A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE INTERTROCHANTERIC FRACTURES MANAGED BY MODULAR EXTENSION OF DYNAMIC HIP SCREW

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BRANCH II

GOVERNMENT KILPAUK MEDICAL COLLEGE & HOSPITAL

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CERTIFICATE

This is to certify that this dissertation entitled **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE INTERTROCHANTERIC FRACTURES MANAGED BY MODULAR EXTENSION OF DYNAMIC HIP SCREW"** is a record of bonafide research work done by **Dr.P.Selvakumar**, post graduate student under my guidance and supervision in fulfilment of regulations of The Tamilnadu Dr. M.G.R. Medical University for the award of M.S. Degree Branch II (Orthopedic Surgery) during the academic period from 2013 to 2016, in the Department of Orthopedics, Govt. Kilpauk Medical College, Kilpauk, Chennai-600010.

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DECLARATION

I declare that this dissertation entitled **"A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE INTERTROCHANTERIC FRACTURES MANAGED BY MODULAR EXTENSION OF DYNAMIC HIP SCREW"**submitted by me for the degree of M.S., is the record of work carried out by me during the period of **August 2013 to August 2015** under the guidance of **Prof.N.Nazeer Ahmed, M.S.Ortho., D.Ortho,** Professor and Head of the Department, Department of Orthopaedics, Govt. Kilpauk Medical College Hospital, Chennai. This dissertation is submitted to **The TamilnaduDr.M.G.R. Medical University**, Chennai, in partial fulfilment Of the University regulations for the award of degree of M.S.ORTHOPAEDICS (BRANCH - II) examination to be held in April 2016.

Place: Chennai ***Signature of the Candidate***
Date: ***(Dr.P.SELVAKUMAR)***

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CONTENTS

INTERTROCHANTERIC FRACTURES

INTRODUCTION

Intertrochanteric fractures are most frequent fractures of proximal femur and occur predominantly in geriatric patient and are among the most devastating injuries in the elderly.

Incidence of fractures of proximal femur is increasing since general life expectancy of population has increased significantly during past few decades[(1)].

Most proximal femoral fractures occur in elderly individuals as a result of only moderate or minimal trauma. In younger patient these fractures usually result from high energy trauma.

Intertrochanteric fracturesinvolve from the extra capsular basilar neck region to the region along the lesser trochanter proximal to development of the medullary canal.

Intertrochanteric fracture occur due to a simple self-fall. Chance of self-fall increases with age, which is further increased by decreased muscle power, decreased reflexes, poor vision and labile blood pressure[(1,3)].

Femur being the main weight bearing bone, in lower limb fracture of intertrochanteric region leads patient to be bed ridden for prolonged period and so increases morbidity and mortality (urinary tract infection, bed sores, respiratory tract infection, and joint stiffness).Appropriate treatment of this fracture is needed to prevent these complications[1,2,3].

To prevent these complications operative treatment is preferred. The better understanding of fracture geometry and biomechanics lead to the development of lot of implants for treating these fracture.

1930 Jewett introduced Jewett nail to provide immediate stability of fracture fragments and early mobilization of patient. These nail plate failed because of lack of controlled impaction.

1950 Earnest Roll in Germany was the first to use sliding screw.

1962 Masiemodified sliding device to allow fracture collapse and impaction of fragments.

Richard manufacturing& co of USA produced Dynamic hip screw.

In 1966 Kuntscher and later in **1970 Ender** introduced condylocephalic intramedullary devices.

In 1984 RussellTaylorreconstruction intramedullary nailfor pertrochanteric and subtrochanteric fractures.

Fracture usually treated by using routine hip compression screw or intramedullary nail. In Screw – Slide plate deviceDynamic compression screw permit the proximal fragment to collapse.

The goal of treatment in intertrochanteric fracture is early mobilization of patient to prevent morbidity and mortality. Early mobilization depends on the stability of surgical construct[5,28].

With thisgoal of stable surgical construct of intertrochanteric fracture this study was conducted to evaluate functional and radiological outcome of unstable intertrochanteric fracture treated with DHS with trochanteric stabilization plate.

A typical intertrochanteric fracturewith lateral wall comminution

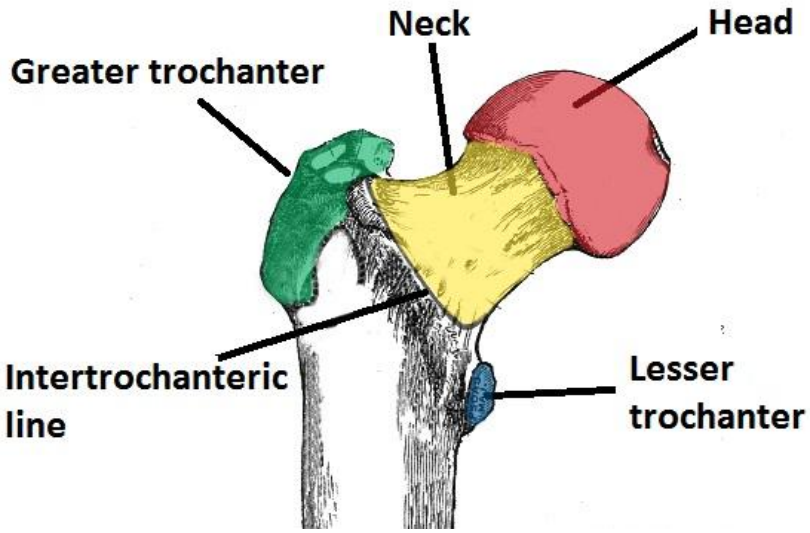
AIM OF STUDY

1. To evaluate the unstable intertrochanteric fractures and their management by using modular extension of dynamic hip screw (TSP).

2. To analyze the functional and radiological outcome of the above procedure.

ANATOMY

The femur is the longest and strongest bone of the body. The proximal end of femur includes the head, the neck the greater trochanter, the lesser trochanter, intertrochanteric line and intertrochanteric crest.[6,15]



Femoral Head

Head forms more than half of sphere and directed medially upwards and slightly forwards it articulates with acetabulum to form the hip joint[3,17].

Femoral Neck

Connects the head to the shaft. Long axis of neck makes an angle of 120^0 to 130^0withlong axis of the shaft and is termed as neck shaft angle and an angle of 10 – 30 with frontal plane which is termed as angle of anteversion (Angle of Femoral Torsion)[20]

Calcar

Calcar femoral is a dense vertical plate of bone extending from the posteromedial portion of the femoral shaft under the lesser trochanter and radiating lateral to the greater trochanter reinforcing the femoral neck posteroinferiorly. The calcar femoral is thicker medially and gradually thins as is passes laterally.[5]

Greater Trochanter

Large quadrangular prominence located at upper part of the junction of the neck with the shaft. Posterosuperior part project upwards and medially beyond the level of the neck and overhangs the trochanteric fossa. The greater trochanter provides insertion for most of the muscles of gluteal region.

Gluteus medius is inserted to lateral surface gluteus minimus in inserted to its anterior surface.

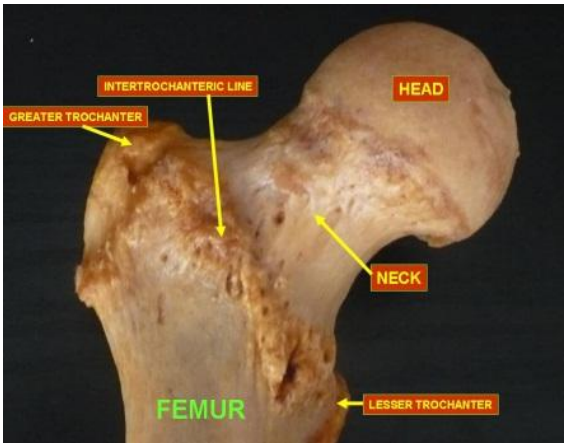
The upper border gives insertion to the piriformis and medical surface to the common tendon of obturatorinternus and two gemelli.

Lesser Trochanter:

Is a conical eminence directed medially and backward from the junction of the posteroinferior part of neck gives attachment to the primary flexor by thigh iliopsoas.

Intertrochanteric line:

Marks the junction of the anterior surface of neck with the shaft of femur which is a prominent roughened ridge which begins above at anterosuperior angle of the greater trochanter and continuous below with spiral line in the front of lesser trochanter.[27]

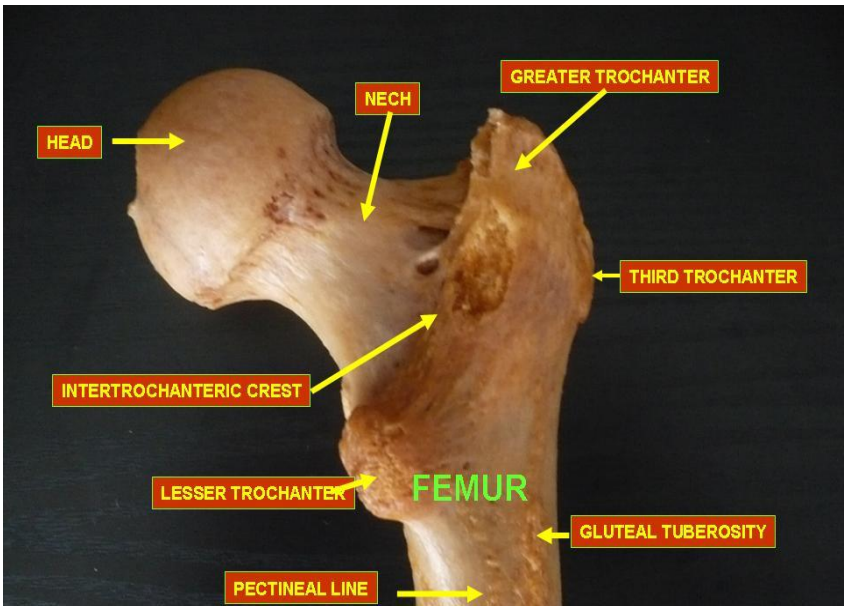


Intertrochanteric Crest

Marks the junction of the posterior surface of the neck with the shaft of femur which is smooth rounded ridge which begins above at the posterosuperior angle of greater trochanter and ends at the lessor trochanter has quadrate tubercle.[32]

Intertrochanteric Region

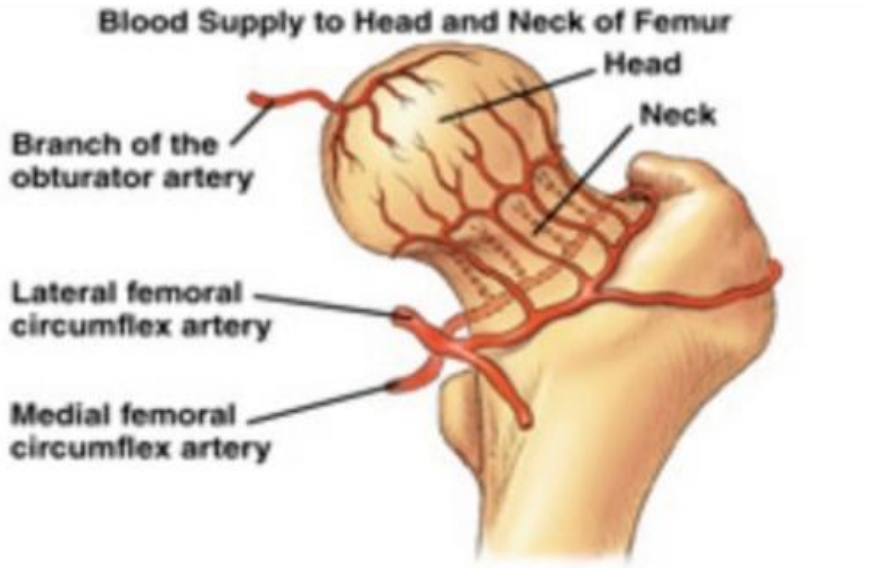
Consisting of the area between greater and lesser trochanters represents a zone of transitions from femoral neck to the femoral shaft. This area is characterized primarily by dense trabecular bone that serves to transmit and distribute stress similar to the cancellous bone of the femoral neck.



Blood Supply

Crock described the blood supply to proximal end of femur into three major group.

1. An extra capsular arterial ring at the base of femoral neck
2. Ascending cervical branches by extra capsular arterial ring on the surface of femoral neck.
3. The arteries of round ligament.



Extra capsular arterial ring formed posteriorly by large branch of the medial femoral circumflex artery and anteriorly by branch from the lateral femoral circumflex artery.

Ascending cervical branches or retinacularvessels.Ascend on the surface of femoral neck in anterior posterior, medial and lateral groups, later groups vessels are most important.

Their proximity to the surface of the femoral neck makes them vulnerable to injury to femoral neck fracture.

Articular margin of the femoral head is approached by the ascending cervical vessels a second less distinct ring is formed the sub **synovial intra – articular arterial ring** and from this ring epiphyseal arteries penetrate the head.

Most important being the lateral epiphyseal arterial group supplying the lateral weight bearing position of the femoral head.

Nerve Supply:

The hip joint is supplied by the femoral nerve , through the nerve to the rectus femoris; the anterior division of the obturator nerve; the nerve to the quaratusfemoris;and the superior gluteal nerve

Trabecular system of proximal femur

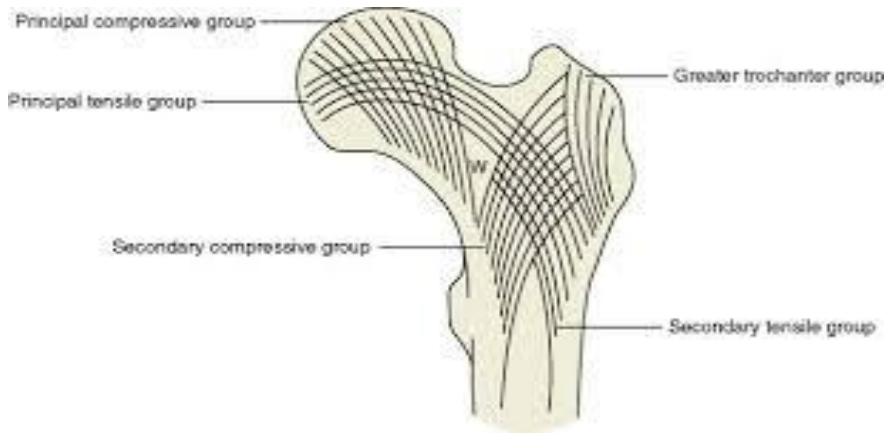
The internal trabecular structure of the proximal femur was first described by **Ward** in **1838**.

In accordance with Wolff's law, trabeculations arise along the lines of force to which the lines of force to which bone exposes.

Primary compressive and tensile trabeculations pass through the neck and separated by an area of sparse cancellous bone labelled Ward's triangle

Five Trabecular Groups

1. Principle compressive group
2. Principle tensile group
3. Greater trochanteric group
4. Secondary compressive group
5. Secondary tensile group



Singh's grading of Trabecular System

On the basis of trabecular system Grade from I to VI

Grade VI

All type trabeculae are visible and proximal end of femur occupied by trabecular bone

Grade V

Secondary tensile trabeculae is almost absent (Secondary compressive trabecula is attenuated)Ward's triangle becomes prominent .

Grade IV

Secondary compressive trabecular are completely resorbed.

Grade III

There isbreak in continuity of principal tensile trabecular near greater trochanter.

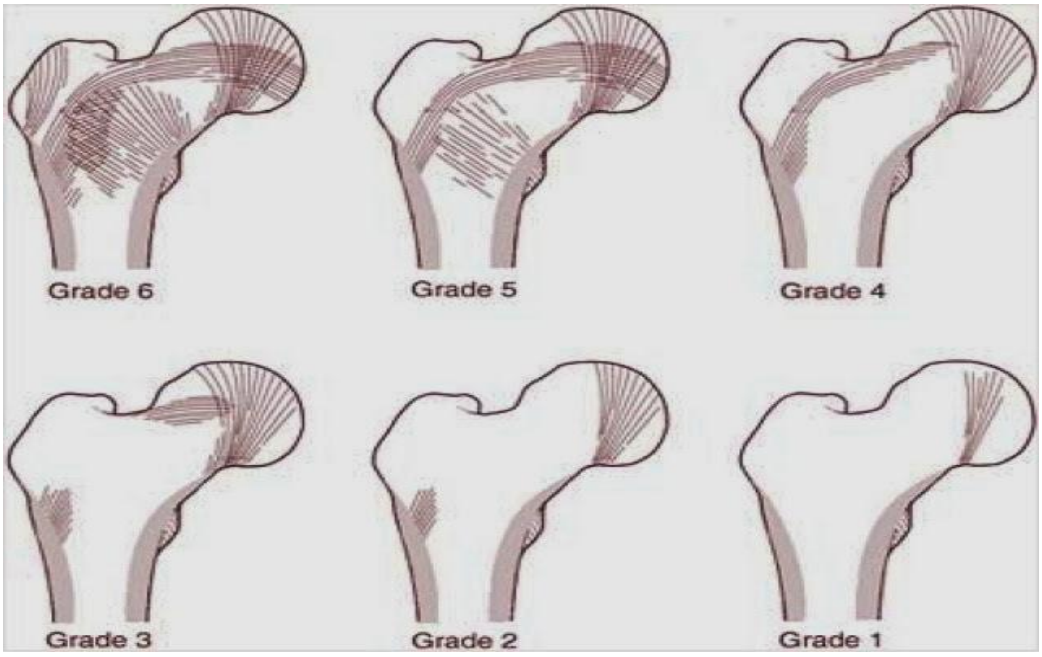
Grade II

Principal compressive trabecular stands out prominently other have resorbed more or less completely.

Grade I

Even principal compressive trabecular is markedly reduced and no longer prominent.

Singh's Index Grade I to III are indication of Osteoporosis.



Singh's grading of Trabecular System

Anatomy of soft tissue of Hip Joint,

Fascia lata:seenafter skin incision in lateral aspect. Gluteus medius and tensor fascia lata inserts in to it and is the abductor and flexor of hip joint innervated by superior gluteal nerve.

Extensors

Gluteus maximus

Origin: Posterior 1/3 of iliac crest sacrum and coccyx.

Inserts:fascialata and posterolateral aspect of femur just below lessertrochanter.

Nerve supply: Inferior gluteal nerve.

Abductors

Gluteus medius and Gluteus minimus

Origin: Entire wing of ilium

Inserts: Greater Trochanter

Nerve supply: Superior gluteal nerve.

External Rotators

(Piriformis, Obturatorinternus, Obturatorexternus, Gemelli and Quadratusfemoris).

Piriformis:

Origin: Lateral margin of anterior aspect of sacrum and greater sciatic foramen.

Insert: Tip of greater trochanter

- Sciatic nerve lies below the piriformis

ObturatorInternus

Origin: Obturator foramen (passes through lesser sciatic foramen)

Insert: Tip of greater trochanter

Nerve: Sacral plexus

ObturatorExternus

Origin: Medial side of obturator foramen

Insert: Trochanteric fossa

Nerve: Obturator nerve

Quadratusfemoris

Origin: upper part of ilium

Insert: Intertrochanteric crest

Nerve: Sacral plexus

Flexors

Major flexor

Psoas major

Origin: Lumbar vertebra

Insert: Lesser trochanter

Iliacus

Origin: Iliac fossa

Insert: below lesser trochanter

Other flexors of hip

Sartorius, Pectineus and Gracilis muscles.

Adductors:

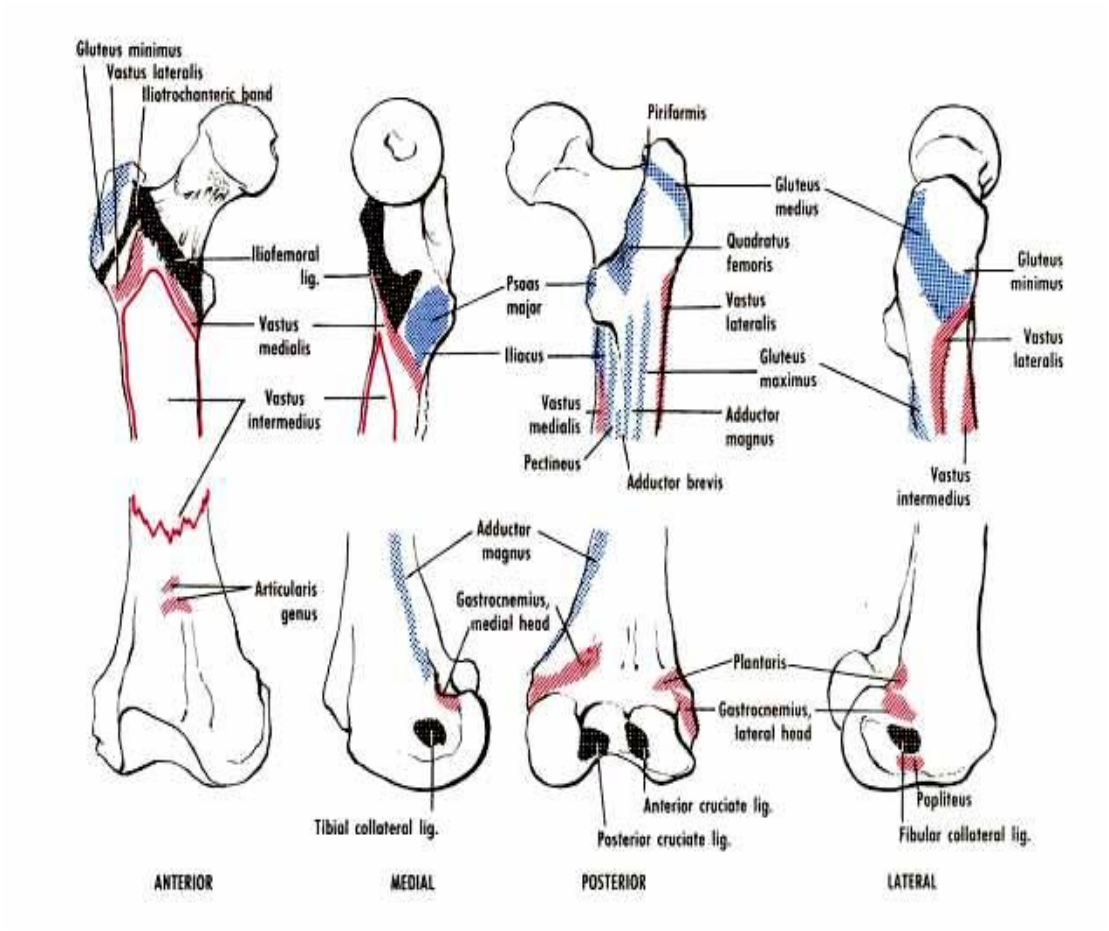
Medial compartment thigh muscle comprise the adductor group. Consist of adductorlongus, adductor brevis, adductor magnus and gracilis.

Origin: From Ischiopubic Ramus, Ischial tuberosity and obturator foramen.

Inserts: Linea aspera of femur and adductor tubercle of femur.

Nerve supply: Obturator nerve.

Muscle Attachments Around Hip Joint And Their Insertion



BIOMECHANICAL CONTRIBUTIONS OF MUSCLE

Muscle attached to the proximal and distal fragments of fracture produce peculiar deformity. Proximal fragment is externally rotated by external rotators, flexed by iliopsoas and adducted by gluteusmedius.

Distal fragment is adducted by adductors with shortening and overriding of fracture fragments.[14,18]

The pull out strength of dynamic hip screw is related to bone density in femoral head. Posteroinferior and center of head has dense bone density andhencescrew has to be placed here. Fracture fixation stability depends upon the degree of comminution and quality of the bone.

Pathomechanics of fracture

Fracture line above the insertion of external rotators the proximal fragment is rotated internally so the fracture reduction is done by internally rotating the distal fragment.[10,12,13]

If fracture with subtrochanteric extension proximal fragment will go into external rotation so reduction done by external rotation of distal fragment.

ANGULATION AT FRACTURE SITE

Proximal fragment will go for varus angulation due to pull of hamstring and gastrocnemius.[15,17]

In unstable intertrochanteric fracture with posterior posteromedial lack of continuity fracture collapse with implant failure veryoften occurs.

In unstable intertrochanteric fracture with lateral cortex defect load over the implant will be more and it leads to fracture collapse and implant failure will occur (screw cut out).[16]

Intact lateral wall is must for controlled compression of proximal fragment which prevents the rotational and varus collapse of fracture fragment.

CLASSIFICATION

Evans Classification (1949)

Evans divided intertrochanteric fracture into unstable and stable groups.[17,26]

Unstable group is further divided into those in which anatomical or near normal anatomical reduction of fracture restores stability and those in which stability cannot be restored after reduction.

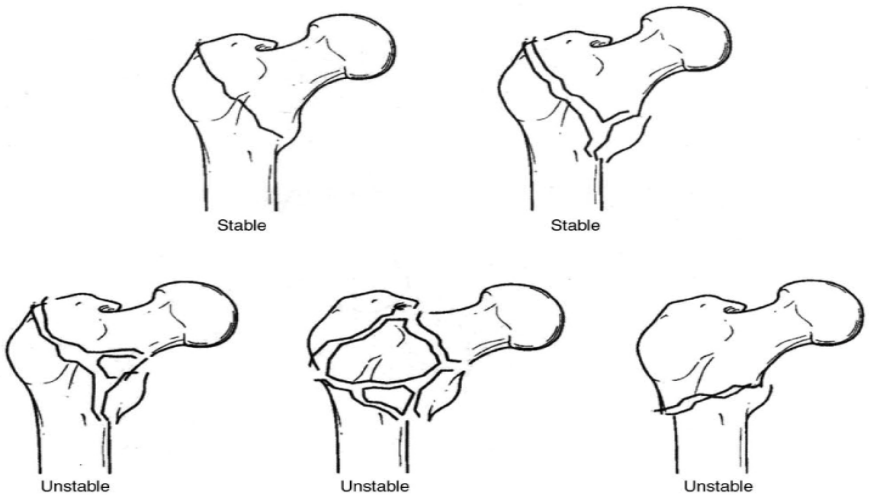
Type I

Fracture line starts at lesser trochanter and run upwards and outwards.

Type II

Reverse obliquity fracture

This is unstable type with medial displacement of distal fragment because of adductor muscle pull.



Boyd and Griffin classification(1949)

This classification includes all the fracture from extra capsular part of the neck toapoint 5 cm distal to lesser trochanter.[17,26]

Type I(stable – two part)

Fractures extend along the intertrochanteric line from greater to lesser trochanter. Reduction usually in simple and maintained with little difficulty.

Type II (unstable with posteromedial comminution)

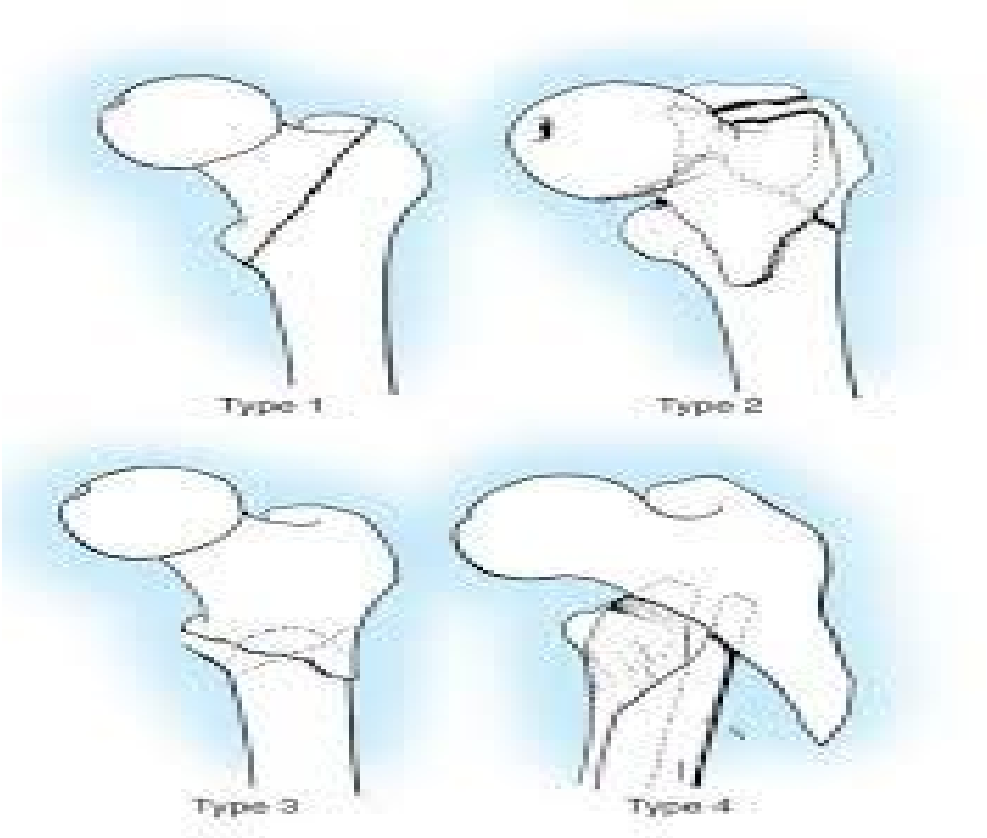
Comminuted fracture the main fracture being along the intertrochanteric line with multiple fractures in the cortex and additional fracture line in coronal plane. Reduction of this type is more difficult.

Type III (reverse obliquity)

Reverse oblique fracture with associated varying degrees of comminution, these fracture are more difficult to reduce.

Type IV

Subtrochanteric region with intertrochanteric extension with the fracture lying in at least two planes



Boyd & Griffin Classification

AO/OTA Classification

Orthopedic trauma association classification system classifies intertrochanteric fracture as 31A Femur, Proximal trochanteric

A1 – Pertrochanteric simple

A1.1 Along intertrochanter line

A1.2 Through greater trochanter

A1.3 Below lesser trochanter

A2 – Pertrochantericmultifragmentary

A2.1 With one intermediate fragment

A2.2 With several intermediate fragment

A2.3 Extending more than 1 cm below lesser trochanter

A3 - Intertrochanteric

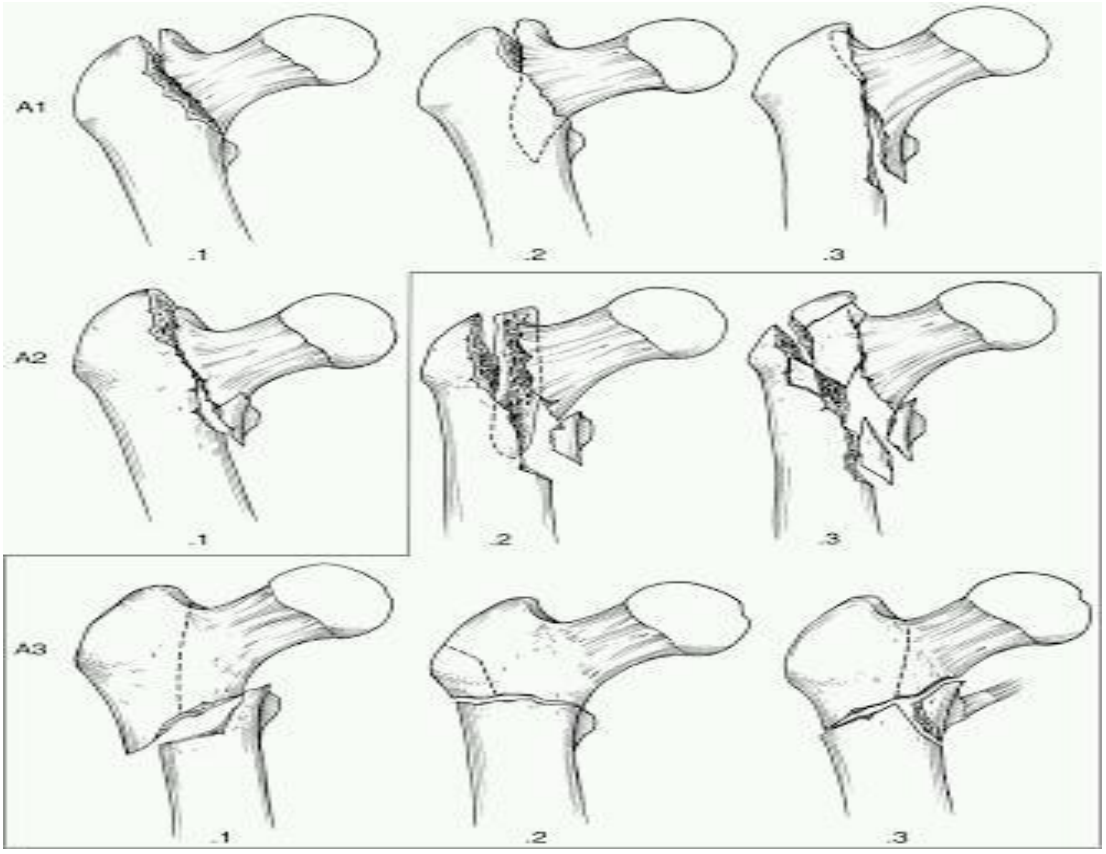
A3.1 Simple oblique

A3.2 Simple transverse

A3.3 Multifragmentary

Hence this remains the most useful classification among others.[36]

AO/OTA CLASSIFICATION



UNSTABLE INTERTROCHANTERIC FRACTURES

- **Posteromedial comminution**-no medial corticalcontinuity after reduction[19,17]
- Fracture with lateral wall comminution
- Four part fracture
- Displaced large fragment including lesser trochanter
- **Reverse oblique** -medial displacement of distal fragment due to adductors
- Fracture with sub-trochanteric extension

In my study the above unstable Fracture pattern has been addressed excluding reverse oblique and subtrochanteric extension.

REVIEW OF LITERATURE

Variety of implants areavailable for fixation of intertrochanteric fracture with variable success rate.[18,20,21]

Includes:

1. Sliding Hip screw
2. Sliding Hip screw withTrochanteric Stabilisation Plate
3. Cephalomedullary Femoral Nail (PFN A, PFN A2, Reconstruction Nail, Gamma nail, TAN)
4. Proximal Femoral Locking Compression Plate
5. Medoff Sliding Plate
6. Percutaneous Compression Plate (Gotfried)

Sliding hip screw in unstable intertrochanteric fracture

Sliding hip screw is widely used implant in unstable intertrochanteric fracture. Sliding hip screw when used in unstable intertrochanteric fractures has the following disadvantages.

Disadvantages[6]

- Significant medial displacement of shaft will occur
- Excessive sliding of hip screw
- Increase chance of screw cutout
- Excessive collapse leading to varusmalpositioning
- Single point fixation leading to rotation of proximal fragment.

Role of lateral wall in unstable intertrochanteric facture

Addressing intactness of later wall is mandatory in these unstable fracture patterns as there is existing posterior medial wall communition.

Intact lateral wall provides a lateral buttress for proximal fragment.[9]Ifdeficient of lateral wall cause excessive collapse leads to varusmalpositioning.

So maintaining integrity of lateral wall is important objective in fixation of unstable intertrochanteric facture with lateral wall comminution.

Role of TSP in unstable intertrochanteric facture with lateral wall communition

Advantages

a. Lateral buttress effect
b. Decreasing rate of controlled impaction in unstable [13] intertrochantericfracture.
c. Prevents excessive collapse and shortening
d. Prevents varusmalpositioning
e. Two point fixation leading to increased rotational stability.

1. **Babst et al., study** reported "**significant reduction** in excessive **collapse** and subsequently **reduced limb length discrepancy** by using a TSP in combination with the DHS"

2. **International Orthopaedics (SICOT) (2010) 34:125–129** states that "improved bony contact between proximal and distal fragments by stabilisation of the comminuted lateral wall using TSP is likely to improve the chances of union and maintenance of adequate lever arm. An **additional antirotation screw** effectively **prevents** the **rotation of the proximal fragment."**

3. **R.K.Gupta et al., study** states that "In unstable trochanteric fractures owing to posterior, medial and lateral comminution, the collapse at the fracture site that occurs with sliding hip screw fixation may be more than usual". In such a situation abductor muscle weakness and its consequent fatigability is likely to be greater. Hence TSP seems to act as a buttress plate against the medialisation of the distal fracture fragment often seen in unstable fractures stabilized with the sliding screw plate systems alone."

MATERIAL AND METHODS

This study was conducted in Government Kilpauk Medical College and Hospital, Chennai-10.

Inclusion Criteria:

1. Clinical diagnosis of unstable trochanteric femur fracture.(**AO Type 31A2.1, 31A2.2 &31A2.3**)
2. Age >40 years and <75 years
3. Both genders

Exclusion Criteria:

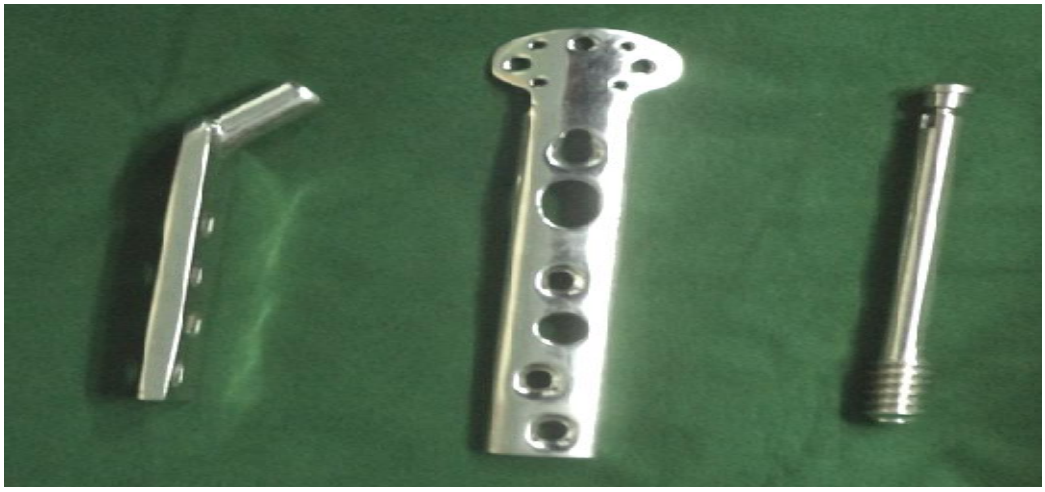
1. Open fractures
2. Patients with pathological fractures
3. Polytrauma patients
4. Patients not able to walk before the fracture
5. History of previous surgery on proximal femur fracture
6. Under 40 years old.
7. Patients with fractures needing other treatments than sliding hip screws
8. Reverse oblique fractures.
9. Patients with dementia, using steroids, immunosuppressant

- Twenty consecutive patients with unstable intertrochanteric fractures were treated with an additional TSP super-imposedon the regular DHS at our institution between August 2013 and August 2015.
- Twenty patients were followed for at least nine months (mean 12 months, range 9 to 24 months)
- **Investigation details**

    1. **Radiological :** Plain X-ray of the affected hip with femur in two standard projections (AP & Frog leg lateral view) (intra-op)
    2. Complete hemogram
    3. Renal function test
    4. Bleeding time & Clotting time
    5. Screening for infections - HIV, HBV, Syphilis
    6. Chest X-ray & Electrocardiogram
    7. If needed CT of concerned hip joint with 3D reconstruction

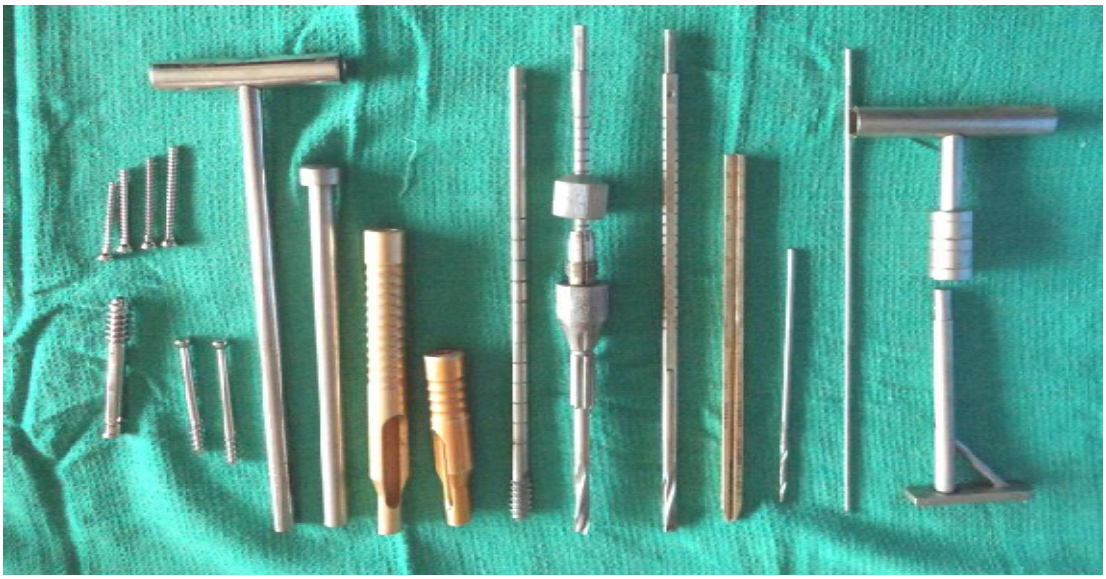
- Post-operative radiological outcome was assessed by periodic X rays of affected hip.
- Post-operative functional outcome was assessed by using Harris Hip Score.

IMPLANT



a b c

a) Standard sliding hip screw barrel plate
b) Trochanteric Stabilisation Plate
c) Richard screw



Harris Hip Score

Pain *(check one)*

- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support

- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked

- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting

- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation

- ☐ Yes (1)
- ☐ No (0)

Stairs

- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks

- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

Less than 30° fixed flexion contracture	☐ Yes	☐ No
Less than 10° fixed abduction	☐ Yes	☐ No
Less than 10° fixed internal rotation in extension	☐ Yes	☐ No
Limb length discrepancy less than 3.2 cm	☐ Yes	☐ No

Range of Motion (*Indicates normal)

Flexion (*140°) _____

Abduction (*40°) _____

Adduction (*40°) _____

External Rotation (*40°) _____

Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

OPERATIVE METHOD

Patient prepared on the morning of day of surgery. Preoperatively prophylactic antibiotic given after test dose on the operation table.

Spinal anaesthesia used for all cases. Patient was placed on fracture table with unaffected leg in flexion and abduction position by using leg holder. Affected leg placed in boot and fixed to the fracture table. C arm placed on the opposite side of affected extremity. Before progressing with fracture reduction, C arm was checked for optimal functioning relative to patient position to ensure proper visualization of fracture in both AP and cross table lateral view.

Reduction Maneuver:

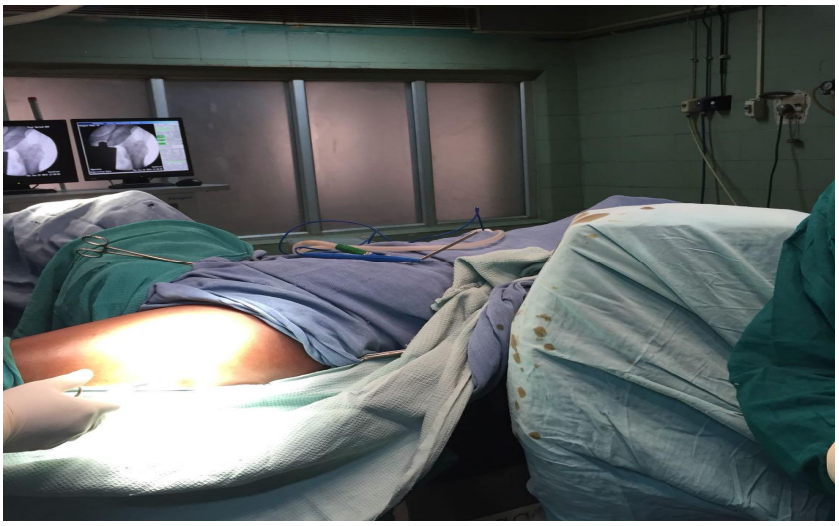
Using preoperative X-rays and peroperative C arm image fracture pattern studied and closed reduction maneuver was planned accordingly.

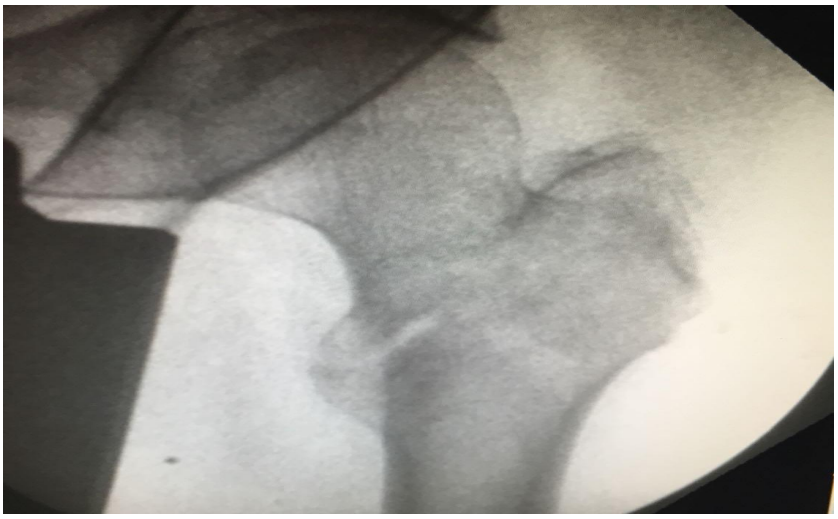
Reduction done by using traction and internal or external rotation depending on fracture pattern.

Other deformities like sagittal plane deformity corrected by applying an anteriorly directed force on distal fragment while simultaneously applying traction to correct the posterior sag.

Surgical Approach:

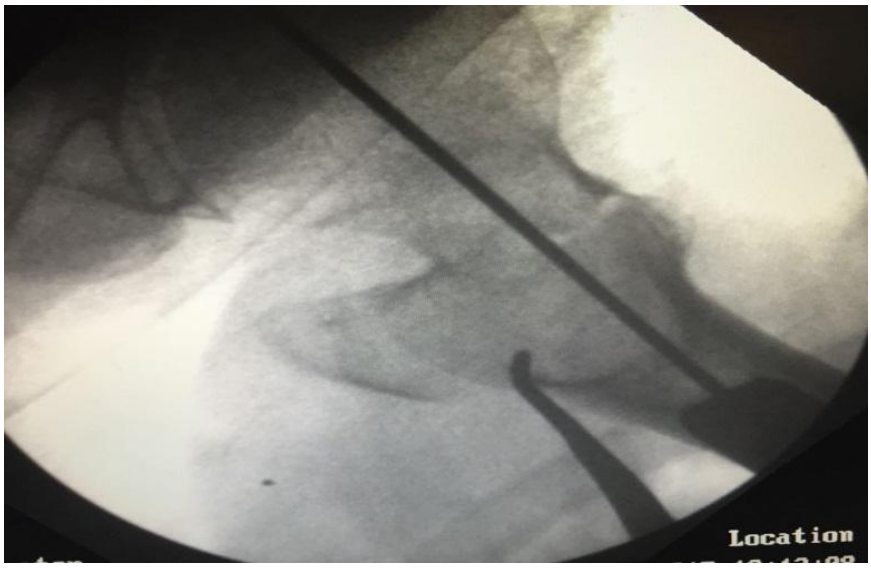
Operated limb painted and draped in standard fashion for hip surgery in supine position.



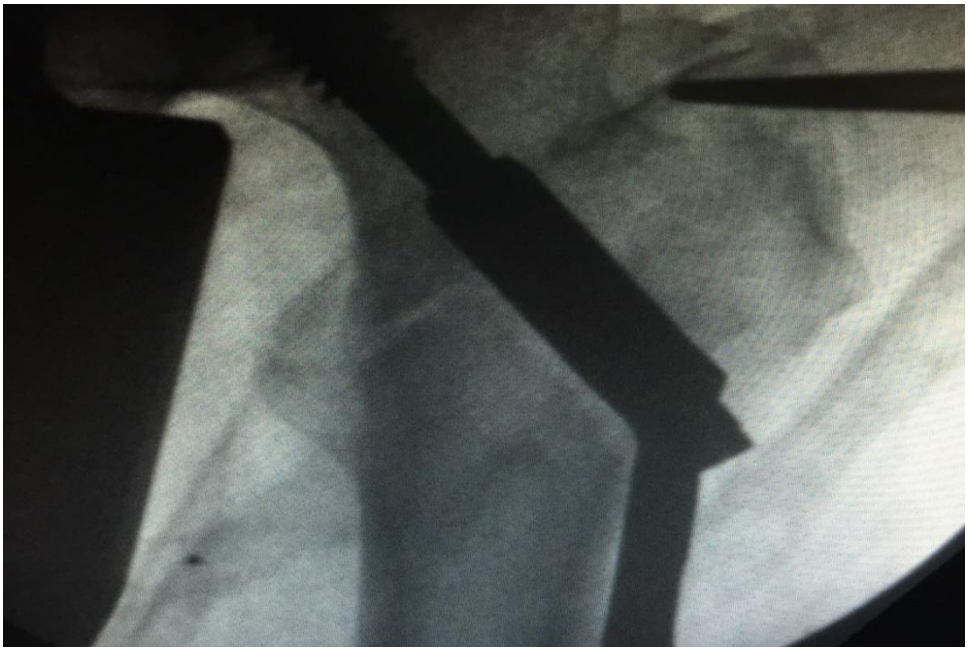


Standard lateral approach to hip joint utilized for exposing the fracture site. Skin and subcutaneous tissue incised. Tensor fascia lata and Vastuslateralis split and proximal femur exposed. In case inadequate reduction achieved by traction and internal rotation as visualized by C arm open reduction done.

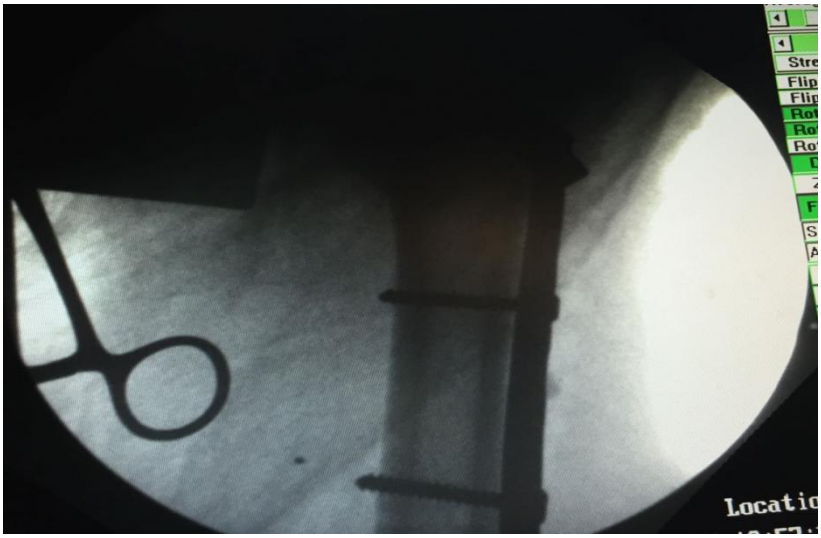
Guide wire inserted approximately 2 cm below the vastuslateralis ridge under C arm guidance with the help of 135° angle guide. Guide wire traverse through CCD angle inferiorly in AP view and central in lateral view. This allowed correct placement of additional anti-rotation screw subsequently. Guide wire placed 5 mm beneath the subchondral bone



Afterwards guide wire length measured and utilizing a triple reamer, reaming done. Adequate size lag screw inserted.

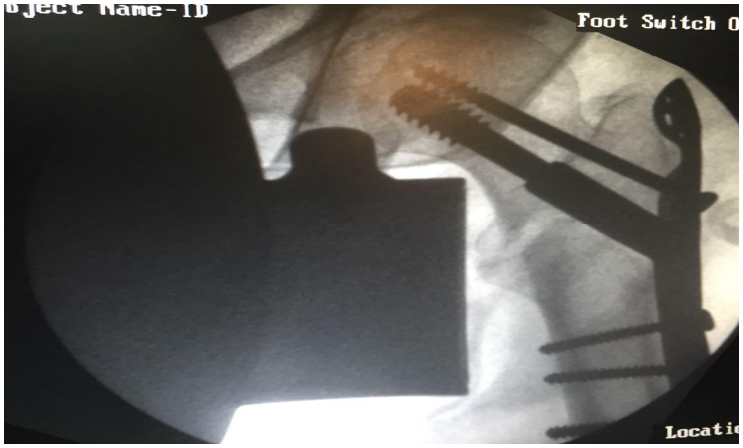


A 5 hole barrel plate fixed to lag screw and fixed to shaft of femur using cortical screws in 2nd and 5th hole of plate

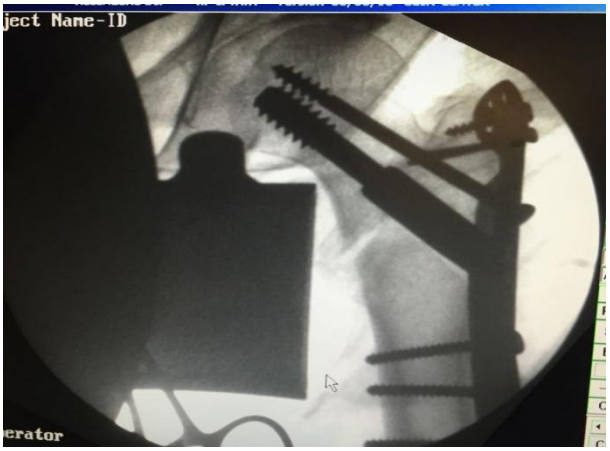


After precontouring trochanteric stabilization plate placed over the plate and fixed using remaining holes in the plate by utilizing cortical screws.

Afterwards anti rotation screw inserted superior to lag screw.



If deemed necessary, greater trochanter is additionally fixed by using 4 mm cancellousscrews or SS wire



Drain inserted. Vastuslateralis muscle, tensor fascia lata and subcutaneous tissue closed using vicryl and skin closed using ethilon suture material.Sterile dressing applied.

POST-OPERATIVE PROTOCOL

- IV antibiotics and analgesic given for first two days
- From 3rd day onwards oral antibiotics and analgesic given for another 1 week.
- Drain removed on 2nd post-operative day.
- Dressing changed on 2nd, 6th and 8th post-operative day.
- Sutures removed on 12th post-operative day.
- Non weight bearing mobilizationstarted under guidance of physiotherapist from 3rd post op day
- Chest physiotherapy started from 2nd post-operative day.
- Weight bearing started as soon as possible on the basis of patient's pain tolerance, bone quality, fracture reduction and biomechanical stability of the construct.
- Patients were followed up once in a month for at least 9 months with appropriate radiographs for assessing union and complications like telescoping and varus collapse.

OBSERVATION

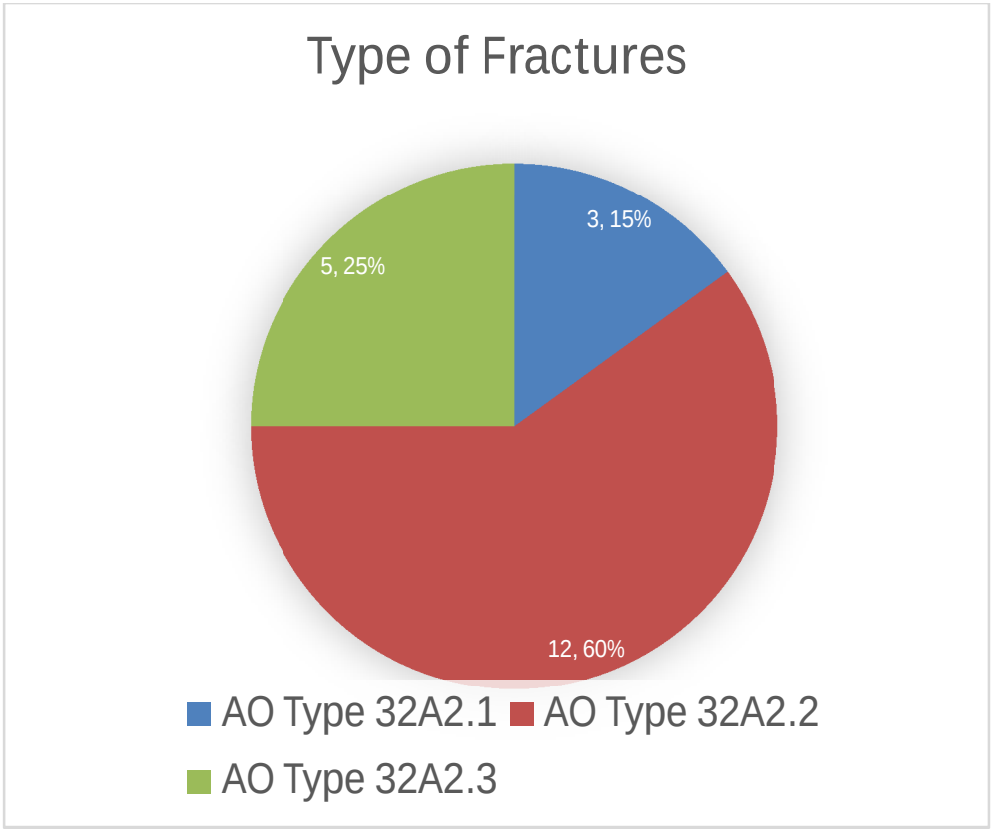
The study was conducted in Government Kilpauk Medical College & Hospital Chennai from August 2013 to August 2015.

20 consecutive patients suffering from unstable intertrochanteric fracture with lateral wall communition were treated with Trochanteric Stabilisation Plate in addition to DHS.

In our study we used AO/ OTA classification system for patient selection. We included AO31A2 fractures in our study. The distribution of fractures according to type is as follows:

Type of Fractures

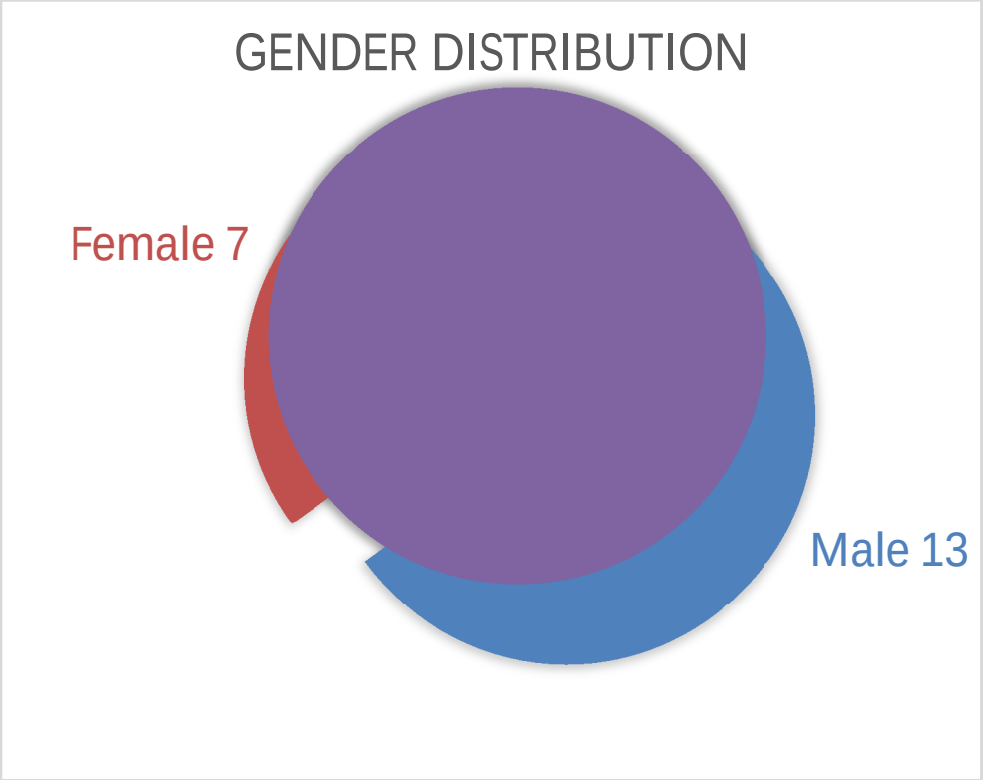
Type of Fracture	Number of patients
31A2.1	3
31A2.2	12
31A2.3	5



Gender Distribution

13 patients were male and 7 were female.

Male – 13 Female – 7

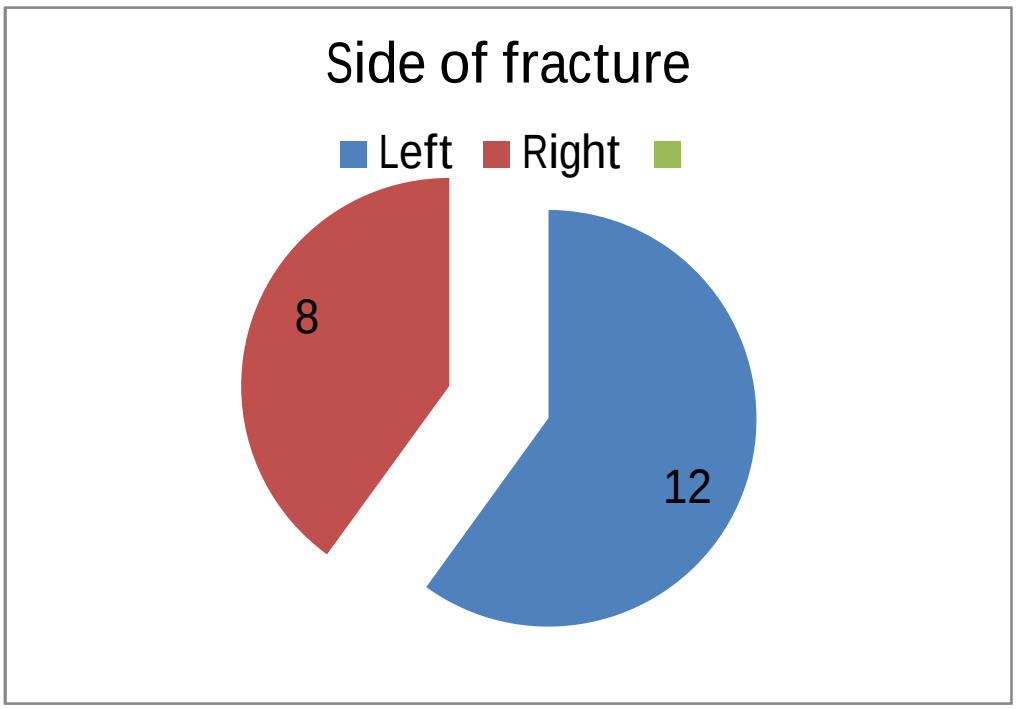


Side of fracture

12 patients had left side intertrochanteric fracture and 8 had right side intertrochanteric fracture.

Left-12

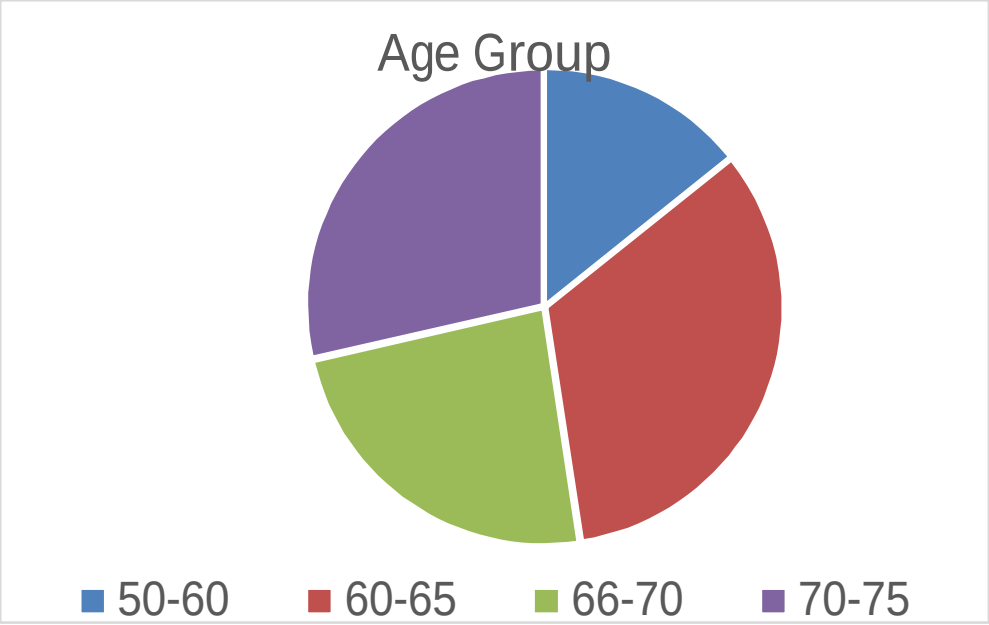
Right-8



Age wise Distribution

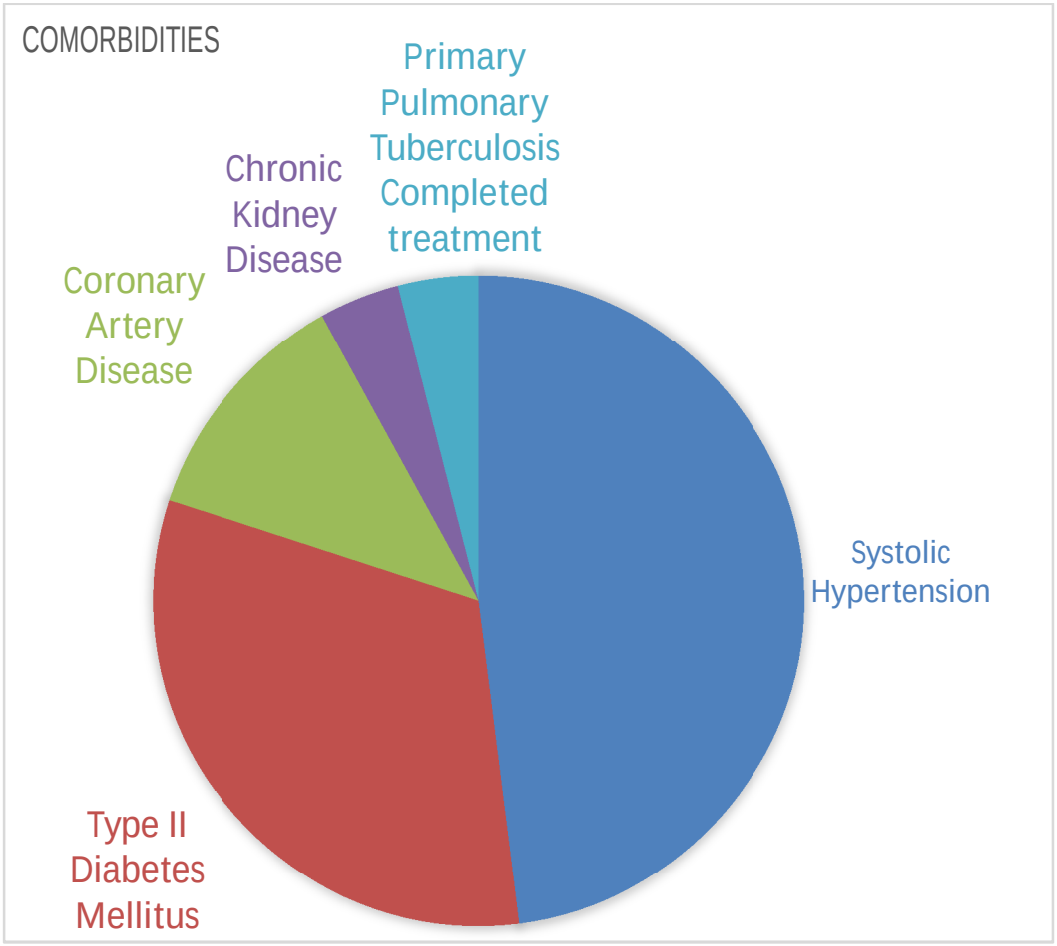
Age wise distribution of patients is as follows:

Age Group	No. of Patients
50-60	3
60-65	7
66-70	5
70-75	6



COMORBIDITIES

In our study 8 patients suffered from Type 2 Diabetes Mellitus, 12 patients suffered from systolic hypertension, 3 patients suffered from coronary artery disease, 1 patient suffered from Chronic Kidney Disease and 1 patient had completed treatment for Primary Pulmonary Tuberculosis.



Operative details of intertrochanteric fractures treated by TSP

All patients had a mean operative delay of 7.6 days.

The mean duration of surgery was 82 minutes.

Mean blood loss during surgery was 166.25 mL.

The mean size of lag screw utilized was 85 mm and mean size of anti-rotation screw was 75 mm.

Mean time of operation after fracture in days	7.6 days
Mean duration of operation	82 minutes
Mean blood loss in mL	166.25 mL
Mean size of lag screw	85 mm
Mean size of anti-rotation screw	75 mm

In Postoperative Period mean duration of hospital stay was 6.9 days. Patient were allowed full weight bearing after an average duration of 13.2 weeks. Two patient had persistent pain in hip region and two patients had persistent thigh pain hence weightwearing was delayed till radiological union occurred and symptoms subsided.

Mean duration of hospital stay	6.9 days
Average duration for full weight bearing	13.2 weeks

RESULTS

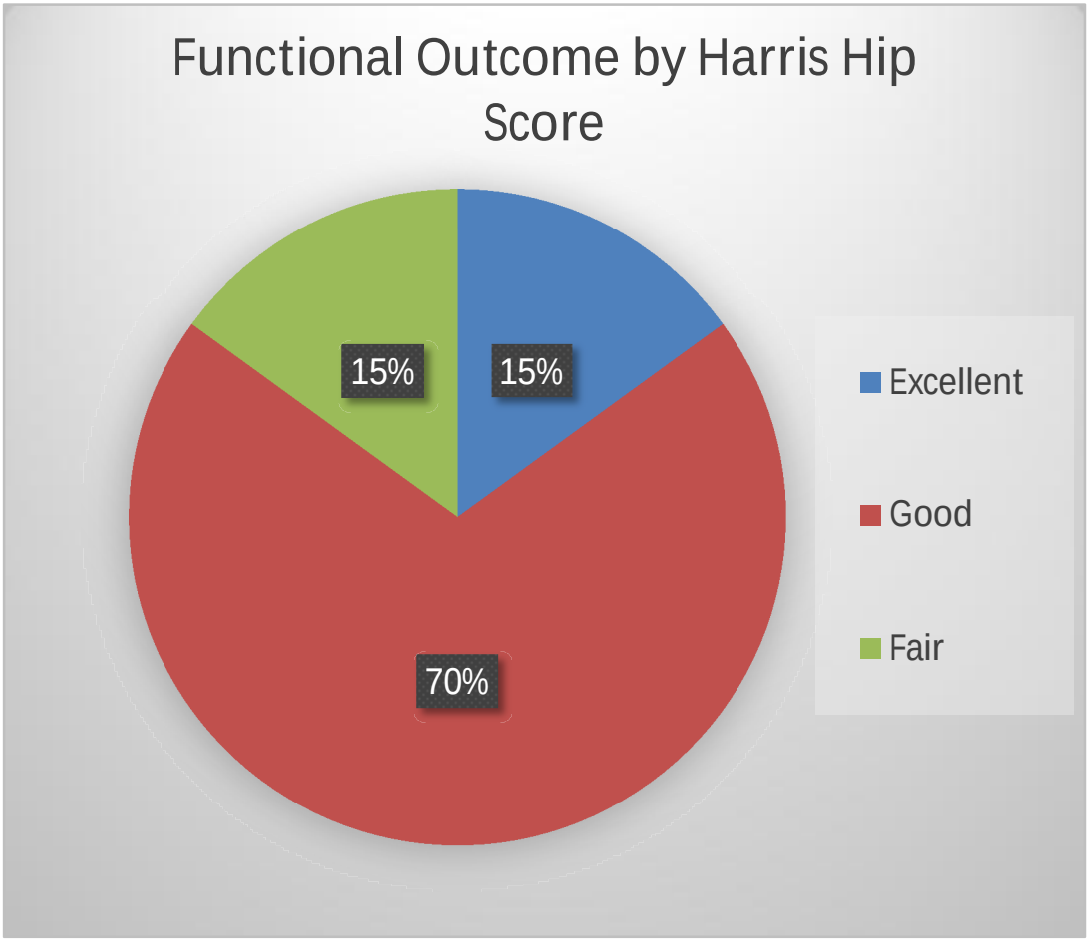
The postoperative radiological outcome was assessed by taking serial X rays of affected hip in anteroposterior and frog lateral view. All patients achieved radiological and clinical union. 6 patients underwent radiological union by 16 weeks, 4 patients underwent by 18 weeks, 5 patients underwent union by 20 weeks and 3 patients underwent union by 22 weeks.

Two patients had varusmalunion, Average limb length discrepancy was 1.4 cm with 7 patients having <1cm shortening, 11 had shortening of 1.5 to 2 cm and 2 had shortening of more than 2 cm (1 patient had shortening of 2.5 cm and another had shortening of 2.9 cm)

Average time for radiological union was 23.5 weeks.

FUNCTIONAL OUTCOME

The postoperative functional outcome was assessed by Harris Hip Score at 20 weeks. Average Harris hip score was 83.2. We had 3 excellent results, 14 good results and 3 fair results.



COMPLICATIONS

The following complications were encountered in patients.

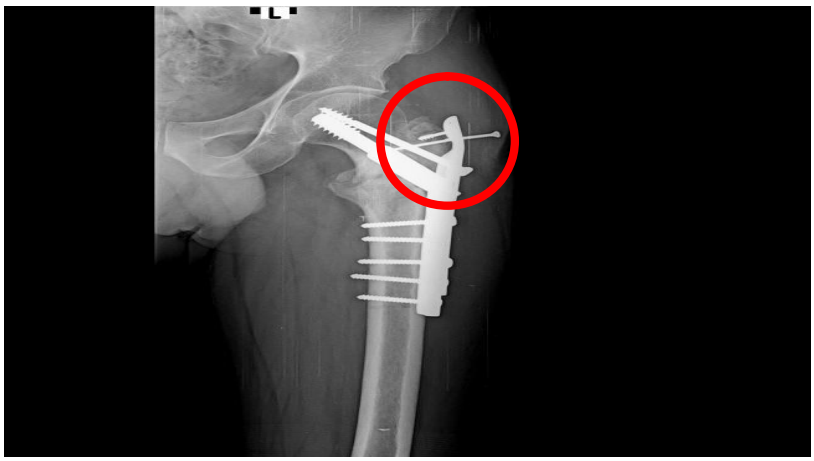
Wound complications

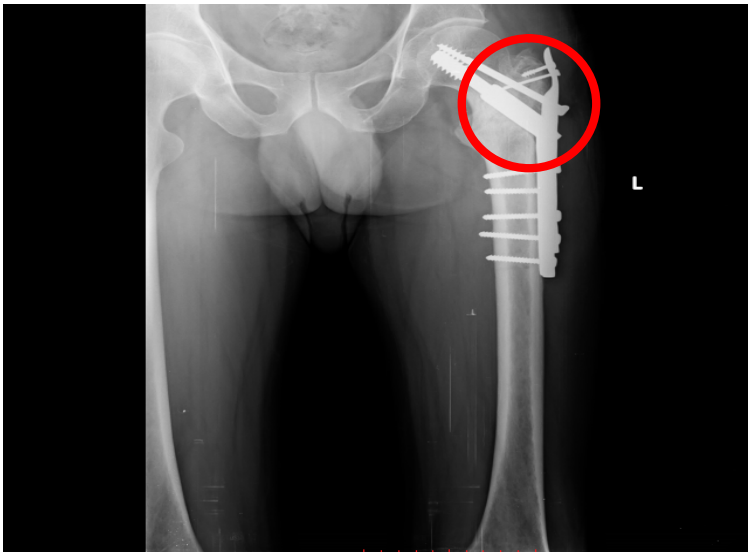
One patient had a superficial wound infection. The patient was a female patient suffering from Type II Diabetes Mellitus. The infection subsided with prolonged antibiotics and one wound wash.

Two male patients had fever on 4th postoperative day. One patient was diagnosed with urinary tract infection and another had lower respiratory tract infection which settled with a course of antibiotics.

Implant related complications

One patient suffered greater trochanter cancellousscrew loosening at 13 weeks. The patient was followed up for another 8 weeks till radiological union occurred and then under spinal anaesthesia the screw was removed.





Shortening:

Two patients had shortening of > 2 cm due to varus collapse out of which one patient had shortening of 2.5 cm and another patient had shortening of 2.7 cm. Which was addressed by heel sole raise foot wear.

One patient had persistent hip pain and another had persistent thigh pain. Weight bearing was deferred in these patients and pain was relieved after radiological union.

Complications

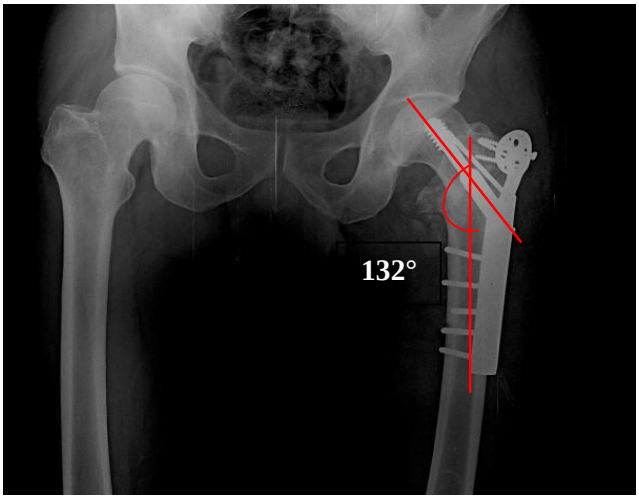
Complications	Total no. of patients
Superficial wound infection	1
Urinary tract infection	1
Lower respiratory tract infection	1
Varus collapse with shortening of >2 cm	2
Persistent Hip pain	1
Persistent Thigh pain	1

CASE ILLUSTRATIONS

Case 1: 50 year old male

Preoperative X-ray

Post-operative X-ray



2 month follow up

8 month follow up

CLINICAL PICTURES

Standing

External Rotation

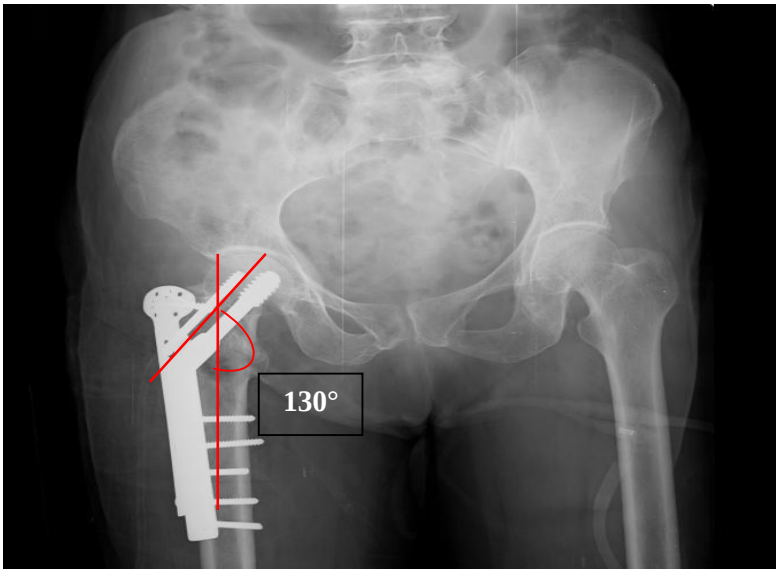
Active SLRT

Flexion

Case 2: 70 year female with diabetes mellitus

Preoperative X-ray

Postoperative X-ray



Clinical Pictures

Standing

Flexion

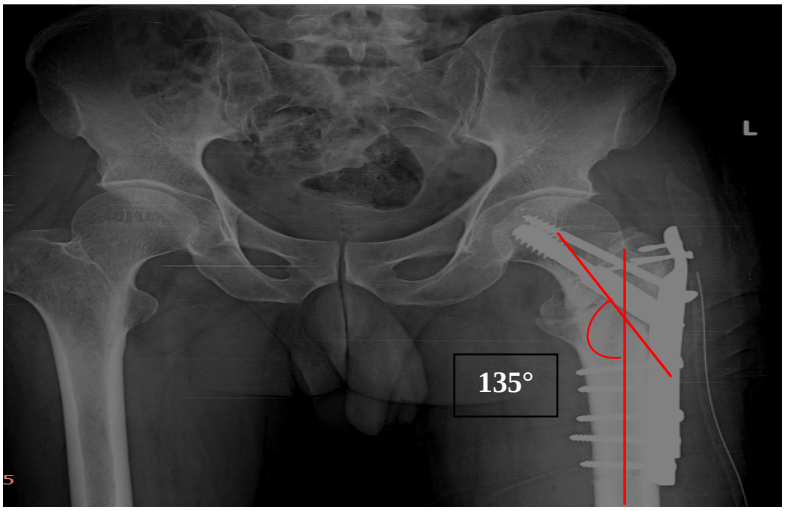
Active SLRT

External Rotation

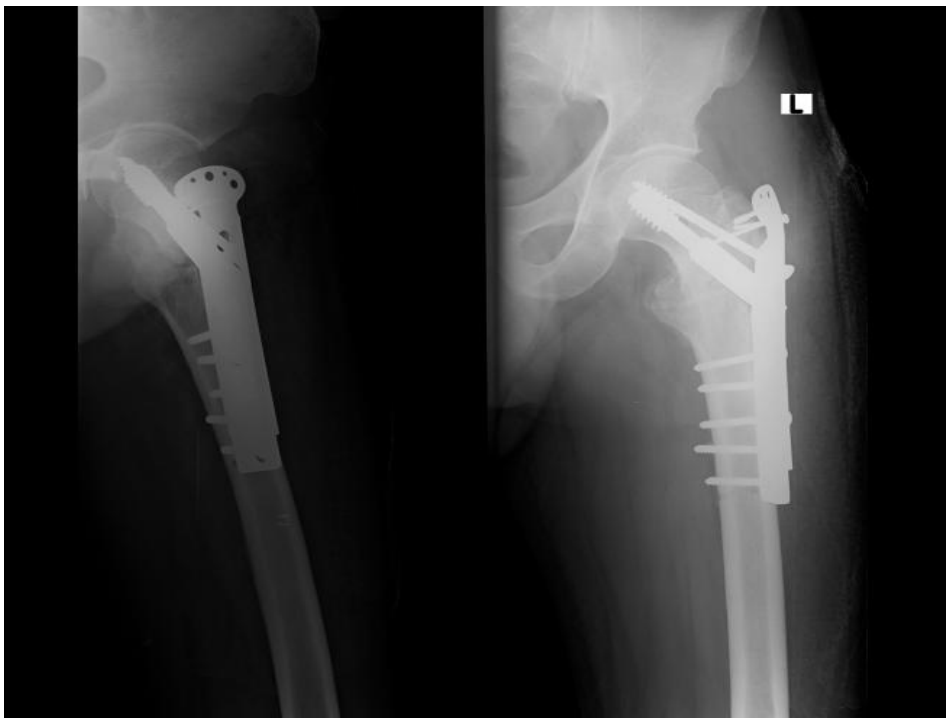
Case 3: 48 year old male

Preoperative X-ray

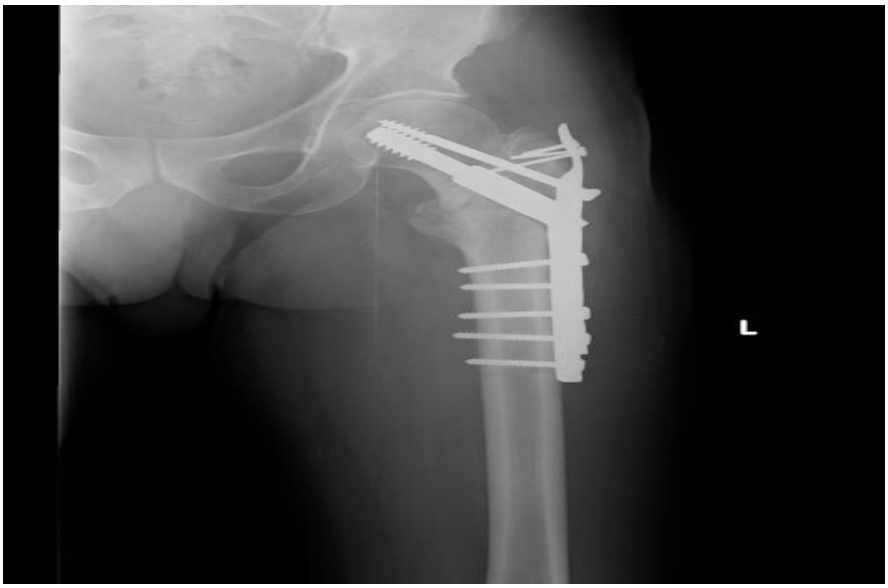
Postoperative X-ray



1 month follow-upX-ray



2 month follow-upX-ray



3 month follow-upX-ray

4 month follow-upX-ray

7 month follow-up

Clinical pictures

Standing

Active SLRT

Flexion

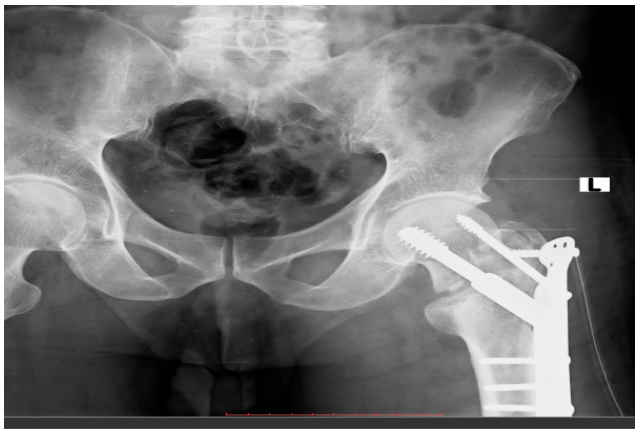
External rotation

Internal ration

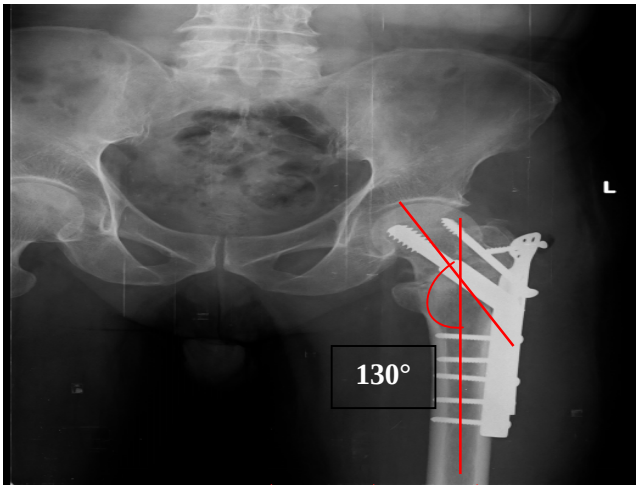
Case 4 75 year male

Preoperative X-ray

Postoperative X-ray

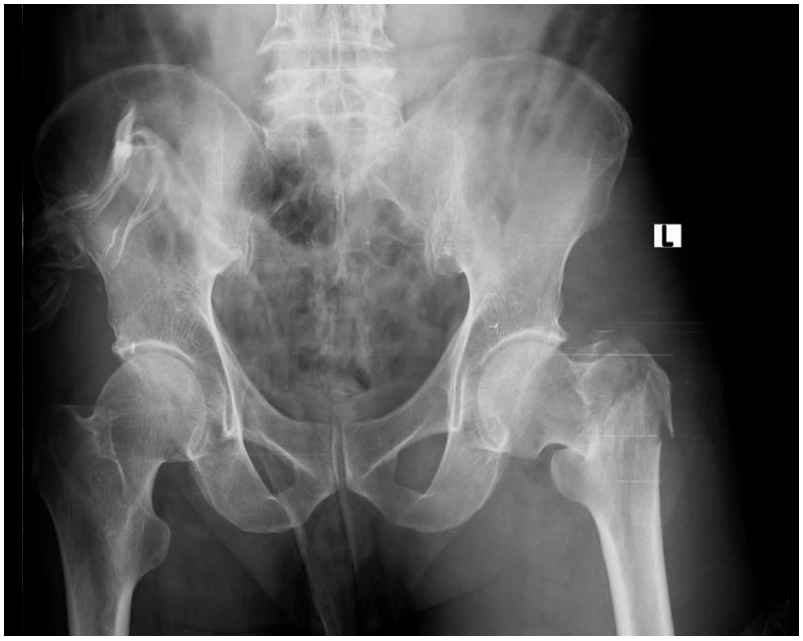


2 month follow-up

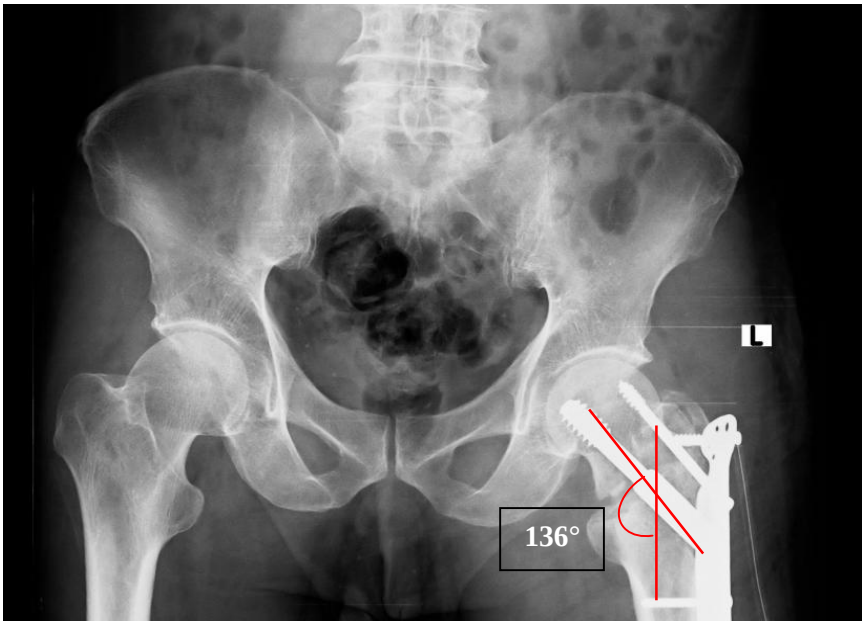


Case 5: 63 year female

Preoperative x-ray



PostoperativeX-ray



Follow up X-ray

Standing

Active SLRT

Flexion

External Rotation

DISCUSSION

Intertrochanteric femur fractures contribute half of total hip fractures in the elderly age group of >60 years with increase in the life expectancy the incidence of intertrochanteric hip fractures in increasing.

Simple fall from standing height is the most common mode of injury in this patient. Diminished vision, reduced reflexes, poor muscle tone and balance contribute to the increased incidence.

Various modalities of treatments are available like sliding hip screw, cephalomedullary nails, dynamic condylar screw, hemiarthroplasty and trochanteric stabilization plate. The goal of treatment being early mobilization of patients to prevent fracture disease complication.

Sliding hip screw is still the most widely used implant for these cases. But in case of unstable intertrochanteric fracture with lateral wall communition it has the disadvantage of excessive varus collapse and screw cutout. The reason being lack of lateral wall support and single point fixation.

In these cases trochanteric stabilization plate provides following benefits:

1. Lateral buttress effect
2. Anti-rotation screw (two point fixation)
3. Similar technique like sliding hip screw
4. Small learning curve

In our study conducted in Government Kilpauk Medical College and Hospital Chennai, 20 consecutive patients of unstable intertrochanteric fractures with lateral wall communition were treated with DHS with trochanteric stabilization plate. The fractures were classified according to AO/OTA classification and fractures of AO Type 31A2.1 to 31A2.3 were included in our study.

All cases were followed up for a minimum of 9 months and were assessed for clinical, radiological and functional outcome. The results were analysed. The observations of our study are as follows:

1. **Age:** Most of the patients in our study were in the age group of 60-70 years.

2. **Gender:** There was a male preponderance with 13 males and 7 females.

3. **Mode of injury:** Fall from standing height was the most common mode of injury.

4. **Type of fracture:** In our study we encountered 3 patients of AO Type 31A2.1, 14 patients of AO Type 31A2.2 and 3 patients of AO Type 31A2.3.

5. **Side of fracture:** 12 patients suffered fracture on left side and 8 patients suffered fracture on right side.

6. **Comorbidities:** 2 patients had systolic hypertension and type 2 diabetes mellitus. 2 patients had coronary artery disease and type 2 diabetes mellitus. 1 patient suffered from chronic kidney disease and systolic hypertension. 10 patients suffered from isolated systolic hypertension. 6 patients suffered from isolated diabetes mellitus. 1 patient was a known case of old healed pulmonary tuberculosis and completed Category 1 Anti TB treatment.

7. All the patients had good preoperative mobility and were ambulating independently unassisted.

8. Majority of patients were operated within 7 days, the average being 7.6 days.

9. Mean operating time was 82 minutes.

10. Mean blood loss was 166.25 ml.

11. Mean length of incision was 11.75 cm. On an average it was 2.75 cm larger than routine DHS incision. Longer incision was required for applyingtrochanteric stabilization plate.

12. Mean lag screw size was 85 mm, mean anti rotation screw (6.5 mm cancellous screw) size was 75 mm.

13. Average hospital stay was 6.9 days.

14. Partial weight bearing in most of cases was allowed immediately on 3rd postoperative day on the basis of construct stability and bone quality.

15. All fractures united on an average of 16.75 weeks.

16. All patients were allowed to full weight bearing on an average by 13.2 weeks on the basis of clinical and radiological union.

17. After analyzing functional outcome of all patients by Harris hip score the average score was found to be 83.2. We had 3 excellent results, 14 good results and 3 fair results.

18. **Complications:** One female patient a known case of Type 2 diabetes mellitus suffered from superficial wound infection. One patient suffered from urinary tract infection and one patient suffered from lower respiratory tract infection. Two patients suffered varus collapse with limb shortening >2 cm. One patient suffered greater trochanter cancellous screw loosening.

CONCLUSION

Trochanteric stabilization plate with sliding hip screw is a biomechanically stable construct allowing reconstruction of lateral wall to maintain adequate lever arm and abductor strength (power arm) in unstable intertrochanteric fractures with lateral wall communition.

Additional Antirotation screw provides enhanced rotational stability to the proximal fragment. Lateral wall buttress effect reduces the chance of varus collapse and screw cutout. The operative technique being similar to sliding hip screw, it has a small learning curve.

Overall in patients with unstable intertrochanteric fractures with lateral wall communition, DHS with trochanteric stabilization plate can give a superior functional and radiological outcome.

PROFORMA

Name :

Age / Sex :

IP number :

Address :

Contact Number :

Date of Admission :

Date of Surgery :

Date of Discharge :

Occupation :

Education :

Socioeconomic Status :

HISTORY:

1. Mode of injury : Road traffic accident / Fall at home / Fall from height / Pedestrian struck injury
2. Presenting complaints :
    a. Pain – site / duration
    b. Swelling – site / extent
    c. Deformity
    d. Disturbances in function of hip & knee – movements/ sensations
    e. Other associated injuries – head injury / limb injuries / spine injuries
3. Comorbid illnesses :

Diabetes mellitus		Hypertension		Coronary heart disease	
Renal disorder		Seizures /Neurological disorder		Hepatic disorder	
Dyslipedemia		Endocrine disorder		Tuberculosis	
Bronchial Asthma		Chronic Obstructive lung diseases		Neoplastic disorders	

4. Drug history : Steroids / Disease modifying anti-rheumatoid drugs / Immunosuppresants

PAST HISTORY:

- Any similar injuries
- Previous surgeries or hospitalisations
- Any major illnesses

PERSONAL HISTORY:

Diet	Vegetarian / Mixed
Marital Status	Married / Single
Bowel and Bladder habits	Regular / Altered
Habits	Smoking / Alcohol / Tobacco / Drug Addictions / Others

OBSTETRIC & GYNAECOLOGY HISTORY:

TREATMENT HISTORY:

FAMILY HISTORY:

CLINICAL EXAMINATION:

GENERAL EXAMINATION:

- ☞ Appearance : ☞ Built:
- ☞ Pallor : ☞ Icterus:
- ☞ Cyanosis : ☞ Clubbing
- ☞ Pedal Edema : ☞ Lymphadenopathy :

VITALS:

1. Pulse :
2. BP :
3. Respiratory rate :
4. Temperature :

SYSTEMIC EXAMINATION :

- ☞ Cardiovascular system :
- ☞ Respiratory system:

- ☞ Abdomen :
- ☞ Central Nervous System :

REGIONAL EXAMINATION

RIGHT / LEFT HIP

OTHER INJURIES

X – RAY FINDINGS

3D CT RIGHT/LEFT HIP JOINT (If needed)

INVESTIGATIONS

Hb%		TC		DC	P L B E M
ESR		BT/CT		RBS	
UREA		S.CREATININE		ELECTROLYTES	Na^+ K^+
HBsAg		HIV		VDRL	
CXR		ECG		URINE ROUTINE	
Blood G & T				ALBUMIN SUGAR DEPOSITS	

FINAL DIAGNOSIS:

INITIAL TREATMENT GIVEN:

PLANNED SURGERY :

PROCEDURE NOTES

POST OP PERIOD

FOLLOW UP (After discharge)	CLINICAL FINDINGS	X–RAY FINDINGS	ADVICE
FIRST WEEK			
SECOND WEEK			
FIRST MONTH			
SECOND MONTH			
THIRD MONTH			
SIX MONTH			

OUTCOME:

PATIENT CONSENT FORM

Study detail:“ A STUDY ON FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE TROCHANCTERIC FRACTURES MANAGED BY MODULAR EXTENSION OF DYNAMIC HIP SCREW"

Study centre : KILPAUK MEDICAL COLLEGE, CHENNAI

Patients Name :

Patients Age :

Identification Number :

Patient may check (✓) these boxes

I confirm that I have understood the purpose of procedure for the above study. ☐

I had the opportunity to ask question and all my questions and doubtshave been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that sponsor of the clinical study, others working on the sponsor’s behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I hereby make known that I have fully understood the use of above surgical procedure, the possible complications arising out of its use and the same was clearly explained to me and also understand that this technique is a new method of treatment of patella fractures and this study is done to know the usefulness of the same in management of patella fracturesI agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms. ☐

I hereby consent to participate in this study. ☐

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological tests. ☐

Signature/thumb impression:

Patients Name and Address: place date

Signature of investigator :

Study investigator’s Name : place date

MASTER CHART

Sl. No	Name	Age/ Sex	OTA	SR/L	Co.mo.con	Pop Rom	In Lincm	LSP	ARS size	LSL in mm	DOS mt	B/L ml	IOPC	FU in w	HHPS	NSF
1.	Devaraj	50/ M	2	L	2	1	12	2	80	85	85	150	2	16	81	1
2.	Irudhaya nathan	48/ M	1	L	2	1	13	2	80	90	75	200	2	16	84	2
3.	Lakshmi pathy	75/ M	2	L	1,2	1	10	2	70	80	90	100	2	26	84	1
4.	Poongav anam	70/F	3	R	4	1	13	2	75	85	110	175	2	20	89	1
5.	Shankar	65/ M	2	L	1	1	10	2	75	85	100	155	2	26	86	1
6.	Sundara m	66/ M	3	R	2	1	12	2	80	90	70	200	2	18	69	1
7.	Arjunan	66/ M	1	L	1	1	14	2	85	95	75	170	2	20	75	1
8.	Ammava sai	60/ M	2	L	2	1	11	2	75	85	70	175	2	22	89	1
9.	Sethura maiya	65/ M	1	R	2	1	14	2	70	80	80	150	2	16	81	1
10.	Senbaga m	63/F	2	R	1,3	1	13	2	75	85	85	175	2	18	75	1
11.	Munusa my	55/ M	2	L	2	1	12	2	70	80	75	175	2	20	72	2
12.	Govinda mmal	71/F	3	L	1	1	10	2	80	90	80	180	2	22	84	1
13.	Mary	62/F	2	R	2	1	13	2	70	80	75	100	2	16	83	1
14.	Natesan	74/ M	2	L	2,5	1	13	2	75	85	70	175	2	22	86	1
15.	Selvaraj	63/ M	2	L	1,3	1	11	2	75	85	80	155	2	20	84	1

16.	Deepa	73/F	2	R	2	1	13	2	80	90	85	150	2	18	73	1
17.	Kanniyammal	61/F	3	R	1	1	12	2	75	85	85	200	2	16	89	1
18.	Subramanian	67/M	3	L	2	1	13	2	70	80	85	200	2	20	81	1
19.	Rajendran	63/M	2	L	1,2	1	11	2	75	85	90	170	2	16	80	1
20.	Sumathi	74/F	2	R	3	1	14	2	75	85	80	170	2	18	82	1

INDEX FOR MASTER CHART

1.OTA Classification
31 A2.1 - 1
31 A2.2 - 2
31 A2.3 - 3

2.S R/L
S - Side
R – Right
L – Left

3.Co.mo.con – Comorbid Condition
1. DM
2. HTN
3. Heart Disease
4. TB
5. CKD

4.Pop Rom – Pre operative Range of Movement
1. Independent
2. Aided
3. With support

5.In L in cm – Incision Length in cm

6.LSP – Lag screw position
1. Centre
2. Inferior and centre

7.ARS size – Anti Rotation Screw Size

8.LSL in mm – Lag Screw Length in mm

9.DOSmts – Duration of surgery in minutes

10.B/L ml – Blood Loss in ml

11.IOPC – Intra operative complications
1. Failure of reduction
2. No complications

12.FU in w – Fracture Union in weeks

13.HHFS – Harris hip function score

14.NSF – Neck Shaft Angle

1. Varus 2.No varus

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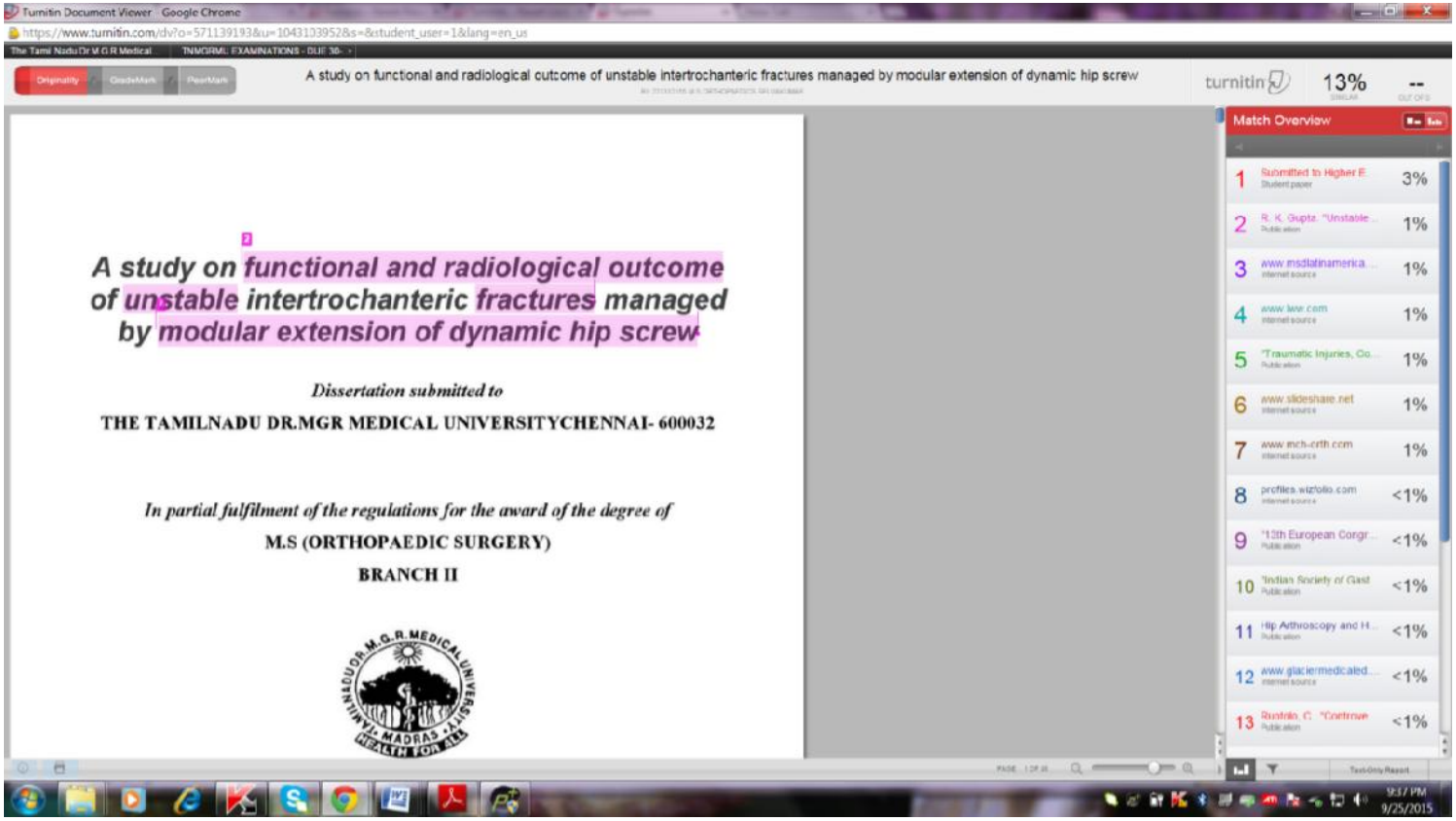
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