individuals is high-energy trauma. Acetabular fractures generally occur in conjunction with other fractures.

The treatment of acetabular fractures is an enigmatic area of orthopaedics that is being continually refined. It involves a definite learning curve [13] .

Acetabular fractures are generally associated with other injuries of the pelvis and lower limbs which may influence treatment options, surgical approach and clinical outcomes . Patient age, fracture stability, the presence of comorbidities and

osteoporosis, combined with surgeon experience also influence treatment options.

The goals of the treatment should be anatomic reconstruction of articular surface and early mobilisation. This goal can be achieved only when acetabulum is adequately exposed and rigid internal fixation is done. Displaced fractures of the pelvis that involve the acetabulum are difficult to treat. With closed methods, it is difficult, if not impossible, to restore the articular surfaces completely and obtain sufficient stability for early motion of the hip.

The treatment of simple fractures of acetabulum is well known and studied. Treatment of complex Acetabular fracture is difficult as it involves both the column of the acetabulum, For reduction and fixation, both columns have to manipulated and fixed.. .

The purpose of this study is to analyse the results and functional outcome of open reduction and internal fixation of fracture involving both acetabular columns (Complex Acetabular

Fractures) with the use of Kocher Langenbeck , ilioinguinal or both approaches .

Fractures involving both acetabular columns are complex Acetabular Fractures[2] (AO Type B & C) . Based on Judet and Letournel classification , the fractures included are

- Transverse fracture
- Transverse with posterior wall fracture
- T type fracture
- Anterior wall or column with posterior hemitransverse
- Both column fracture.

AIM OF THE STUDTY

The aim of this study is to analyze the results and functional outcome of open reduction and internal fixation in patients with complex acetabular fractures.

REVIEW OF LITERATURE

Historically, Acetabular fractures are relatively uncommon injury. The severity of these injuries is demonstrated by the fact that early descriptions of acetabular fractures are the results of autopsy findings of patients who had sustained significant trauma[16].

In 1821, Cooper reported the first detailed description of an acetabular fracture. This case described autopsy findings in a patient with an associated central dislocation of the femoral head into the pelvis

In 1909, Schroeder reported detailed compendium of the first 49 cases reported in the literature.The majority of these are reports of autopsy findings in patients who died of complications related to hemorrhagic shock or the late onset intra-abdominal sepsis.

In 1911, Skillern reported an additional four cases of fracture of the “floor” of the acetabulum .Early literature refers to fractures through the area of the cotyloid or acetabular fossa below the roof, either anteriorly or posterioly, as fractures of the floor of the

acetabulum. Throughout the 20th Century, there was little uniformity in terminology, classification, description, and treatment of these injuries .In 1926, MacGuire described the lateral traction and treatment via a percutaneously placed threaded pin into the proximal femur.Approximately three months of immobilization was recommended at that time.

Campbell reported on the treatment of posterior dislocation of the hip with acetabular fractures in 1936 . He noted that fracture of the acetabulum was relatively common with dislocation of the hip[13].

In the early 1940s, Levine reported the successful results of open reduction an internal fixation of a central fracture of the acetabulum

In the 1950s, Thompson and Epstein published their classification of hip dislocation .

Knight and Smith described operative reduction of “central dislocation of the acetabulum” . These authors described fractures as vertical (i.e., column-type fracture) or horizontal (i.e.,

transverse-type fracture pattern).Knight and Smith advocated restoration of the “weight-bearing vault” of the acetabulum. They also advocated anterior (iliofemoral) approach for horizontal fractures and posterior approach for the vertical fracture types, which in their series were largely posterior column injuries .

In 1961, Rowe and Lowell published their landmark article entitled “Prognosis of Fractures of the Acetabulum” . This was a retrospective study of 93 acetabular fractures in 90 patients, all with a minimum of one-year follow-up.They described a view with the patient placed prone, with the uninjured hip rotated to 60 degree to evaluate posterior acetabular fractures.

In 1962, Brav described a series of 523 patients with hip dislocations and fracture dislocations with follow-up on 264 of these patients in two years

In 1964, Judet et al. published their now classic article entitled “Fractures of the Acetabulum, Classification and Surgical Approaches for Open Reduction”. This manuscript describes the use of the AP and two 45* oblique views of the pelvis to evaluate

the acetabular fractures. These radiographic views, now known as “Judet” views, named after the author, include the obturator view, and the iliac oblique view. These are now the standard radiographic films used for evaluation of acetabular fractures. This article represented a substantial step forward in the understanding of acetabular anatomy and fracture classifications.

The 1980s saw substantial developments in the treatment of acetabular fractures. Computed tomography was introduced in the 1980s and was widely championed by Mears and others

In 1984, Letournel held his first international course on treatment of fractures of the pelvis and acetabulum in Paris. Letournel advocated an approach or protocol to treatment of acetabular fractures that includes extensive study of the X-rays to understand the anatomy of the fracture pattern and subsequent correct classification followed by appropriate operative positioning of the patient whenever possible to operate the fracture through a single surgical approach. Emphasis has been placed on obtaining anatomic reduction of the articular surface. Long-term clinical

outcome data suggest that the more accurate the articular reduction, more is the clinical outcome .

In 1986, Matta published two articles that helped establish the modern basis of nonoperative treatment of acetabular fractures .Using the AP and the 45* oblique Judet views of the pelvis, Matta developed the concept of a “roof arc measurement”.

Other authors have advocated protocols with multiple approaches, either simultaneously or consecutively, as a routine approach for certain types of acetabular fractures

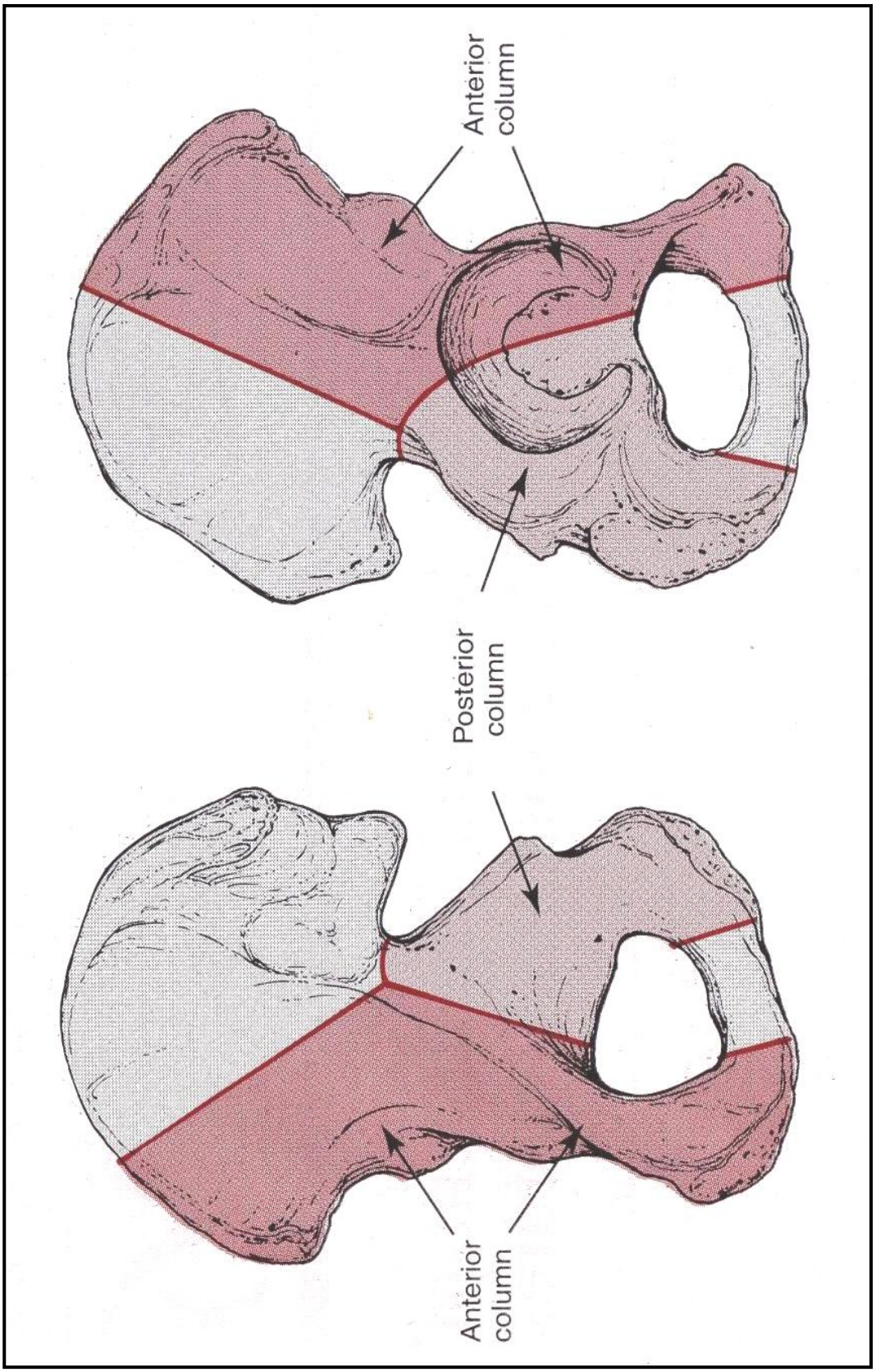
APPLIED ANATOMY

The coalescence of the three bones, the ilium, ischium, and pubis, join to each other centrally to form the cotyloid or acetabular cavity. It is useful for the surgeon to divide the acetabulum and innominate bone into anterior and posterior columns.

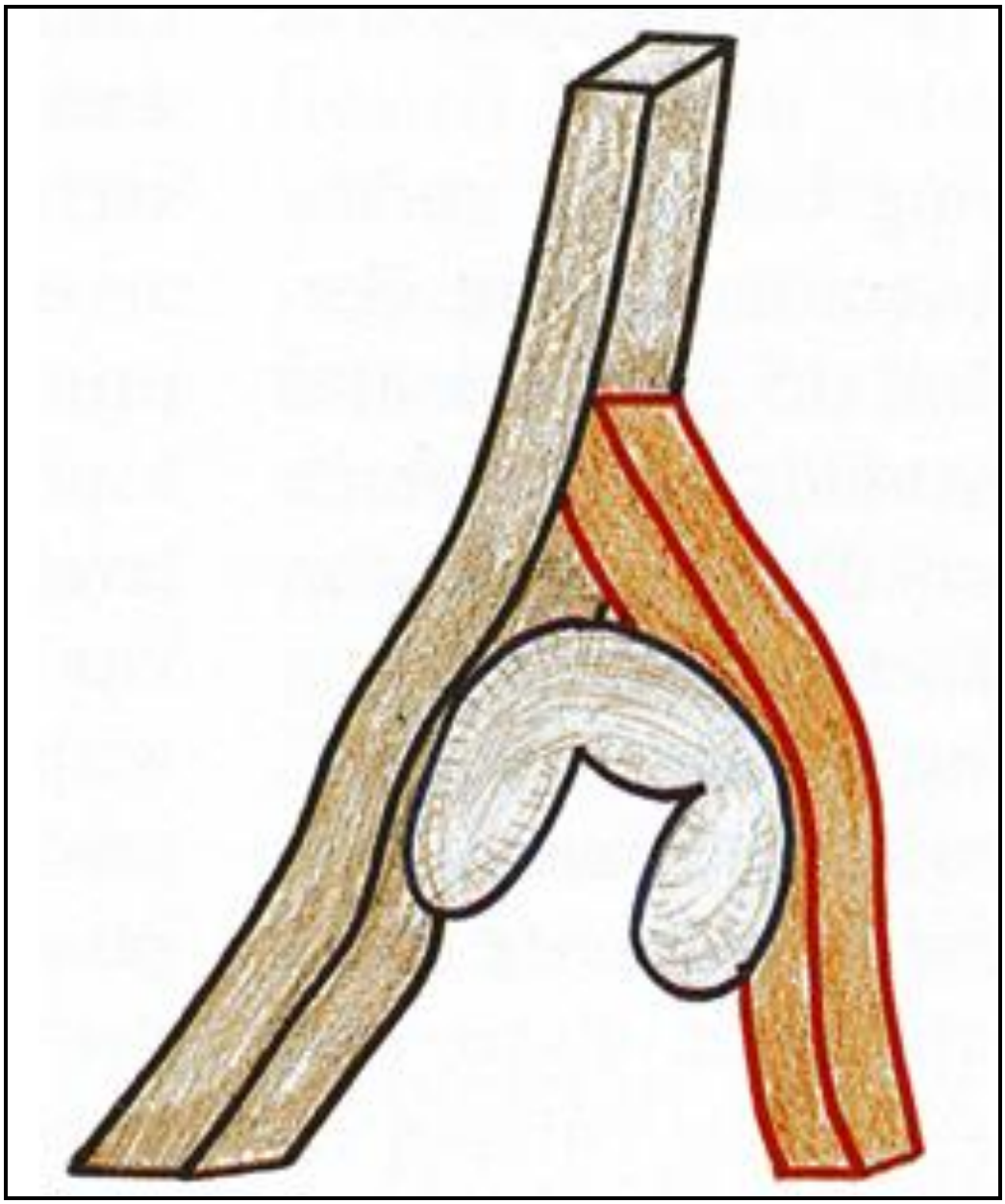
The anterior column comprises the anterior border of the iliac wing, the entire pelvic brim, the anterior wall of the acetabulum, and the superior pubic ramus.

The posterior column comprises the ischial portion of the bone, including the greater and lesser sciatic notch, the posterior wall of the acetabulum, and the ischial tuberosity.

The upper end of the posterior column attaches to the posterior aspect of the anterior column forming an angle of about 60 degrees . Columns are connected to the SI joint by a thick area of bone above the greater sciatic notch known as the sciatic buttress.


Anterior column
Posterior column
Anterior column

The two columns forms a inverted **Y** shape



Brown-Anterior column

Red- Posterior column

ANATOMIC RELATIONSHIP OF ACETABULUM:

ANTERIOR STRUCTURES :

Muscular relations

The external oblique is the outer layer of abdominal muscle. It arise from lower eight ribs and inserts as fleshy fibers into anterior half of iliac crest . From ASIS , it becomes aponeurotic which forms the inguinal ligament and attach to pubic tubercle .It forms the anterior part of rectus sheath.

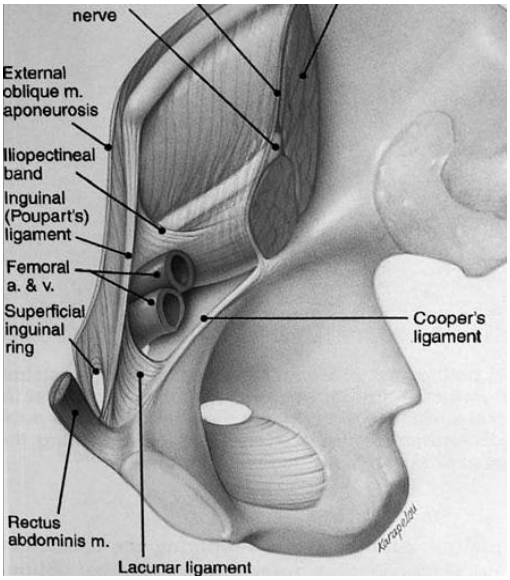
The Internal oblique and transverse abdominis arises from lateral half of inguinal ligament , iliac crest , thoracolumbar fascia, and lower ribs . It travels to midline to form rectus sheath . It forms the floor of inguinal canal.

Psoas major arises from the transverse process of T12 to L5. Iliacus originate from the inner aspect of iliac crest and upper 2/3 rd of iliac fossa . Both muscles merges , course below inguinal ligament and attaches to the lesser trochanter .

The Iliacus fascia gives a vertical expansion extending along the pelvic brim from anterior sacroiliac joint to pectineal eminence called Iliopectineal fascia . This forms a distinct band between two compartments below the inguinal ligament – **Lacuna musculosum** containing iliopsoas , femoral nerve and lateral cutaneous nerve of thigh and **Lacuna vasculorum** containing femoral vessels and lymphatics. Careful identification of this fascia is essential in ilioinguinal approach.

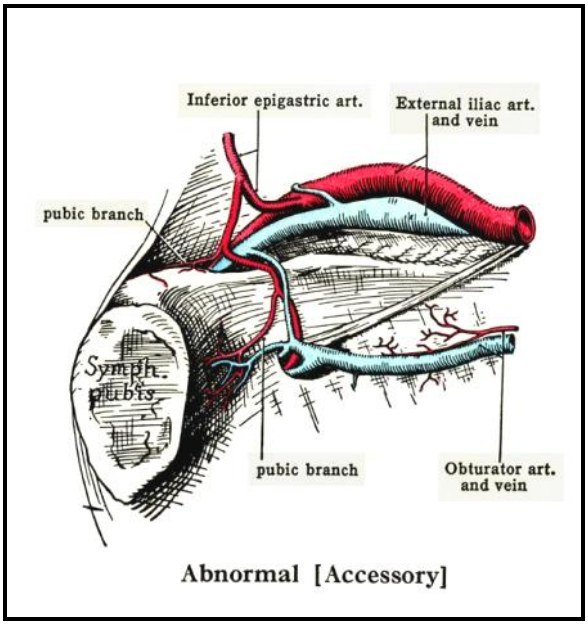
Vascular relations

External iliac vessels arises from bifurgation of common iliac vessels . They proceed anterior and inferior along the medial border of the psoas major muscles. They exit the pelvic girdle posterior and inferior to the inguinal ligament. It divides the medial and middle window of Ilioinguinal approach.



OBTURATOR ARTERY

Obturator artery arises from the internal iliac artery .Small caliber anastomoses between the obturator and external iliac systems are common. The pubic branch of the obturator artery commonly anastomoses behind the body of the pubis with the pubic branch of the inferior epigastric artery. In a small percentage of cases this anomalous vessel is of large caliber and can result in severe bleeding if it is unknowingly lacerated.This is the so-called **Corona Mortis**



Nevre relations

LATERAL CUTANEOUS NERVE OF THIGH*:* The lateral cutaneous nerve of the thigh will course 1cm medial to ASIS and needed to be isolated during dissection.

FEMORAL NERVE: The femoral nerve runs beneath the inguinal canal lying on the iliopsoas muscle. Take care to avoid vigorous retraction, as stretching the nerve will result in a paralysis of the quadriceps muscle.

Other relations

The spermatic cord contains the vas deferens and testicular artery. Although it is easily mobilized, it must be treated gently during the approach and the closure to avoid ischemic damage to the testicle.

The bladder can be easily mobilized off the back of the symphysis pubis. Fractures of the lower half of the anterior column may can cause bladder and urethral damage .

POSTERIOR STRUCTURES**:**

Muscular relations

The outer muscle layer consists of gluteus maximus . It arises from outer aspect of iliac crest , posterior surface of ilium , aponeurosis of erector spinae , dorsal surface of sacrum and coccyx . It inserts into gluteal tuberosity and iliotibial tract.

Gluteus medius is a fan shaped muscle originating from gluteal surface of ilium and inserts into greater trochanter .

Short external rotators form the inner layer. They are pyriformis , superior gemellus , tendon of obturator internus , inferior gemelli , and quadratus femoris .

There are 10 critical structures in deep surgical dissection .

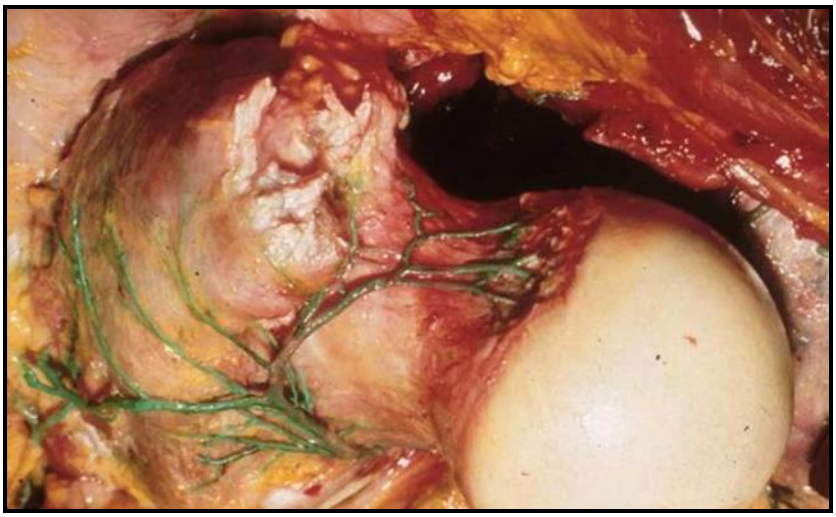
- Superior gluteal nerve and vessels (above pyriformis)
- Inferior gluteal nerve and vessels
- Pudendal nerve
- Internal pudendal artery
- Nerve to obturator internus
- Sciatic nerve
- Posterior femoral cutaneous nerve
- Nerve to quadratus femoris .

Vascular relations:

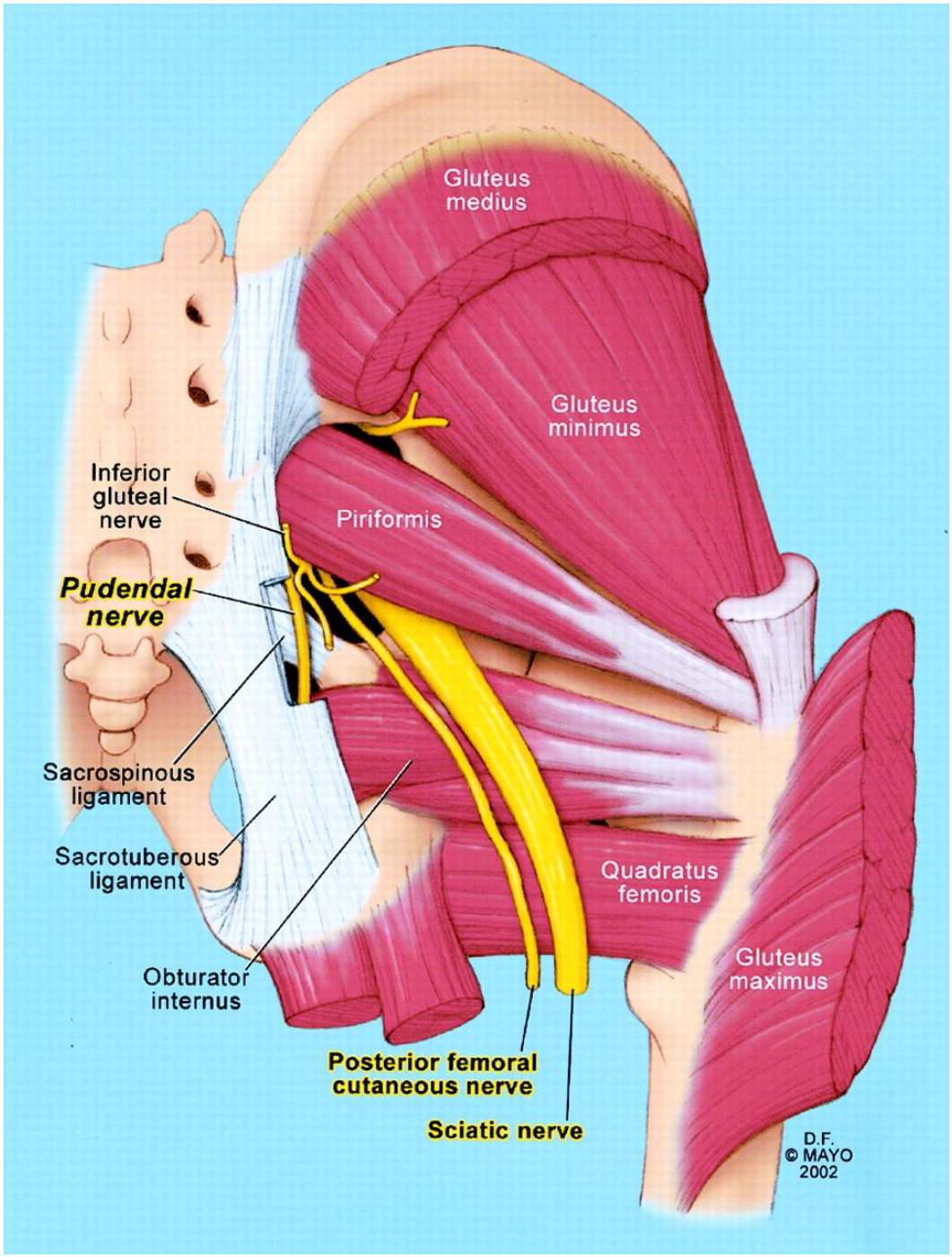
SUPERIOR GLUTEAL ARTERY:

Commonly injured in Greater sciatic notch Can be damaged by aggressive superior or lateral retraction of the abductor muscles during Kocher-Langenbeck exposure

ASCENDING BRANCH OF MEDIAL FEMORAL CIRCUMFLEX:



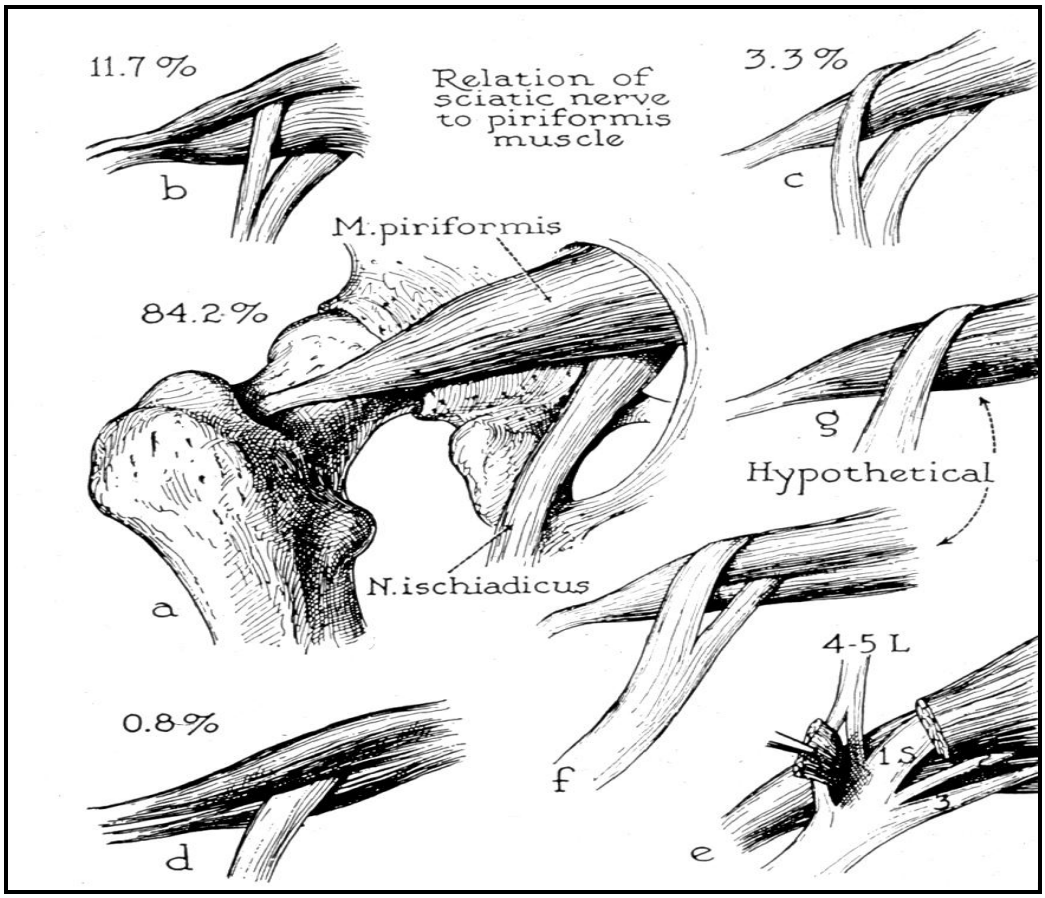
It is the main blood supply to femoral head. It lies deep to quadratus, obturator internus, and piriformis, superficial to obturator externus



Structures in deep dissection in posterior approach

Nerve relations

SCIATIC NERVE*:* Most common traumatic & iatrogenic nerve injury. It exits from greater sciatic notch below the pyriformis. Sciatic nerve must be isolated and protected through out the procedure. Variations of its coarse must be kept in mind.



Anatomical variations of Sciatic nerve

SUPERIOR GLUTEAL NERVE & INFERIOR GLUTEAL NERVE

Superior and inferior gluteal nerve lies in greater sciatic notch above and below the pyriformis respectively. They can be damaged by aggressive superior or lateral retraction of the abductor muscles during Kocher-Langenbeck exposure.

MECHANISM OF INJURY

Acetabular fractures occur as force is transmitted from the femur to the pelvis via the femoral head.

The fracture pattern, therefore, is dependent on the

- Position of the hip at the time of injury,
- Direction of force and
- Magnitude of the impact.

The magnitude of displacement as well as the comminution or degree of articular impaction depends on the magnitude of the force applied as well as the strength of the bone it is applied to. A relatively low-energy injury may produce a severely comminuted fracture in an osteoporotic patient.

FRACTURE PATTERN BASED ON FORCE APPLIED

Force	Hip Abduction	Hip Rotation	Fracture pattern
Along the femoral neck	Neutral	Neutral	Anterior column with posterior hemitransverse
	Neutral	25*ER	Anterior column
	Neutral	50*ER	Anterior wall
	Neutral	20*IR	T shaped
	Neutral	50*IR	Posterior column
	Adduction	20*IR	Transtectal transverse
	Abduction	20*IR	Juxta/ infratectal transverse
Along the femoral shaft Hip flexed 90*	Neutral	Any	Posterior wall
	Abduction	Any	Transverse with posterior wall
	Adduction	Any	Posterior dislocation
Along the femoral shaft Hip extended	Neutral	Any	Posterosuperior wall fracture
	Abduction	Any	Transtectal transverse

ER-External Rotation IR-Internal Rotation

Courtesy: Rockwood and green ,Fracture in adults 6th edition

FRACTURE CLASSIFICATION

Classification of acetabular fractures is a key element in understanding the injury and is the first stage of surgical planning. Decisions concerning the choice of approach and the alternative fixation techniques available require full appreciation of the fracture anatomy.

In our Institution, We are following Judet and Letournel classification because it is simple and useful in planning the treatment.

Letournel and Judet's anatomical classification is divided into two groups: elementary and associated fractures, with five patterns in each.

JUDET AND LETOURNEL CLASSIFICATION[13]

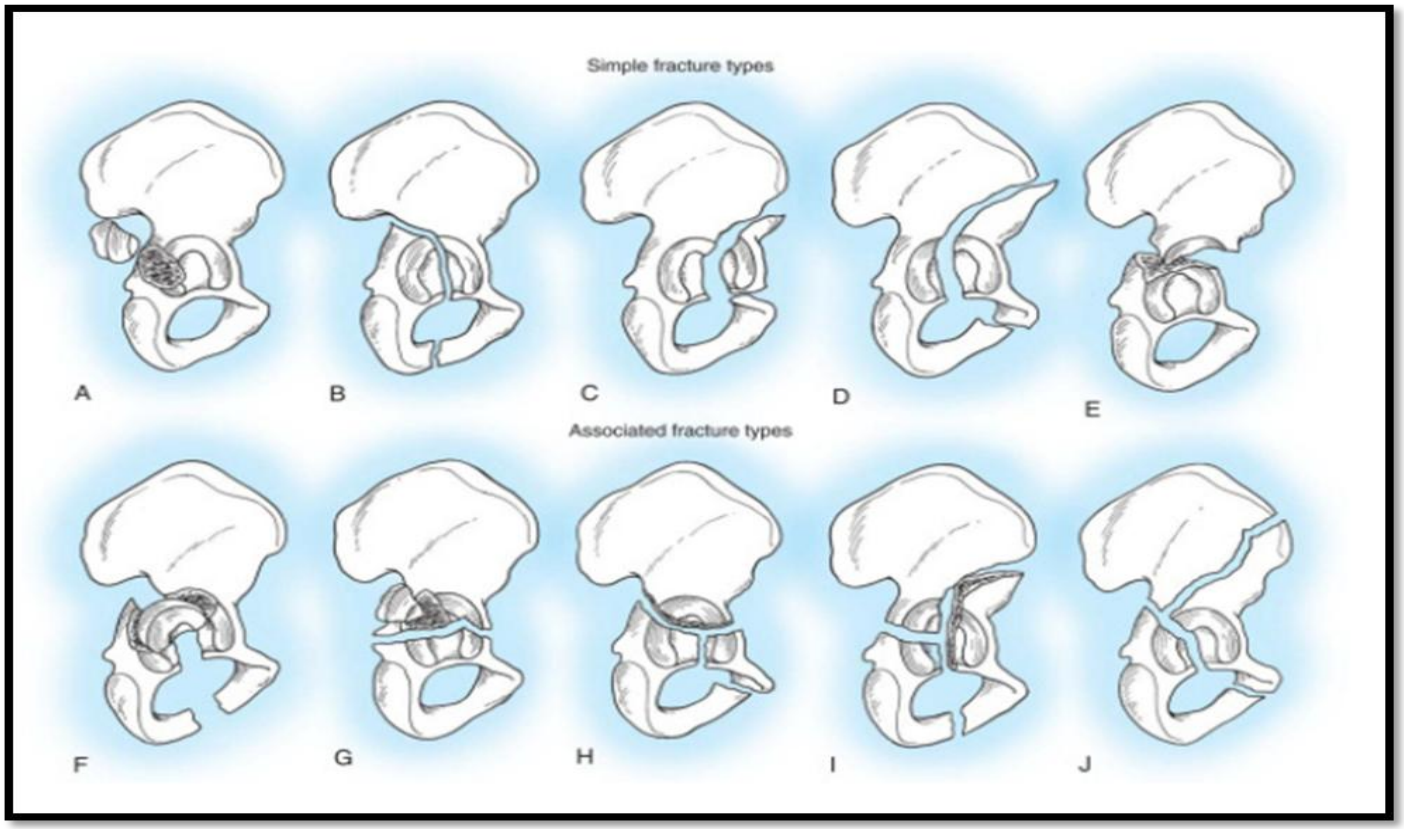
ELEMENTARY TYPES

- Posterior wall
- Posterior column
- Anterior wall

- Anterior column and
- Transverse fractures.

ASSOCIATED FRACTURE TYPES

- T type fractures
- Combined fractures of the posterior column and wall
- Combined transverse and posterior wall fractures
- Anterior column fractures with a hemitransverse posterior fracture and
- both-column fractures.



Letournel and judet classification

Tile described a modification of Letournel's classification .This modification enables these complex fracture patterns to be categorized into the A, B, and C types of the comprehensive classification of fractures developed by the Arbeitsgemeinschaft Fu¨r Osteosynthesefragen. The goal of this modification is to *"allow surgeons to speak the same language"* and to aid in determining prognosis.

COMPREHENSIVE CLASSIFICATION: ACETABULAR FRACTURES

Type A: Partial articular fractures, one column

A1 Posterior wall fracture

A2 Posterior column fracture

A3 Anterior wall or anterior column fracture

Type B: Partial articular fractures, transverse

B1 Transverse fracture

B2 T-shaped fracture

B3 Anterior column and posterior hemitransverse fracture

Type C: Complete articular fractures, both columns

C1 High

C2 Low

C3 Involving sacroiliac joint

COMPREHENSIVE CLASSIFICATION: ARTICULAR SURFACE MODIFIERS

a: Femoral head subluxation

a1 Femoral head subluxation, anterior

a2 Femoral head subluxation, medial

a3 Femoral head subluxation, posterior

§: Femoral head dislocation

§1 Femoral head dislocation, anterior

§2 Femoral head dislocation, medial

§3 Femoral head dislocation, posterior

x: Acetabular surface

x1 Acetabular surface, chondral lesion

x2 Acetabular surface, impacted

d: Femoral head surface

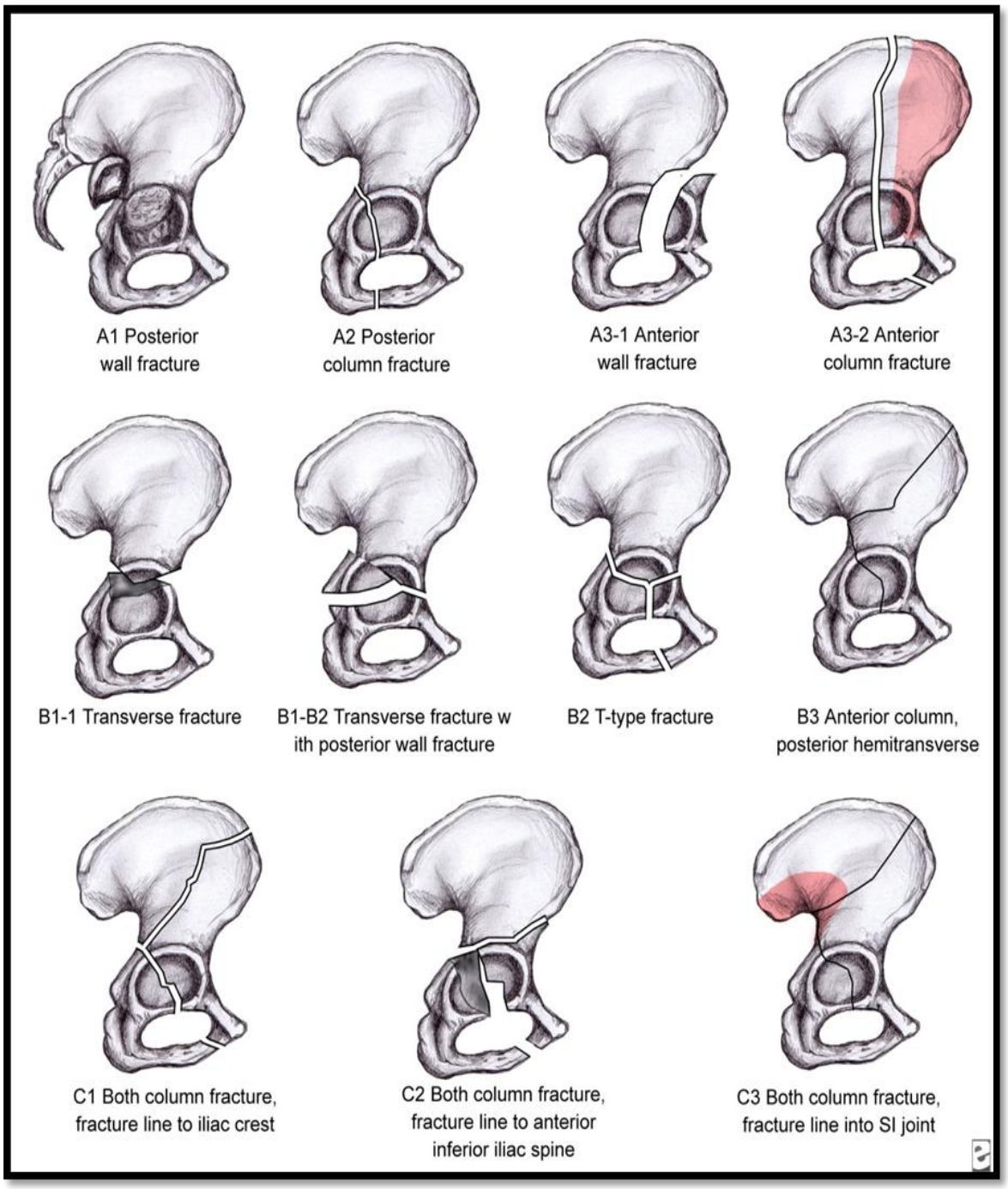
d1 Femoral head surface, chondral lesion

d2 Femoral head surface, impacted

d3 Femoral head surface, osteochondral fracture

e1 Intra-articular fragment requiring surgical removal

ø1 Nondisplaced fracture of the acetabulum



AO classification

CLINICAL AND RADIOLOGICAL ASSESSMENT

On receiving the patient in emergency department, general condition was assessed rapidly. Primary survey of Airway, Breathing and hemodynamic status was assessed and resuscitation was done . Secondary survey was done in detail which includes complete skeletal examination, examination of abdomen and pelvis and CNS.

History is important as the mode of injury gives the magnitude of force and its direction, on which the pattern, displacement and comminution of fracture depends and it was taken in detail .

A thorough physical examination includes inspection for external injuries, wounds, contusions and bruises was done . Special attention was given to look for Morel Levelle lesion , bleeding per urethral meatus, rectal tear and other perineal injuries. Attitude of the injured limb and its distal neurovascular status was assessed .

Rectal examination is done to rule out rectal tear and central dislocation of head of femur which is palpated as a globular mass.

RADIOLOGICAL INVESTIGATIONS :

After clinical assessment , patient was shifted for radiological assessment if the patient condition was hemodynamically stable .

Three radiographic views of acetabulum and CT Scan forms the standard protocol.

- Anteroposterior pelvis
- Judet views- obturator and iliac oblique views.
- CT scan

ANTEROPOSTERIOR PELVIS

The following lines were looked in a anteroposterior view

Iliopectineal line comprises Anterior 3/4 corresponding to pelvic brim, and Posterior 1/4 corresponding to lower half of

internal surface of the sciatic buttress and roof of greater sciatic notch.It represents anterior column.

Ilioischial line corresponds to quadrilateral surface. It represents posterior column.

Teardrop formed by Internal limb - outer wall of obturator canal, External limb –medial surface of middle 1/3 of cotyloid fossa and Inferior border- ischiopubic notch

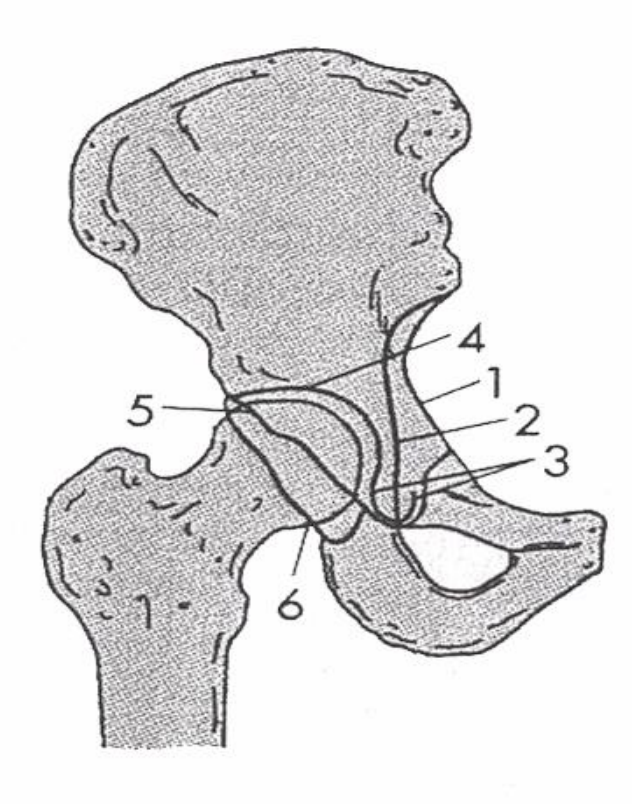
Acetabular roof *r*epresents the superior weight bearing area of the acetabulum

Anterior / posterior walls represents the lateral extensions of articular surfaces

Other associated pelvic fractures ,femoral head fractures , and congruency of femoral head in acetabulum can also be visualized.

.

Antero posterior View showing Acetabular landmarks



1-Iliopectineal line

2-Ilioischial line

3-Tear drop

4-Medial wall of acetabulum

5-Anterior wall

6-Posterior wall

JUDET OBLIQUE RADIOGRAPHS

These are 45° oblique pelvic radiographs.It emphasizes acetabular columns. Coccyx tip should lie above the center of the femoral head to ensure adequate rotation

OBTURATOR (INTERNAL) OBLIQUE

This view is taken with injured side up. Coccyx is centered over ipsilateral femoral head.

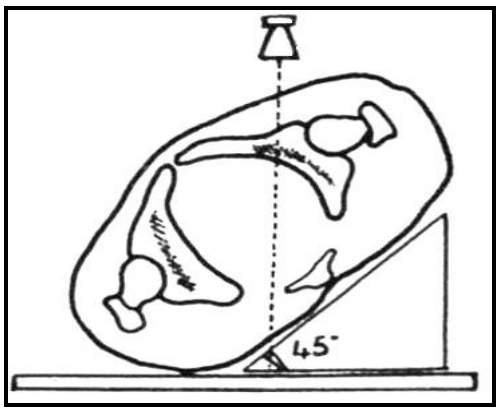
- ❖ Obturator foramen in profile
- ❖ Highlights pelvic brim, anterior column and posterior wall
- ❖ Assess congruency of femoral head in acetabulum .

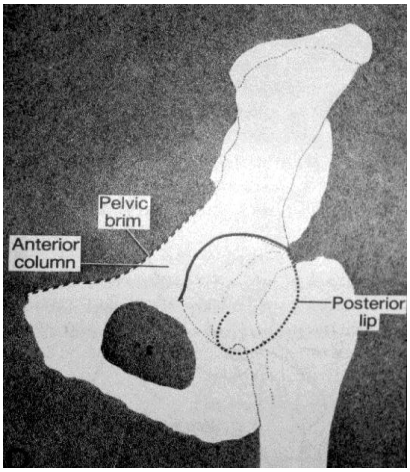
ILIAC (EXTERNAL) OBLIQUE

This view is taken with injured side down. Coccyx is centered over contralateral femoral head.

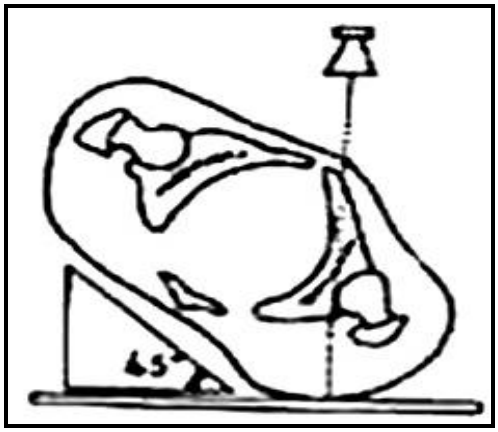
- ❖ Iliac wing in profile
- ❖ Highlights posterior column, anterior wall, posterior border of innominate bone and quadrilateral plate
- ❖ Assess congruency of femoral head in acetabulum .

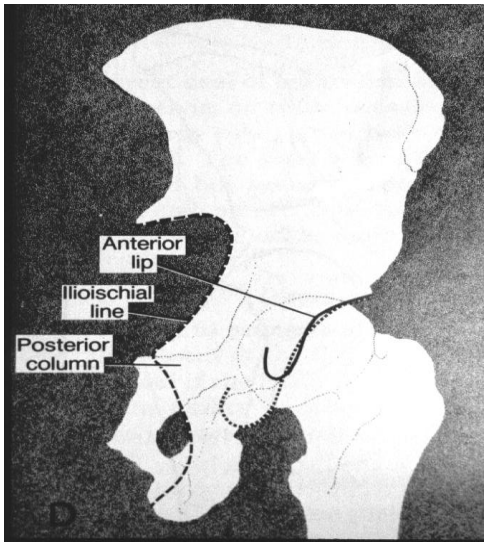
Obturator oblique view





Iliac oblique view





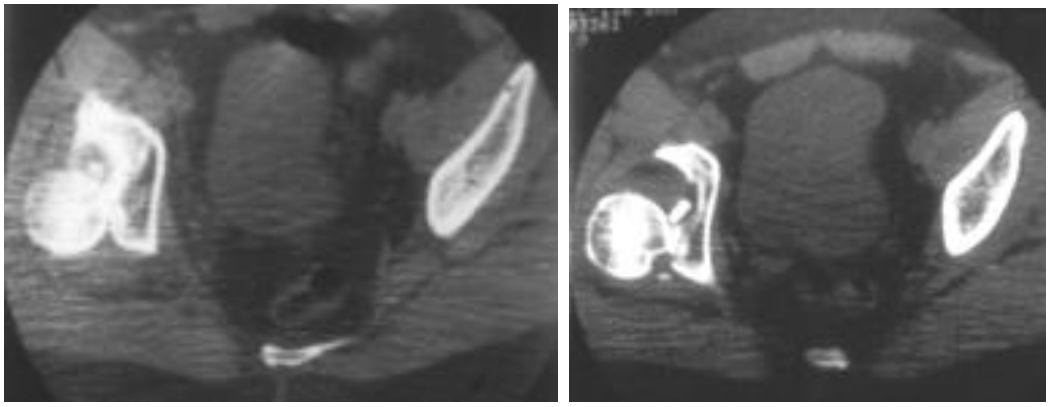
CT SCAN

CT scan helps in identification of fracture lines not visualized by radiographs. Orientation of fracture line, vertical portion of T-type acetabular fracture and rotation of fracture fragments are well made out . CT Scan may give additional informations regarding

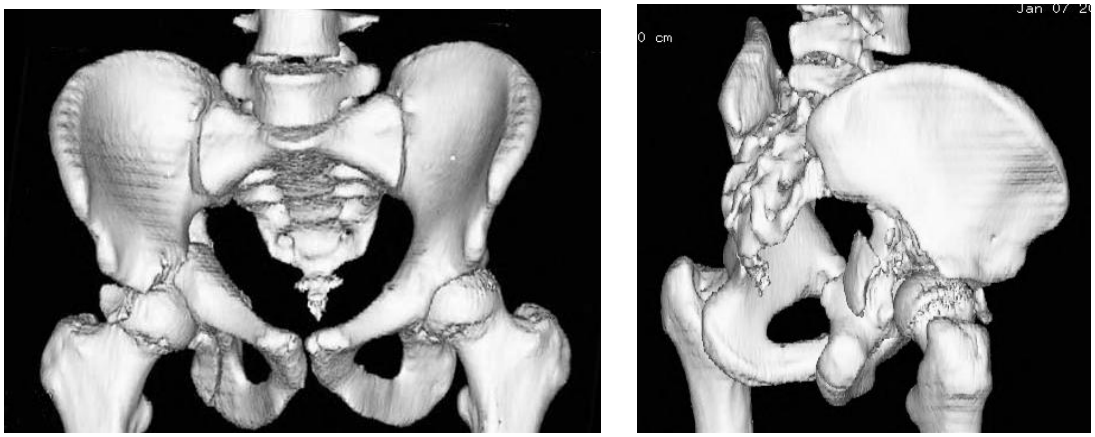
- Intra-articular loose fragments
- Marginal impacted fragment
- Degree of fracture comminution
- Position of the femoral head
- Femoral head lesions
- Joint Congruence
- Sacroiliac joint and the posterior pelvic ring

3-D CT SCAN

It is converted from 2 dimensional CT scan data. 3D CT allows for subtraction of femur and varying degree of rotation of pelvis which provide a good overall picture of the fracture configuration.



CT cuts of Acetabulum



3 D reconstruction view of pelvis

SURGICAL EXPOSURES

Surgical exposure is of great value in acetabular fracture surgery as accurate reduction and fixation can be possible with good surgical exposure .

Extensile approaches like extended iliofemoral and triradiate have much complications like skin necrosis , vascular compromise to abductors and heterotopic ossification in particular . We had used non extensile approaches either alone or in combination .They are

1. Anterior ilioinguinal approach

2. Posterior Kocher Langenbeck approach.

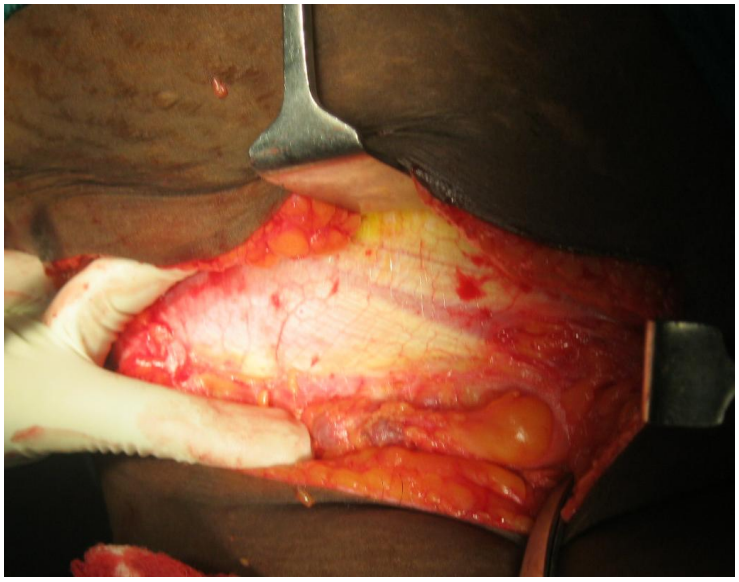
Anterior ilioinguinal Approach

Patient was placed on radiolucent operating table in supine position. Skin incision was placed in midline 2 fingerbreadths above the symphysis pubis ,extended to the anterior superior iliac spine and then continued posteriorly along the line of the iliac crest.

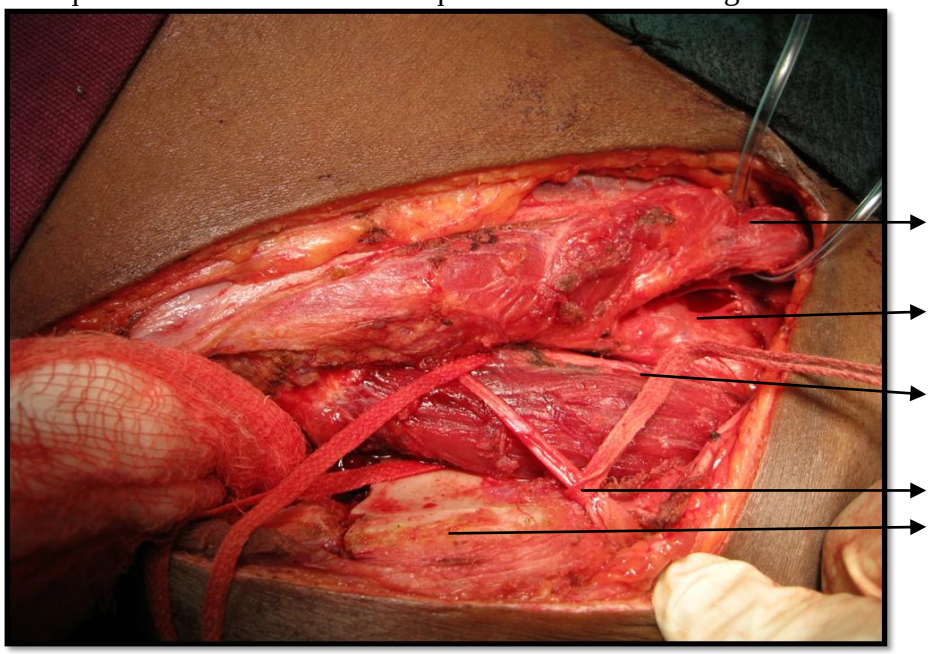
The aponeurosis of the external obliqus was incised in line with the skin incision. An incision was carefully made along the inguinal ligament from its medial attachment to the pubis to the anterior superior iliac spine along its fibres.

Three windows were created for visualisation .The first window was formed by medial retraction of the iliopsoas and femoral nerves allowing visualization of the entire internal iliac fossa, the sacroiliac joint, and the pelvic brim. After mobilizing the iliopsoas muscle , Iliopectineal fascia was palpated and its medial and lateral surfaces was defined before its division .Blunt dissection was continued below the vessels . The second window was created by lateral retraction of the iliopsoas and femoral nerve, combined with medial retraction of the external iliac vessels and third window by lateral retraction of the vessels .

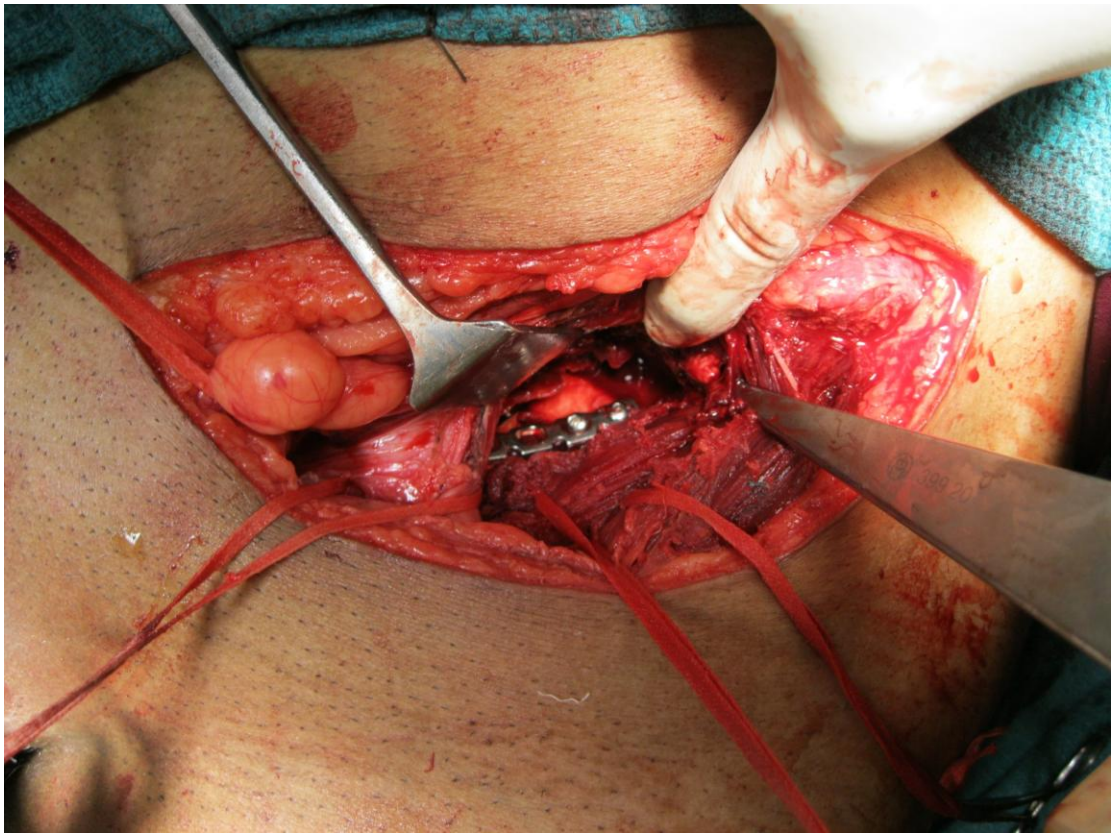
Ilioinguinal approach



Oblique fibres of external oblique with external ring



Structures dividing three windows – iliac crest,lateral cut.n. of thigh,iliopsoas with femoral nerve, femoral vessels and spermatic cord from down upwards.



Anterior ilioinguinal approach with its three windows after plating

Posterior Kocher Langenbeck Approach

The patient was usually positioned in a prone position on radiolucent table. Skin incision was placed lateral to the posterior superior iliac spine, extended to the greater trochanter, and then continued along the axis of the femur to almost the midpoint of the thigh .

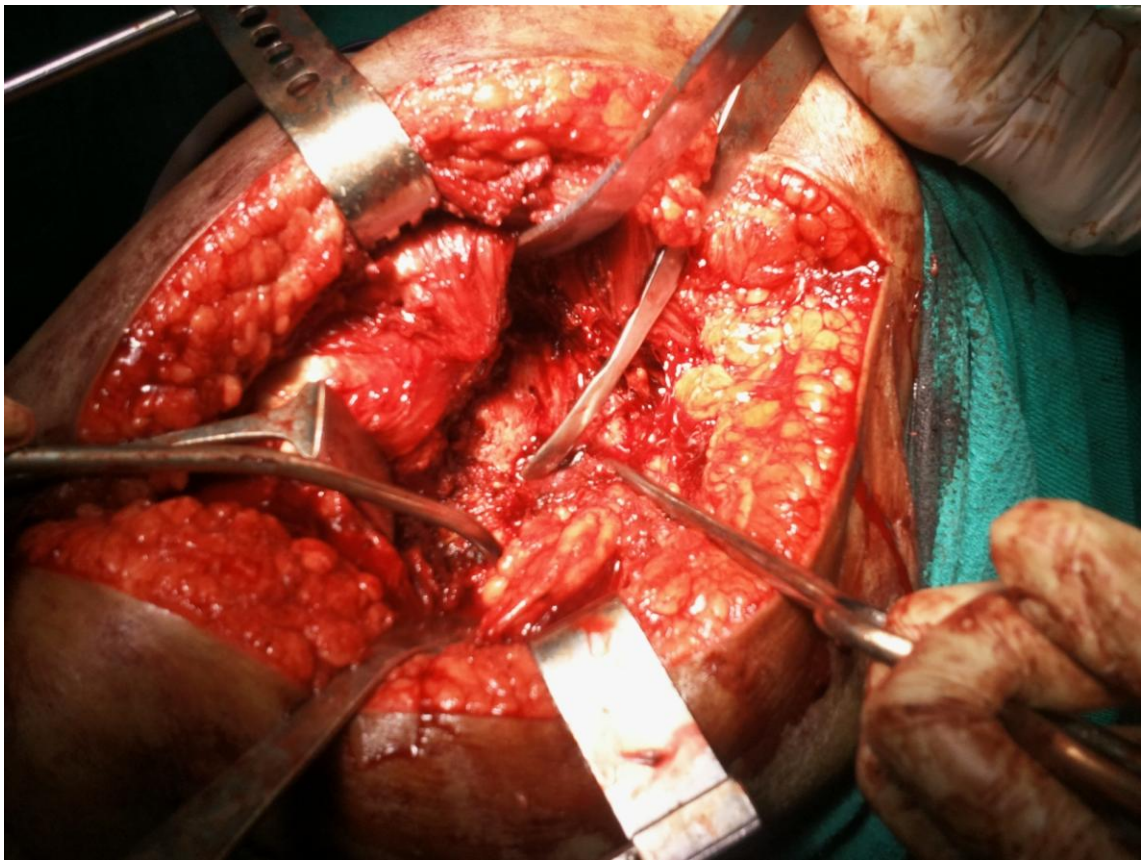
The sciatic nerve was identified on the posterior surface of the quadratus femoris and followed proximally until it disappears beneath the piriformis. The tendons of the piriformis and obturator internus are transected at their trochanteric insertion and retracted posteriorly, exposing the greater and lesser sciatic notch.

Subperiosteal elevation was done to exposes the inferior aspect of the iliac wing.

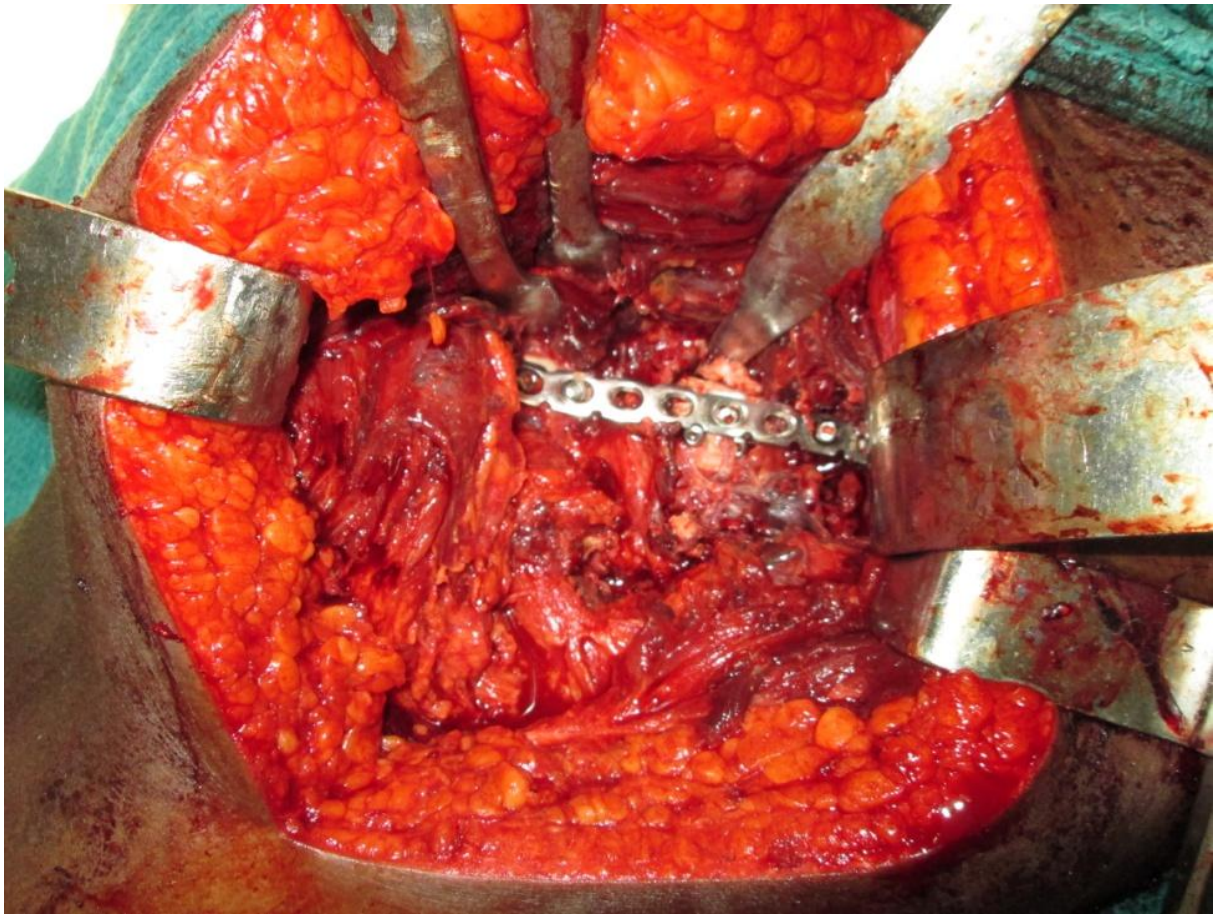
A trochanteric osteotomy can help in further visualization of the inferior iliac wing and the interior of the joint. Alternatively, the tendon of the gluteus medius can be partially transected. The

gluteus maximus tendon was transected at its femoral insertion if needed

Kocher Langenbeck Approach



Posterior Kocher Langenbeck approach exposed short external rotators.



Posterior Kocher Langenbeck approach after putting lag screws and buttress plate

TREATMENT PROTOCOL

GENERAL ASSESSMENT AND RESUSCITATION

In our study , on receiving the patients in emergency room, general assessment and resuscitation was done . After stabilization of vital parameters, complete skeletal survey and associated injuries especially vascular and nerve injuries was assessed.

Radiological assessment was done with anteroposterior, judet views of acetabulum and computed tomography with 3-d reconstruction of acetabulum if needed.

Closed reduction was done in dislocated patients under i.v sedation and skeletal traction was applied in all patients.

TIME OF SURGERY

Open reduction and internal fixation was done within 5 to 7 days of injury.

PRE OPERATIVE PLANNING:

After completing clinical and radiological examination pre operative planning regarding approach and implant to be used was

made on basis of fracture type, displacement and associated injuries.

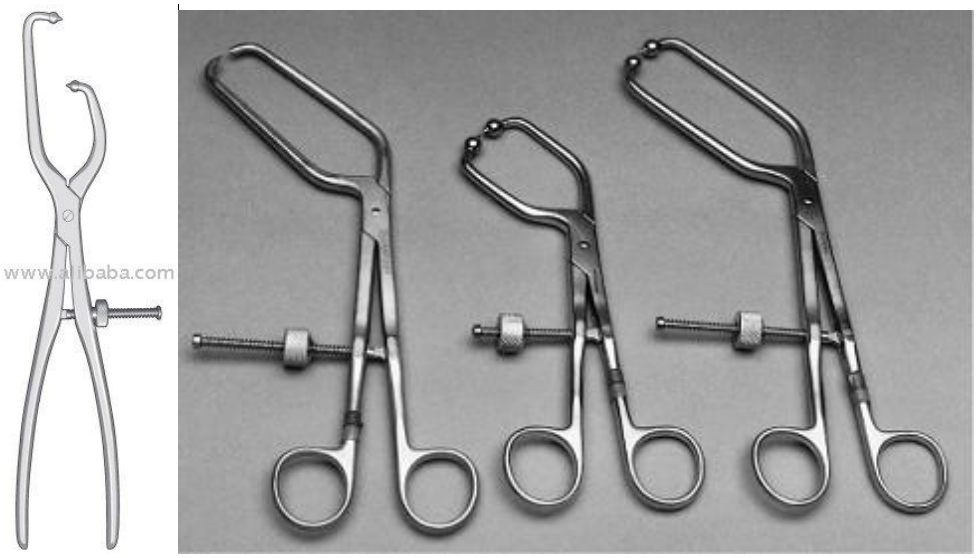
SURGICAL EXPOSURE

Surgical exposure was decided preoperatively based on fracture displacement. Kocher Langenbeck approach was used for posterior fractures and anterior ilioinguinal approach was used for anterior fractures . After reducing and fixing one column the reduction of other column was assessed by image intensifier and need for exposing the other column was made.

REDUCTION TECHNIQUES

After exposure reduction poses the challenge. Reduction cant be achieved easily as in any long bones and maneuvers are not the same . In posterior approach, schanz pins was placed in trochanter, ischial tuberosity and iliac crest for simultaneous manipulation . Various reduction clamps are available to facilitate reduction and holding. In anterior approach a farabeuf clamp or a schanz pin was placed in iliac crest to manipulate and reduce. Matta's Quadrangular clamp of various sizes and with offsets and Picador

ball spike pusher are very important instruments in Acetabular surgery. Reduction was fixed with lag screws whenever possible. Lagging was done with 4mm cancellous screws or 3.5 mm cortical screw with washer. 3.5mm Reconstruction plates are used as neutralistion plate .



Matta ‘s Quadrangular clamps

Farabeuf clamps

Multipurpose plate bender for recon plate

picador ball spike pusher with pusher

POST OPERATIVE PROTOCOL

- All patients were given pre operative antibiotics and post operatively for 5 days.
- Drain removal done on 2nd post operative day .
- Suture removal was done on post operative day 12 to 14.
- Indomethecin[15] 25mg TDS was prescribed orally for 6 weeks from next day after surgery.
- Low molecular weight heparin was given for 7 days when anterior approach is used as DVT prophylaxis .
- Passive mobilization was started on post operative day 2. Active movements started gradually in accordance with pain.
- Weight bearing was allowed as the fracture consolidates mostly on the 3rd or 4th month

- Radiological and functional examination was done on monthly review for first 6 months and third monthly there after.

ANALYSIS

Patients in our study were analysed by the Matta's radiographic assessment post operatively and modified Merle d' Aubigné and postel Hip Score at each follow up.

Functional Outcome

Modified Merle'd Aubigné And Postel Grading System:

CLINICAL GRADING SYSTEM

Pain

None - 6

Slight or intermittent -5

After walking but resolves -4

Moderately severe but patient is able to walk -3

Severe, prevents walking -2

Walking

Normal -6

No cane but slight limp -5

Long distance with cane or crutch -4

Limited even with support -3

Very limited -2

Unable to walk -1

Range of motion*

95-100% -6

80-94% -5

70-79% -4

60-69% -3

50-59% -2

<50% -1

Clinical score

Excellent -18

Good -17,16,15

Fair 13 or 14

Poor <13

*The range of motion is expressed as the percentage value for the normal hip. This is calculated by obtaining a total of the ranges, in degrees, of flexion-extension, abduction, adduction, external rotation, and internal rotation for the injured hip and dividing it by the total for the normal hip.

Post operative Radiological assessment:

Matta's criteria

Anatomic reduction <1mm;

Imperfect 1–3mm;

Poor >3mm.

METHODS AND MATERIALS

This is a prospective study done to assess the functional and outcome of complex acetabular fractures treated by open reduction and internal fixation in 20 patients over the period of two and half years from April 2010-October 2012 at Our Institute of Orthopaedics and Traumatology , Madras medical college and Rajiv Gandhi Government general hospital, Chennai.

Inclusion criteria consists of

- Age greater than or equal to 18 years ,
- Closed fractures,
- Complex acetabular fractures including
  - Transverse fractures,
  - Transverse with posterior wall fracture,
  - T Type fracture,

- Anterior column or wall with posterior hemitransverse fracture ,
- Both column fractures.

Excluson criteria are

- Open injuries,
- simple fractures,
- fracture greater than 3 weeks old ,
- patient operated within last six months

In our study after general resuscitation of the patients, a detailed clinical examination and radiological assessment was done.

Patients were put on skeletal traction. Patients were operated between 5 to 10 days based on Damage Control Orthopaedics .

AGE INCIDENCE AND DISTRIBUTION

The Mean age of the patients was 35.45 year ranging from 18 to 60 years.

Age	No of Patients	Percentage
< 20 Years	03	15 %
21 to 30 Years	05	25%
31 to 40 Years	07	35%
41 to 50 Years	02	10%
51to 60 years	03	15%

Sex Incidence

Males dominated in our study with M:F ratio of 9:1 .

MODE OF INJURY

Majority of the patients suffered Road Traffic Accidents followed by Fall from Height.

Mode of injury	No . of Patients	Percentage
RTA	16	80%
Fall from Height	4	20%

FRACTURE DISTRIBUTION

Fracture type (Judet and Letournal)	No. of Patients	Percentage
Transverse	7	35%
Transverse with posterior wall	4	20%
Anterior column with posterior hemitransverse	2	10%
T type	4	20%
Both column	3	15%

ASSOCIATED INJURIES

In our study 8 patients had associated injuries.

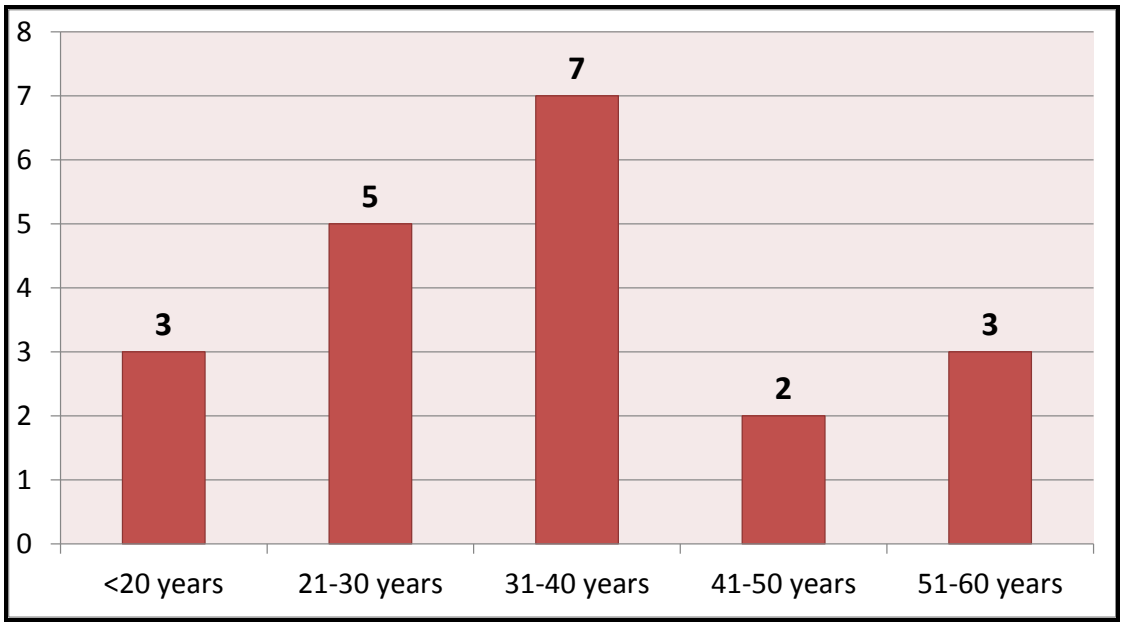
Associated injuries	No. of Patients
Fracture of clavicle	1
Fracture of Distal radius	2
Fracture of superior pubic rami B/L	1
Fracture of Inferior pubic rami B/L	1
Fracture Neck Of contralateral Femur	1
Intertrochanteric Fracture of ipsilateral Femur	1
Fracture shaft of contralateral Femur	1
Fracture supracondylar femur ipsilateral side	1
Fracture both bone contralateral leg	2
Fracture Medial malleolus contralateral side	1
Fracture Metacarpal	1
Sciatic Nerve palsy	1
Urethral injury	1

SURGICAL APPROACHES

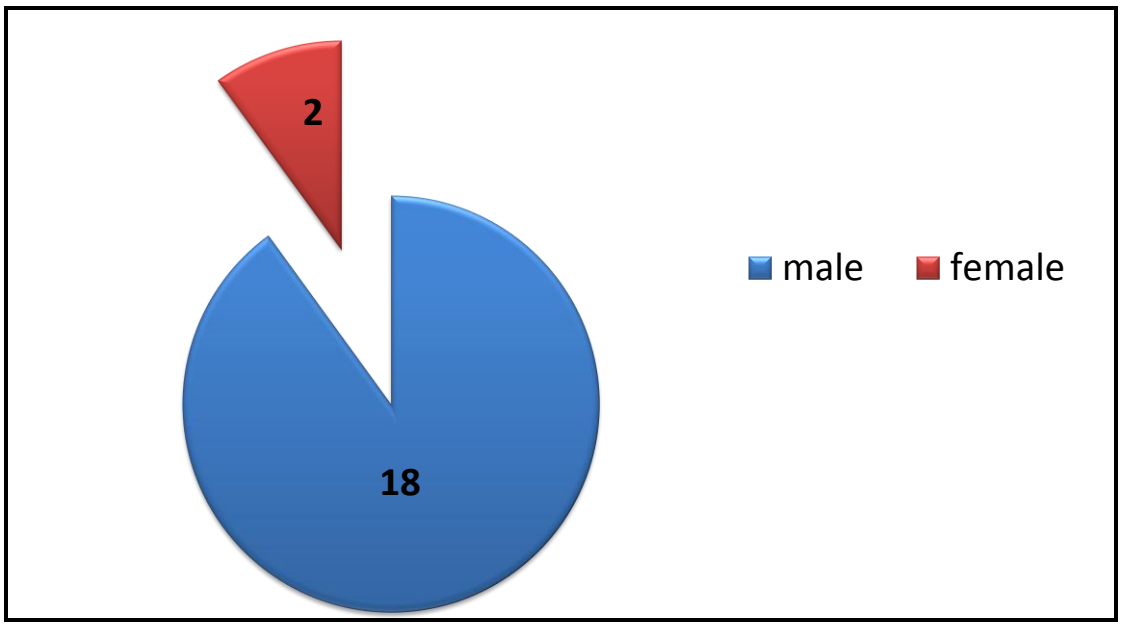
Procedure	No.of Patients
Kocher Langenbeck Approach	14
Ilioinguinal Approach	3
Ilioinguinal approach Followed by Kocher langenbeck Approach	1
Kocher Langenbeck Approach followed by ilioinguinal approach	2

Radiologic assessment was done post operatively by Matta's criteria and Functional status of the patient was assessed by Modified Merle'd Aubinge and Postel score .

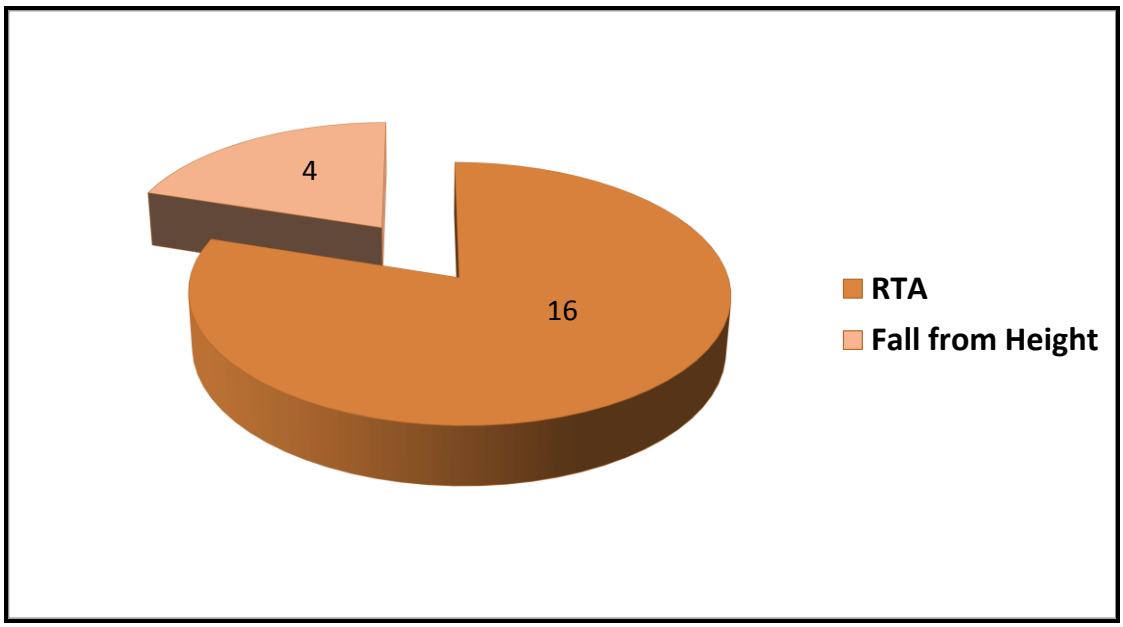
AGE DISTRIBUTION



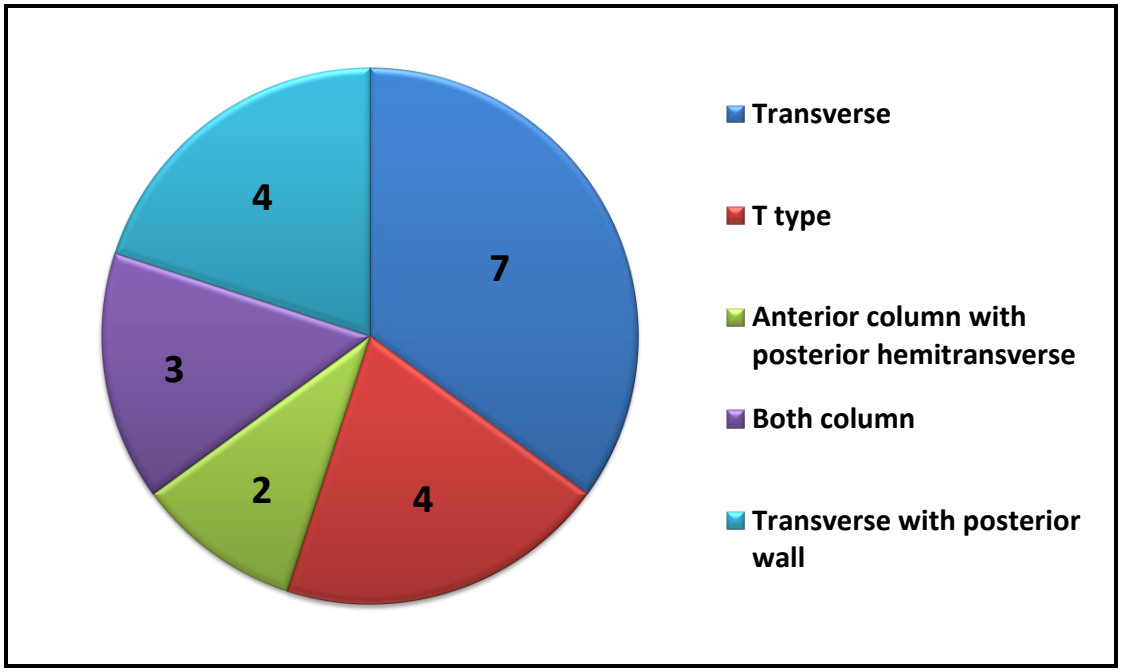
SEX DISTRIBUTION



MODE OF INJURY



FRACTURE DISTRIBUTION (TOTAL NO. OF CASES 20)



OBSERVATION AND RESULTS

Twenty patients with complex acetabular fractures were treated surgically and analysed with average follow up of 10.5 months ranging from 6 months to 2 ½ years .

The following observations were made .

1) 75% belong to less than 40 years. 35% patients belong to 4th decade followed by 3rd decade (25%).

2) Males dominated our study group with a ratio of 9: 1

3) Road traffic accidents contributed to the injury in 80% of our patients and rest sustained by fall from height .

4) Transverse fracture was the most common type in our study (7 cases). Anterior column with posterior hemitransverse was least common type (2 cases).

5) Eight patients had associated skeletal injuries. One patient had sciatic nerve injury and one patient had urethral injury.

6) Most of the patient were operated by Kocher langenbeck approach (17 Patients). Three patients was operated by ilioinguinal approach. Three patients was operated by combined approach.

7) In contrast to pelvic injuries, all patients were hemodynamically stable at the time of admission.

8) In our study the average surgical time delay was 6 days ranging from 5 to 11 days.

9) The average surgical time was 127 minutes ranging from 60 minutes to 4 hours.

10) Four patients have encountered operative complications.

One patient operated by ilioinguinal approach had superficial infection which settled with antibiotics .

One patient had a deep circumflex vein tear managed by ligation following which he developed DVT that resolved with heparin.

One patient was found have intraaticular screw after being operated via anterior approach.

One patient operated by posterior Kocher langenbeck approach developed sciatic nerve palsy.

11) No patient had sacroiliac disruption or pubic diastasis.

12) No patient died during treatment or follow up.

13) According to Matta's criteria, 6 patients had anatomic reduction, 7 patients had satisfactory reduction and 7 patients had poor reduction (>3mm gap).

14) The mean score in anatomically reduced fractures was 15.1 , in imperfect reduction is 15.8 and in poorly reduced fracture is 14.5

14) Out of 18 patients, four patients had excellent , eight patient had good , five patient had fair and 1 patient had a poor results.

15) 60% patient are having near normal life and 94% patient are having satisfactory result in our study.

16) Function outcome score for the patients ranged from 10 to 18 (Maximum Score- 18).

17) The poor result (Score-10) in one patient was due to Avascular necrosis of femoral head . Patient had transverse with posterior wall fracture operated by posterior Kocher Langenbeck approach. Total hip replacement was done for this patient at 8 months after surgery.

16) There are seven patients with transverse fracture . one was lost to follow up. All patients with transverse fracture had excellent or good result except one patient who had fair result due to associated multiple skeletal injuries in lower limb .

17) Two patients with both column fracture was operated by anterior Ilioinguinal approach and one patient had excellent and other had good result.

18) Associated posterior wall fracture had reduced the outcome score .

19) T type fracture , Anterior column with posterior hemitransverse and Transverse with posterior wall fracture had reduced outcome score than other two types .

Fracture	**No**	**Average score**	**Result**			
			Excellent	**Good**	**Fair**	**Poor**
Transverse	6	16.5	2	3	1	0
Transverse with posterior wall	4	14.5	0	2	1	1
Anterior column with posterior hemitransverse	2	14.5	0	1	1	0
T type	4	15	1	1	2	0
Both column	2	17	1	1	0	0

DISCUSSION

The treatment of simple acetabular fractures has been studied in detail and there has not been much of change over time. The options for treatment of complex acetabular fractures are wide and are continuously refined over time. The treatment of complex acetabular fracture is difficult because it involves both the columns and reduction of the both by single or double approach is must.

The mean age group in our study was 35.4 years which is comparable with Swiontkowski et al[2] on complex acetabular fracture. Males predominated as in other studies[2] .Road traffic accident forms the major mode of injury .

The highlight of open reduction and internal fixation is anatomic reduction, rigid fixation and early mobilization which will keep the joint functional as described by Matta[5] . Pennal et al [18] reported that the quality of the clinical result depends directly on the quality of the reduction that was achieved when open reduction and internal fixation were performed . In our study , there is decreased mean functional score (14.5) in the fracture group with

poor reduction compared to rest (Anatomical Reduction 15.1 and Imperfect reduction -15.8).

Management of displaced acetabular fracture requires adequate exposure with minimal morbidity. An ideal approach would allow visualisation of both columns and the joint surface with minimal complications. We used only two non extensile approaches - Posterior Kocher Langenbeck approach and anterior Ilioinguinal approach.

We used single approach in most of the patients except in 3 patients . With this single approach we are able to get 65% of satisfactory reduction and 94% of favorable result in short term. According to Tile , even with best hands depending on the type and complexity of fracture , anatomic reduction can be obtained in 70% cases of acetabular fractures . In our study we included only complex fractures and we were able to get satisfactory reduction in 65% patients.

H. J. Kreder et al listed factors influencing the outcome[19]- degree of initial displacement, damage to the superior weight

bearing dome or femoral head, degree of hip joint instability caused by posterior wall fracture, adequacy of open or closed reduction and late complications like AVN, heterotrophic ossification, chondrolysis or nerve injuries are assessed. In our study associated posterior wall fracture has reduced the functional outcome .

Giannoudis et al [20] in his meta-analysis reported 5.6 % of AVN in posterior approaches . In our study , We had a case of avascular necrosis of femoral head leading to poor outcome (5%) . Patient came with AVN at 8 month follow up for whom total hip replacement was done .

Extensile approaches around the hip joint have reported a high rate of complications. Alonso et al. reported 53% incidence of heterotopic ossification with Triradiate approach and 86% incidence with the use of Extended iliofemoral approach. No case of heterotopic ossification has been encountered till date in our study . Heterotopic ossification was reported as high as 20% in non extensile approaches used for complex fractures accoording to Jiong Jiong Guo, et al .We used Indomethacin for patients for 6 weeks as prophylaxis for heterotopic ossification.

Giannoudis et al [20] reported 8% of iatrogenic sciatic nerve palsy in posterior approaches. In Our Study ,We report one case of sciatic nerve palsy in posterior approach (5.8%) . Swiontkowski et al[2] also showed 8.3 % iatrogenic sciatic nerve palsy in his study. one case of DVT in anterior ilioinguinal approach .We had a case of intra articular screw penetration in anterior approach, but the patient was asymptomatic and had excellent functional outcome.

The complication rate is very low when compared to Matta[5] and Swiontkowski studies[2]

The non-extensile approaches which we advocated have operating time and average blood loss which are similar to those reported by others (Matta et al ı986;Goulet and Bray 1988 ; Reinert et al 1988 ; Routt and Swiontkowski 1990 ; Helfet et al 1992).

The mean functionl outcome score is 15.4 ranging from 10 to 18 (Maximum—18). The least score is seen in a patient with transverse with posterior hemitransverse fracture operated by Kocher langenbeck approach and developed Avacular necrosis of femoral head .

According to Marwin M Tile , Transverse has the best and T Type and anterior column and posterior hemitransverse fracture has worst prognosis . In our study Transverse fractures and both column fractures showed better results .T Type and anterior column with posterior hemitransverse had reduced outcome .

Even though our study comprised of small group of 20 patients with good pre operative planning , use of non extensile approaches and early rehabilitation , we have been able to produce 94 % good to satisfactory result according to modified Merle d Aubigne and Postel scoring systems. However, further follow up is needed to comment on long term outcome .

CONCLUSION

From our study , We conclude that

Complex acetabular fractures treated by open reduction and internal fixation have a satisfactory functional outcome .

Use of non extensile approaches itself is sufficient to produce adequate fracture reduction with reduced complications.

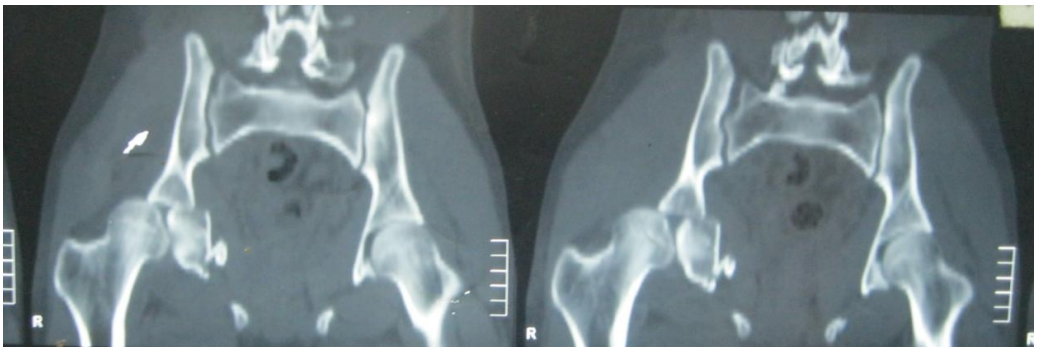
Every chance of reducing the fragments anatomically, fixing rigidly and mobilizing early must be done for better function which is not possible by conservative means..

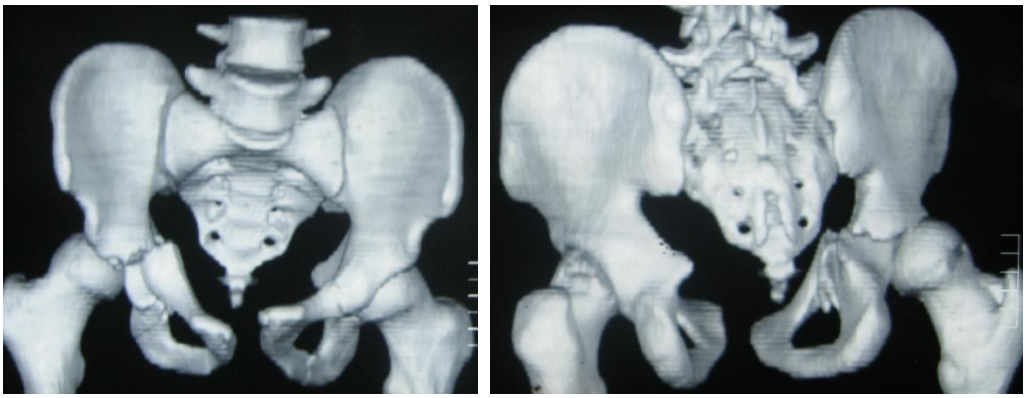
Treatment of acetabular fractures is a challenging task for any orthopaedic surgeon. With definite learning curve , proper pre operative planning , non extensile exposure , accurate reduction , rigid fixation and early rehabilitation , it is possible to produce a improved outcome .

CASE-1

20 years old male patient sustained Road traffic accident and was diagnosed to have Transverse fracture of right Acetabulum. He was operated on 5th day . Open reduction and Internal fixation done by posterior Kocher Langebeck Approach . Immediate post operative X ray showed reduction of both columns . With 1 Year of follow up ,Patient showed Excellent result .

PRE OPERATIVE RADIOLOGY



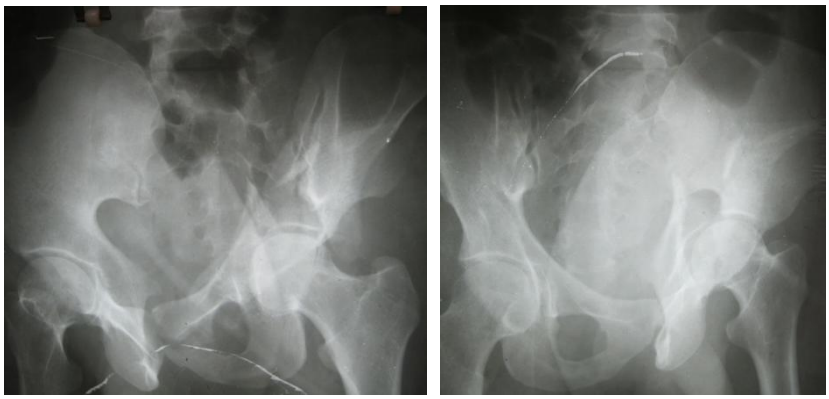


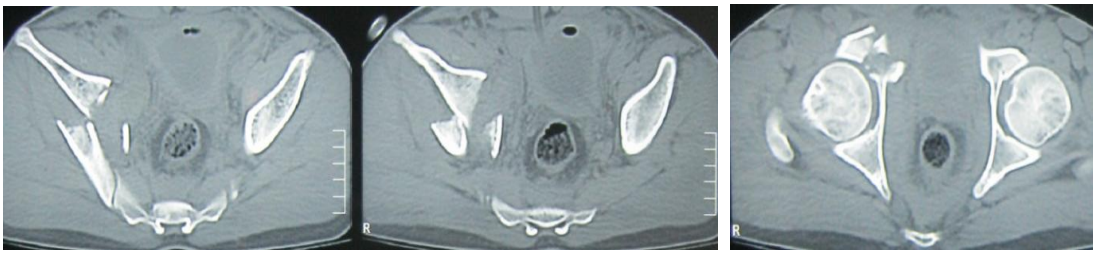
ONE YEAR FOLLOW UP

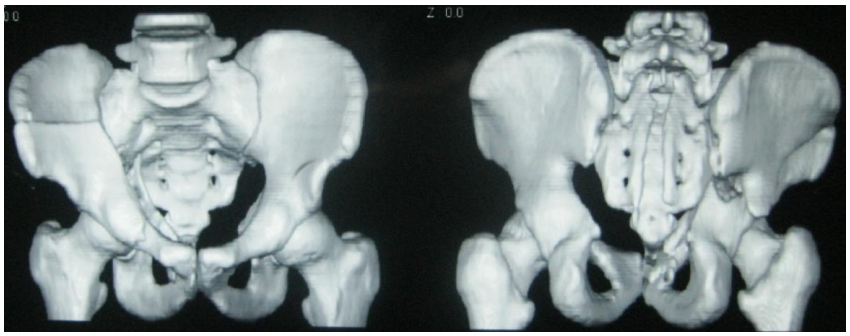
CASE-2

32 years male patient sustained a fall from electric transformer. He was diagnosed to have both column fractures of right Acetabulum .Patient had associated urethral injury treated by Supra pubic cathetrisation and distal radius fracture treated with closed manual reduction and plaster immobilization .With delay in 7 days Open reduction and internal fixation done by Anterior ilioinguinal approach . After one and half year follow up patient showed excellent result .

PRE OPERATIVE RADIOLOGY





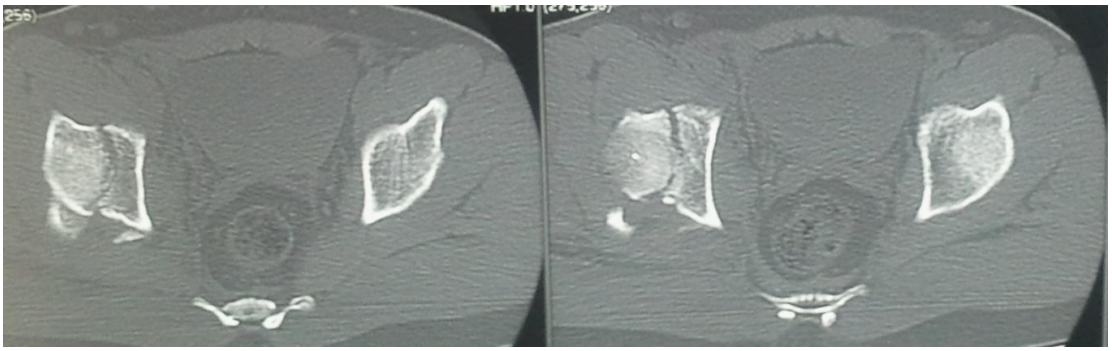


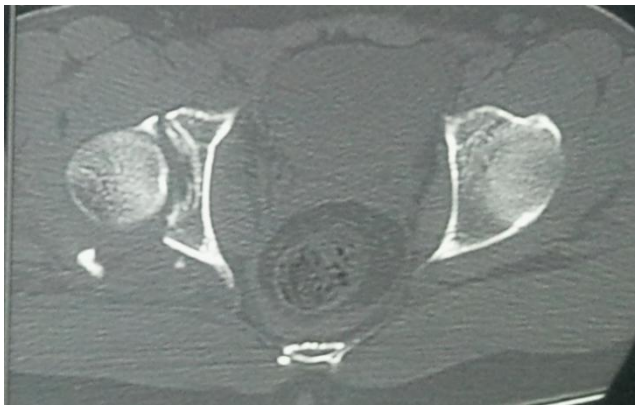
ONE AND HALF YEAR FOLLOW UP

CASE-3

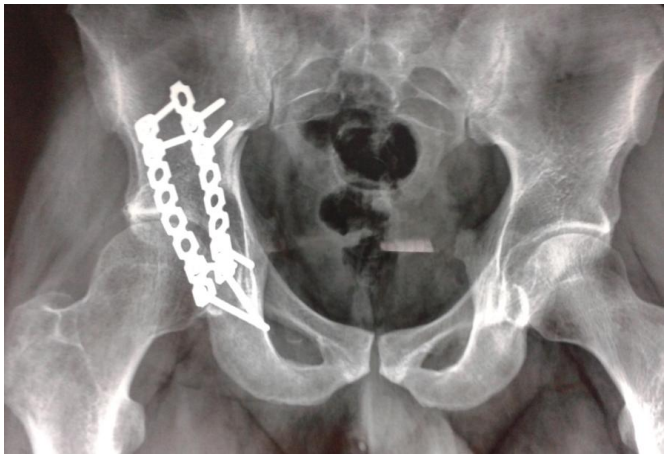
29 years old male sustained road traffic accident and diagnosed to have Transverse fracture with posterior wall fracture with posterior dislocation of right Acetabulum. Dislocation reduced by closed manual reduction. Patient had associated 4^{th} metacarpal fracture treated conservatively. With delay in 9 days open reduction and internal fixation done by posterior Kocher langenbeck approach. After nine months post op patient showed good result .

PRE OPERATIVE RADIOLOGY





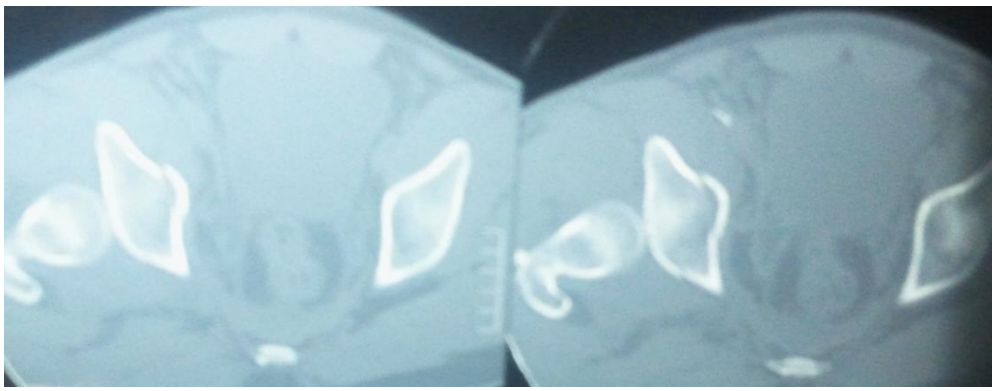
NINE MONTH POST OP



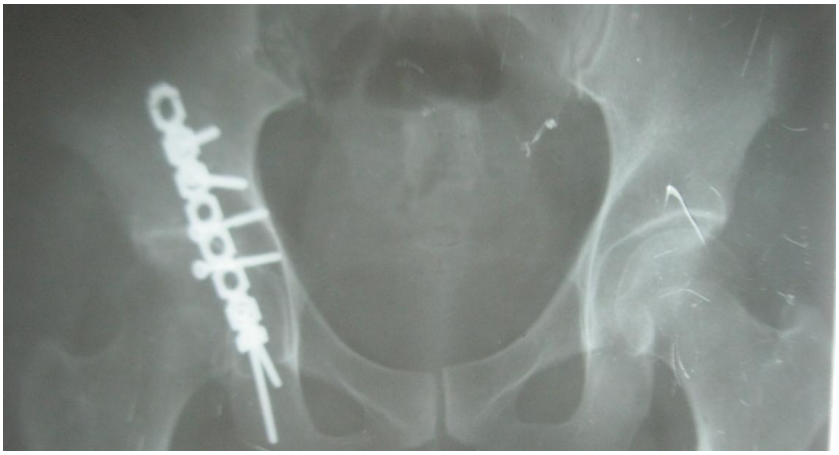
CASE-4

29 year old male sustained Road traffic accident while driving bike. He was diagnosed have Transverse with posterior wall fracture with posterior dislocation right side. Closed manual reduction done on day 1 and put on upper tibial pin traction. With five days of delay, open reduction and internal fixation was done by kocher langenbeck approach. Patient developed sciatic nerve palsy post operatively. At ten months post operative follow up, patient showed good result. Sciatic nerve palsy not recovered tiill now.

PRE OPERATIVE RADIOLOGY



TEN MONTHS FOLLOW UP



S. No	Name & IP No	Age years	Sex	Date of Admission	Mode Of injury	Diagnosis	Asso. Injuries	Date Of surgery	Time Delay In days	Procedure	Surgical time	Complications	Follow Up	Outcome Total=18	Result
1	Victoria vani 60425	20	F	4.5.10	RTA	Transverse # Rt	Nil	9.5.10	5	ORIF Via Kocher langenbeck approach	90 min	Nil	2 ½ years	15	Good
2	John basha 66402	20	M	27.5.10	RTA	Transverse # Rt	Nil	1.6.10	5	ORIF Via Kocher langenbeck approach	100 min	Nil	1 year	18	excellant
3	Veerasekar 23850	21	M	29.5.10	FALL	Transverse # Rt	Nil	4.6.10	6	ORIF Via Kocher langenbeck approach	60 min	Nil	1 year	17	good
4	Guru 78212	56	M	24.9.10	RTA	T Type # Lt	Nil	1.10.10	7	ORIF Via kocher langenbeck approach followed by ilio inguinal approach	4 Hours	Deep circumflex vein tear, DVT	1 year	13	Fair
5	Shakthi 81893	35	M	6.10.10	RTA	Anterior column with posterior hemitransverse# Lt	#BB Leg Rt,Medial Malleolus # Rt	11.10.10	5	ORIF Via Kocher langenbeck approach	100 min	Nil	7 mon	13	Fair
6	Manikandan 83384	32	M	7.12.10	FALL	Both column # Rt	Distal radius # Rt, Urethral injury	14.12.10	7	ORIF Via Ilioinguinal Approach	120 min	Nil	1 ½ years	18	excellant

S. No	Name & IP No	Age years	Sex	Date of Admisssion	Mode Of injury	Diagnosis	Asso. Injuries	Date Of surgery	Time Delay In days	procedure	Surgical time	Complications	Follow Up	Outcome Total=18	Result
7	Velayutham 37042	45	M	28.4.11	RTA	Anterior column with posterior hemitransverse# Rt	Sciatic nerve palsy	2.5.12	5	ORIF Via ilio inguinal approach followed by kocher langenbeck approach	120 min	Infection	8 mon	16	good
8	Saravanan 57521	37	M	20.5.11	RTA	Transverse # Rt	# NOF, #SOF Lt, #IT Rt femur	27.5.11	7	ORIF Via Kocher langenbeck approach	110 min	Nil	6 mon	13	fair
9	Nandakumar 46807	23	M	29.5.11	RTA	T Type # Lt	Nil	6.6.11	8	ORIF Via Kocher langenbeck approach	120 min	Nil	1 ½ years	16	good
10	Prabakaran 80570	35	M	30.5.11	RTA	T Type # Lt with posterior wall fracture dislocation	#BB Leg Rt	6.6.11	7	ORIF Via Kocher langenbeck approach	100 min	Nil	7 mon	13	Fair
11	Thangaraj 76365	40	M	26.8.11	RTA	Transverse # Lt	Distal radius # , SC Femur # Lt	3.9.11	8	ORIF Via Ilioinguinal Approach	150 min	Nil	10 mon	16	good
12	Venkatesh 80657	35	M	4.9.11	RTA	Transverse with posterior wall # Rt	Nil	12.9.11	8	ORIF Via Kocher langenbeck approach	180 min	Nil	1 year	14	fair

S. No	Name & IP No	Age years	Sex	Date of Admisssion	Mode Of injury	Diagnosis	Asso. Injuries	Date Of surgery	Time Delay In days	procedure	Surgical time	Complications	Follow Up	Outcome Total=18	Result
13	Thanikachalam 78906	60	M	22.9.11	RTA	Both column # Rt	B/L SPR, IPR. # Lt clavicle	29.9.11	7	ORIF Via Kocher langenbeck approach	180 min	Nil	1 year	16	Good
14	Thangapechi 92880	59	F	14.10.11	Fall	Both column # Lt	Nil	19.10.11	5	ORIF Via Kocher langenbeck approach	120 min	Nil	NA	NA	NA
15	Muthukumar 107275	29	M	29.11.11	RTA	Transverse with posterior wall # Rt	4th MC # Rt	8.12.11	9	ORIF Via Kocher langenbeck approach	90 min	Nil	9 mon	17	good
16	Raja 109870	29	M	8.12.11	RTA	Transverse with posterior wall # Rt	Nil	13.12.11	5	ORIF Via Kocher langenbeck approach	180 min	Sciatic Nerve palsy	10 mon	17	good
17	Ramadoss 117652	48	M	19.12.11	RTA	Transverse # Rt	Nil	25.12.11	6	ORIF Via Kocher langenbeck approach	120 min	Nil	NA	NA	NA
18	Mannangati 9798	39	M	31.1.12	Fall	Transverse with posterior wall # Lt With Posterior Dislocation	Nil	6.2.12	6	ORIF Via Kocher langenbeck approach	150 min	AVN	8 mon	10	poor

S. No	Name & IP No	Age years	Sex	Date of Admisssion	Mode Of injury	Diagnosis	Asso. Injuries	Date Of surgery	Time Delay In days	procedure	Surgical time	Complications	Follow Up	Outcome Total=18	Result
19	Sitandar 6246	28	M	17.3.12	RTA	Transverse # Lt	Nil	22.3.12	5	ORIF Via Ilioinguinal Approach	60 min	Intra articular screw	6 mon	18	Excellant
20	Surendar 77584	18	M	20.8.12	RTA	T Type # Rt with posterior wall fracture dislocation	Nil	1.9.12	11	ORIF Via kocher langenbeck approach followed by ilio inguinal approach	150 min	Nil	4 Mon	18	Excellent

REFERENCES

1) Christopher c. schmidt, gary s. gruen , Non-extensile surgical approaches for two column acetabular fractures *JBoneJointSurg(Br] 1993; 75-B:556-61*.

2) ,M.L chip routt, marc .F. Swiontkowski, seattle , Washington Operative treatment of complex acetabular fracture . *JBoneJointSurg(Br]* 1990 *VOL. 72-A, NO. 6,* ***897***

3) H. J. Kreder,N. Rozen C. M. Borkhoff ,Determinants of functional outcome after simple and complex acetabular fracture involving the posterior wall, *J Bone Joint Surg [Br]*2006;88-B:776-82

4) Letournel E, Judet R. *Fractures of the acetabulum*. Second ed. Berlin: Springer-Verlag, 1993

5) Matta JM**.** Fractures of the acetabulum: accuracy of reduction and clinical results in patients managed operatively within three weeks after the injury. *J Bone Joint Surg [Am]* 1996;78-A:1632-45.

6.) Rk sen , O N nagi Anterior fractures of acetabulum,*IJO vol 36, jan 2002,*

7). Cj Thakkar Complex fractures of acetabulum, *IJO vol 36, jan 2002 8.*

8) Joel m. matta, m.d.t, los angeles, california, Fractures of the Acetabulum: Accuracy of Reduction and Clinical Results in Patients managed Operatively within Three weeks after the Injury, *Journal of Bone and Joint Surgery1996;78:1632-45.*

9) P. K. Sancheti, Atul Patil, A.K. Shyam, Kailash Patil , Milind Merchant, Outcome of Operatively Treated Anterior Column Fracture of the Acetabulum- A Short term Prospective Cohort study. *Journal of Orthopaedics 2009;6(4)e7*

10) Berton R. Moed, Paul H. Yu and Konra I. Gruson Functional Outcomes of Acetabular Fractures **, ,***J Bone Joint Surg Am.* 2003;85:1879-1883.

11) Murphya,, M. Kaliszer , J. Rice , J.P. McElwain Outcome after acetabular fracture Prognostic factors and their inter-relationships, *Injury, Int. J. Care Injured 34 (2003) 512–517*

12) Mark C Reily Fractures of acetabulum .In Bucholz, Robert W.; Heckman, James D.; Court-Brown, Charles *M Rockwood & Green's Fractures in Adults*,Lippincott willims and wilkins 6th Edition 2006 chap 42 .

13) James L. Guyton Edward A. Perez , Fractures of acetabulum and pelvis . In Canale & Beaty: *Campbell's Operative Orthopaedics, Mosby elsivier* 11th ed.2007-3306

14) Rajkumar S amaravathy et al *Treatment of acetabular Fractures IJO* jan 2005 vol 39.

15) K. David Moore, Katy Goss, Jeffrey O. Anglen Indomethacin *versus* radiation therapy for prophylaxis against heterotopic ossification in acetabular fractures British Editorial Society of *Bone and Joint Surgery march 1998 vol. 80-b, no. 2.*

16) . Steven A. Olson Diagnosis and treatment of acetabular Fractures. In. Smith,Wade R. II. Ziran, Bruce H. III. Morgan, Steven J. *Pelvic bones and Acetabulum Fractures*. Informa Healthcare USA 2007

17) Hegg et al , conservative treatment of acetabular fracture *J.Trauma 1987, 27 (5).555-559.*

18) Pennal GF, Davidson J, Garside H, et al. Results of treatment of acetabular fractures. *C/in Orthop 1980; 151 :11S-23.*

19) H. J. Kreder,N. Rozen,C. M. Borkhoff,Y. G. Laflamme,M. D. McKee,E. H. Schemitsch,D. J. G. Stephen Determinants of functional outcome after simple and complex acetabular fractures involving the posterior wall, *J Bone Joint Surg [Br]* 2006;88-B:776-82.

20) P. V. Giannoudis, M. R. W. Grotz, C. Papakostidis, H. Dinopoulos Operative treatment of displaced fractures of the acetabulum a meta-analysis *J Bone Joint Surg Br January 2005 vol. 87-B no. 1 2-9*