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"A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOMES AND COMPLICATIONS OF TROCHANTERIC FEMORAL NAIL IN INTERTROCHANTERIC FRACTURES"

By

DR. KULKARNI ONKAR SATISH

Thesis submitted to the

BLDE (DEEMED TO BE UNIVERSITY),

VIJAYAPURA, KARNATAKA

In partial fulfilment of the requirements for the degree of

DOCTOR OF SURGERY

IN

ORTHOPAEDICS

Under the guidance of

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I hereby declare that this dissertation entitled **"A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOMES AND COMPLICATIONS OF TROCHANTERIC FEMORAL NAIL IN INTERTROCHANTERIC FRACTURES"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. RAMANAGOUDA B. BIRADAR** Associate Professor Department of ORTHOPAEDICS Shri.B.M.Patil Medical College , Hospital and Research Center, Vijayapur

Date:26-09-2020

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ACKNOWLEDGEMENT

On completion of this contribution of scientific document it gives me deep pleasure to acknowledge the guidance provided by my distinguished mentors. With privilege and respect I would like to express my gratitude and indebtedness to my guide **Dr.RAMANAGOUDA B BIRADAR** Associate Professor, Department of orthopaedics BLDE (DEEMED TO BE UNIVERSITY) Shri B. M. Patil Medical College, Vijayapur, for his constant Inspiration, extensive encouragement and support which he rendered in pursuit of my Post-graduate studies and in the preparation of this dissertation.

I am extremely grateful to my eminent and esteemed teacher **Dr. ASHOK R NAYAK** **M.S.** Professor and Head Of Department of Orthopaedics, BLDE University's Shri B.M. Patil Medical College, Vijayapur for his overall guidance and Inspiration during my study.

I am extremely thankful to Principal of B.L.D.E(DEEMED TO BE UNIVERSITY) Shri B. M.Patil Medical College Hospital and Research Centre, Vijayapur, for permitting me to utilize the resources in completion of my work.

I find no words to express my indebtness to Dr. O. B. Pattanshetty, Dr Santosh Nandi, Dr. Dayanand BB, Dr. Sandeep Naik, Dr. Anil Bulgond, Dr. Srikant Kulkarni, Dr. Rajkumar Bagewadi, Dr. Sreepad Kulkarni, Dr.Raghavendra kembhavi, Dr. Gireesh Khodnapur, Dr. Sarvesh K, Dr. Vijaykumar Patil without whom completing my thesis would have been difficult.

My heartfelt thanks to the entire co post graduate students Dr.Abhinav Kumar, Dr.Abhishek Shenoy, Dr.Puneet Singh, Dr Rajesh Patel, Dr.Siddhant, Dr.Vikram, Dr. Ravikant, Dr. Adithiyaa, Dr. Pranav, Dr. Shivaprasad, Dr. Sagar, Dr. Amit, Dr. Karthik, Dr. Basavaraj, Dr. Shreesagar, Dr. Jayesh, Dr. Razvi.

I thank **Mr Shahanawaz,** the statistician for her invaluable help in dealing with all the statistical work in this study .

I express my gratitude to **Library Staff, OT Staff** and all Hospital Staff for their co-operation in my study.

Last but not the least, I convey my heartfelt gratitude to all the patients, without whose co-operation, this study would be incomplete.

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INTRODUCTION

A trivial fall account for 90% of intertrochanteric fractures of femur in elderly occurs commonly because of osteoporotic bone [1, 2]. Where as in young individuals it may be a result of high energy injury such as motor vehicle accident or fall from height.[2]

The incidence of fractures of the proximal femur is increasing since the general life expectancy of the population and related osteoporosis has increased significantly during the past few decades. They are second most common fractures related to osteoporosis, next only to spine. There were an estimated 1.66 million hip fractures worldwide in 1990 and this world wide annual number is expected to reach 6.26 million by the year 2050, intertrochanteric ones taking a major share of them.

Cummings et al.[3] noted that neither age related osteoporosis, nor the increasing incidence of falls with age sufficiently explains the exponential increase in the incidence of hip fracture with aging.

Intertrochanteric fractures in elderly people are usually comminuted and unstable because of indirect forces which include pull of the iliopsoas muscle on the lesser trochanter and pull of the abductor muscle on the greater trochanter. Hence they are associated with high rates of morbidity and mortality if they are not treated surgically, intertrochanteric fractures are associated with complications like pressure sores, pulmonary infection, DVT, atelectasis, malunion etc and hence surgery (Trochanteric Femoral Nail) is aimed at early rehabilitation and mobilization.[4]

The dynamic hip score has been considered the device of choice because it is time tested implant in fracture union. The drawback of sliding hip screw is loss hip offset and shortening of leg.

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The goal of treatment in treating intertrochanteric fracture is to achieve stable anatomical reduction, rigid fixation, and early mobilization. The mechanism of action of TFN is controlled collapse at the fracture site on weight bearing leading to compression at the fracture. The distal screws lock the nail and help in control of rotation and telescoping of the fracture fragments.

Management options available for INTERTROCHANTERIC FRACTURES at this time

1. Conservative
2. Close Reduction and internal fixation with D.H.S.
3. Close Reduction & internal fixation with TFN
4. Hemiarthroplasty
5. Total HIP Arthroplasty
6. Ender's Nail
7. External fixation

It had been noticed complications such as implant failure, screw back-out, protrusion of implant over the tip of the greater trochanter causing impingement, the z effect involves lateral migration of inferior head screw and medial migration of superior head screw and opposite is reverse z effect.

We have hereby conducted the study to evaluate the functional outcomes and complications of trochanteric femoral nail in intertrochanteric femur fractures based on clinical and radiological findings.

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OBJECTIVE OF THE STUDY

To study the functional outcome and complications of trochanteric femoral nail used in intertrochanteric fracture.

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REVIEW OF LITERATURE

HISTORICAL REVIEW

The introduction of the Tri-flanged nail by Smith-Peterson (1931) for the management of fracture neck of femur has resulted in a great reduction of mortality and improvement in the percentage of union.

In the 1930s, lag screw type of devices are introduced by **Henry, Littman, Henderson**, and others instead of nails.[5,6,7]

In1937, Thornton Plate an side plate bolted to the Smith-Petersen nail was introduced by **Lawson Thornton**.[8]

Until 1940’s the treatment of trochanteric fractures was reduction of the fractures, and immobilization either in hip spica or in traction.

In 1941 Jewett introduced fixed angle nail plate for the management of Trochanteric fractures, which was a breakthrough to conservative treatment.

In 1945 Virgin and Mar Ausland introduced the screw, which produce a Dynamic compression at the fracture site.

In 1949 Boyd and Griffin first classified the types of Trochanteric fractures. In same year E.Mervyn Evans classified Trochanteric fractures as stable and unstable

Boyd and Griffin classification

Their classification included all fractures from the extra capsular part of the neck to a point 5cms distal to the lesser trochanter

TYPE I:

Fractures extending along the Intertrochanteric line, from greater trochanter to the lesser trochanter.

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TYPE II:

Comminuted fractures, the main fracture being along the inter trochanteric line, but with multiple fractures in the cortex.

TYPE III:

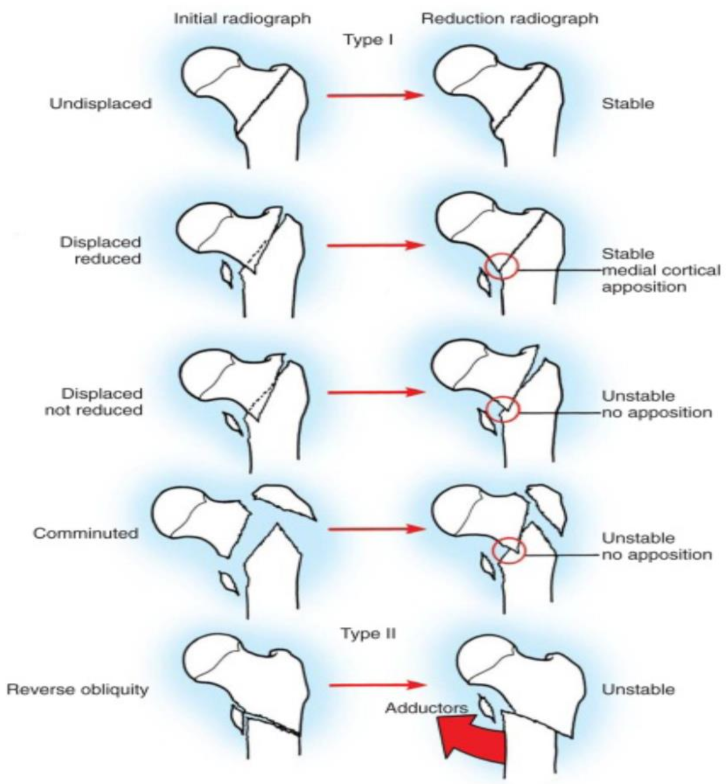
Fractures that are basically subtrochanteric, with at least one fracture line passing across the proximal end of the shaft from just distal to the lesser trochanter, with varying degrees of comminution.

TYPE IV:

Fractures of the trochanteric region and the proximal shaft with fracture in at least two planes.

Reduction of TYPE I fractures are simple & can be maintained with little difficulty TYPE II, III & IV fractures are increasingly more difficult to reduce & to maintain reduction & are associated with more complications.

Evans Classification



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In 1949, Boyd and Griffin introduced Trochanteric buttress plate with Neufeld plate for unstable fractures to prevent medicalization.

In 1950, intertrochanteric fractures management were begins with external fixation, but it became failure due to increased rate of pin-tract infection, pin loosening, instability, and failure.[9,10,11]

In 1955 Schumpelick W. Jantzen published the use of sliding screw plate and in the same year Pugh and Badgelyin USA developed a sliding nail with a trifin tip to avoid the joint penetration.

In 1960 a USA based "Richards manufacturing company" produced dynamic compression screw and hence it is also known as Richards screw.

In 1985 Gamma nail was developed after cadaver studies and clinically on 421 patients.

In 1993 sliding plate (Medoff) was devised for DHS in the treatment of intertrochanteric fractures.

In 1996, AO/ASIF Developed a new device **Proximal Femoral Nail** which has been usefull in early mobilization and treatment of unstable intertrochanteric femoral fractures.[12]

In 2000, Gottfried developed the **Percutaneous Compression Plate (PCCP) system**, to provide rotational stability to the intertrochanteric fractures fixation, and it minimises the damage to the greater trochanter (lateral wall of the femur).[13]

The **Proximal Femoral Nail Antirotation(PFNA) system** was developed by the AO/ASIF in 2004.The main design characteristic of the implant is the use of a single blade with a large surface area. Insertion of the blade compacts the cancellous bone. These characteristics provide optimal anchoring and stability when the implant is inserted into osteoporotic bone.[14]

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In **June 2004,** the **Short Proximal Femoral Nail** was introduced in India by **Gadegone WM** and **Salphale YS.**

In **April 2010, Gadegone WM, Salphale YS** concluded after reviewing out comes of 100 Asian patients who underwent short proximal femoral nailing for stable and unstable intertrochanteric fractures. They concluded that Trochanteric Nail is a better implant for stable and unstable intertrochanteric fractures in terms of operating time, surgical exposure, blood loss, and complications, especially for patients with relatively small femur.[15]

The PFN has a proximal diameter of 15 mm, expanded to give additional strength. The proximal 2 screws are of 6.4mm and 8mm. Both screws are self-tapping and partially threaded to allow for sliding compression. The distal screws are of 4.9 mm fully threaded self-tapping locking bolt. The nail has 6 degrees valgus bend proximally. It is available in short and long versions from 240 to 420mm in length. It is available in 9 to 12mm of distal diameter and neck shaft angle of 130 and 135 deg.

The advantages of proximal femoral nail over the sliding hip screw[16].

a) A Proximal femoral nail provides more efficient load transfer.
b) An Proximal femoral nail have shorter lever arm which decreases tensile strain on the implant so decreasing the risk of implant failure.
c) Because a Proximal femoral nail incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained.
d) Intramedullary location of the Proximal femoral nail limits the amount of sliding and therefore limb shortening and deformity that can occur.
e) Proximal femoral nail requires shorter operative time and less soft tissue dissection than a sliding hip screw, So decreasing the overall morbidity.

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G. S. Kulkarni et al[17] studied 100 patients from May 2010 to February 2014 reviewed the current concepts of treatment of Intertrochanteric fractures. They concluded that unstable Intertrochanteric fractures can be helped by medullary fixation as there is more failure of Dynamic hip screw. Proximal femoral nail developed by A.O. has two sliding screws. Advantages of their screws are:

1. More stable fixation.
2. Prevention of rotational deformity.

Simmermacher R. K et al[18] reviewed 191 patients in 1999 having proximal femoral fractures treated with PFN in one year. After the 4 months of follow up technical failures were seen in just 4.6% of the cases. They concluded that the result of this new implant compare favourably to the currently available implants for the treatment of the unstable pertrochanteric femoral fractures.

Christian Boldin, Franz J. Seibert et al[19] in 2000 carried a prospective study 55 patients having proximal femoral fractures treated with the Proximal femoral nail. They achieved good results in most of the patients with very less complications at 12 month follow up. They concluded that proximal femoral nail is a good minimal invasive implant for unstable proximal femoral fractures.

Pajarinen J. et al[20] performed a randomised clinical trial of 108 patients in January 2005 comparing the Dynamic hip screw and Proximal femoral nail in patients with peritrochanteric fractures emphasizing functional outcomes and rehabilitation. At four months review patients treated with proximal femoral nail regained their pre-injury walking ability, Shortening of the both femoral neck and shaft was seen in patients treated with Dynamic hip screw, this difference was statistically significant.

Klinger H. M. et al[21] have done a study in august 2005 on Dynamic hip screw and trochanteric buttress plate Vs proximal femoral nail in management of 173

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unstable intertrochanteric femoral fractures. In case of proximal femoral nail 17.2% revisions were necessary and in the case of dynamic hip screw with TBPP 21.6%. A shorter operation time and a considerable shorter in patient stay were common with proximal femoral nail. They concluded that Dynamic hip screw with TBPP had a higher incidence of complications in unstable trochanteric fractures than proximal femoral nail.

Reska M. et al[22] reviewed 83 patients in June 2006 with proximal femoral fractures treated with Proximal femoral nail. In their study except for 2 cases post-operative course was favourable in rest of the patients. They concluded that with the use of proximal femoral nail early mobilisation of patient is possible. A careful surgical approach and technique with a stable Osteosynthesis have markedly contributed to a more rapid mobilization of a patient with the use of proximal femoral nail.

Pavelka T. et al[23] reviewed 79 patients in April 2007 with ipsilateral fractures of the hip and femoral shaft treated with a long proximal femoral nail. In follow up for at least 12 months bone union was achieved in all patients.. The outcomes were excellent in 64%, good in 28% and satisfactory in 8%. They concluded that the long proximal femoral nail is a high quality implant that increases our options of treatment of all the reconstruction nails.

W.M. Gadegone and Y.S. Salphale[24] in 2006 carried out a study on 100 consecutive patients who had suffered an Intertrochanteric or high subtrochanteric fractures treated with Proximal femoral nail. Complications occurred in 12 patients. They concluded that Osteosynthesis with the Proximal femoral nail offers the advantage of high rotational stability of the head-neck fragment.

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Ramesh Krishna.K[25] in 2009 carried out a study on 30 patients with Intertrochanteric fractures treated with Dynamic hip screw and Proximal femur nail with follow up 0f 6 months, 5 patients lost for follow up (3 dynamic hip screw and 2 proximal femur nail) and two patients expired due to associated medical problems. They conclude that proximal femur nail is better alternative to dynamic hip screw in the management Intertrochanteric fractures it reduces operating time , radiation exposure , blood loss and intra-operative complications but it is technically difficult and need more expertise.

In 2009, A retrospective study was conducted of 26 cases, they concluded that in the management of unstable intertrochanteric fractures PFN is a suitable implant which needs open reduction and internal fixation. It has less intra operative and postoperative morbidity.[26]

EgolK A, ChangEY, CvitkovicJ, KummerFJ, KovalKJ(2004)[27] did a study on the mismatch of current intramedullary nails with the anterior bow of the femur. They inferred that the implant which is developed according to western population were over size, had the Intra-operative complications such as splintering and fractures.

The available length of proximal femoral nail in India is of 240-250 mm. In an average Indian subject. It passes through the mid diaphysis of the femur and occasionally abuts against the bowed femur. This may causes the intra-operative femoral shaft fractures and thigh pain, due to implant touches the anterior cortex of the femur.

The fixation of intramedullary nail is affected by the anterior curvature of the femur.

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If there is significant difference in the nail and the anterior femoral curvature leads to cortical penetration or fracture angulation.[28]

The proximal diameter of the gamma nail and proximal femoral nail is 15mm,which is too large for average Indian femur, which may give rise to widening of the trochanter and fractures. In Chinese population a study has done with the modification in the gamma nail by reducing its diameter and length.[29]

In the series of 295 patient with trochanteric fractures treated with the PFN by Domingo et al. the average age of the patients was 80 years, which possibly accounted for 27% of the patients who developed complications in the immediate post-operative period.

TROCHANTERIC FEMORAL NAIL (TFN)

It is having a smaller proximal diameter of 14mm.The proximal 2screws are of 6.4mm and 8mm. The distal bolts are of 4.9mm bolts. The nail has 6 degrees valgus bend proximally. It is available in length 180 mm standards. Available in 9, 10, 11 and 12mm of distal diameters and neck shaft angle of 130^0 and 135^0.

The advantages of the TFN as an intramedullary device

a) Due to its location in intramedullary fixation provides more efficient load transfer than does a sliding hip screw.

b) It decreases the tensile strength due to its shorter lever arm, thus decreasing the risk of implant failure.

c) Because an intramedullary fixation device incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained.

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d) It decreases the complications like limb shortening and deformity by limiting the amount sliding of fracture fragment.

e) The Operative time to insert the intramedullary hip screw requires shorter time. It requires less soft tissue dissection than a sliding hip screw, so decreasing the overall morbidity.

In addition it has several other favourable characteristics

1. The presence of two proximal screws provides better rotational control of proximal fracture fragment.
2. It allows length and rotational control even when the lesser trochanter is not intact.
3. It can be dynamically locked.
4. Short length – to overcome the impingement of the nail on the anterior cortex by PFN

The main advantages of TFN over its precursor gamma nail are Since the 2 proximal screws are smaller in diameter; it is not necessary for the nail to be stout unlike gamma nail and hence theoretically induces less comminution of proximal segment and less disruption of abductor insertion.

Gadegone WM, Salphale YS(April 2010)[30] reviewed outcomes of 100 Asian patients who underwent Trochanteric Nailing for stable and unstable intertrochanteric fractures. They concluded, that short proximal femoral nail is a superior implant for stable and unstable intertrochanteric fractures in terms of operating time, surgical exposure, blood loss, and complications, especially for patients with relatively small femora.

TFN (Trochanteric Femoral Nail) is a newly introduced intra medullary device has advantages over PFN. Because of its short length and tapering distal end leads to

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less stress at the distal tip, this reduces risk of fracture at distal tip. Because of short length, TFN can be used in femur with increased bowing or altered anatomy of distal half of femur. Straighter configuration and availability of distal jig reduce operative time as compared to PFN.

A study was done by Mandal S, Kundu S, Hyam A , in Short-term evaluation of results of trochanteric femoral nailing (TFN) " in comminuted unstable trochanteric hip fractures" in 25 cases. In that study all cases show union, majority (64%) within 16wks. In 80% patients Harris hip score was >70 within 10 wks. In 60% cases shows excellent alignment. The complications like neck-screw cut out, and varus malunion is lesser than DHS. With respect to collapse of fracture area TFN gave more stable fixation than gamma nail. The stress-rising effect of PFN over the anterior femoral cortex can be avoided by using TFN.

In their Study they concluded that, an unstable intertrochanteric fracture treated with TFN has more advantages than the extramedullary implants in terms of biological and biomechanical point of view. It is a minimally invasive intramedullary device and there clinical results were excellent as compared to techniques like gamma-nail and PFN, with less complications.[31]

SURGICAL ANATOMY[32, 33, 34, 35]

The hip joint is a **multiaxial synovial joint** of the **ball and socket variety**, formed by the femoral head & the acetabulum.

BONE STRUCTURE (Fig. 1 & 2)

The femoral head is an imperfect sphere of cancellous bone covered by articular cartilage. The size of the head varies in proportion to the body mass varying from 40 to 60 mm in diameter.

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The femoral neck comprises the region from the head to the intertrochanteric region. The neck forms an angle of 125 to 140 degree with the shaft in the antero posterior plane & angle of 10-20 deg (anteversion) in the lateral plane. The intertrochanteric region consists of the greater & lesser trochanter, representing a zone of transition from the neck to the shaft. This area consists primarily of dense trabecular bone that serves to transmit & distribute stress. The *Calcar femorale*, is a vertical wall of dense bone extending from the posteromedial aspect of the femoral shaft to the posterior portion of the neck, which forms an internal trabecular strut within the inferior portion of the neck.

The subtrochanteric region, extends from the lesser trochanter to an area 5 cm distal to it. Subtrochanteric region had high stress concentration with large compressive forces medially & tensile forces laterally.

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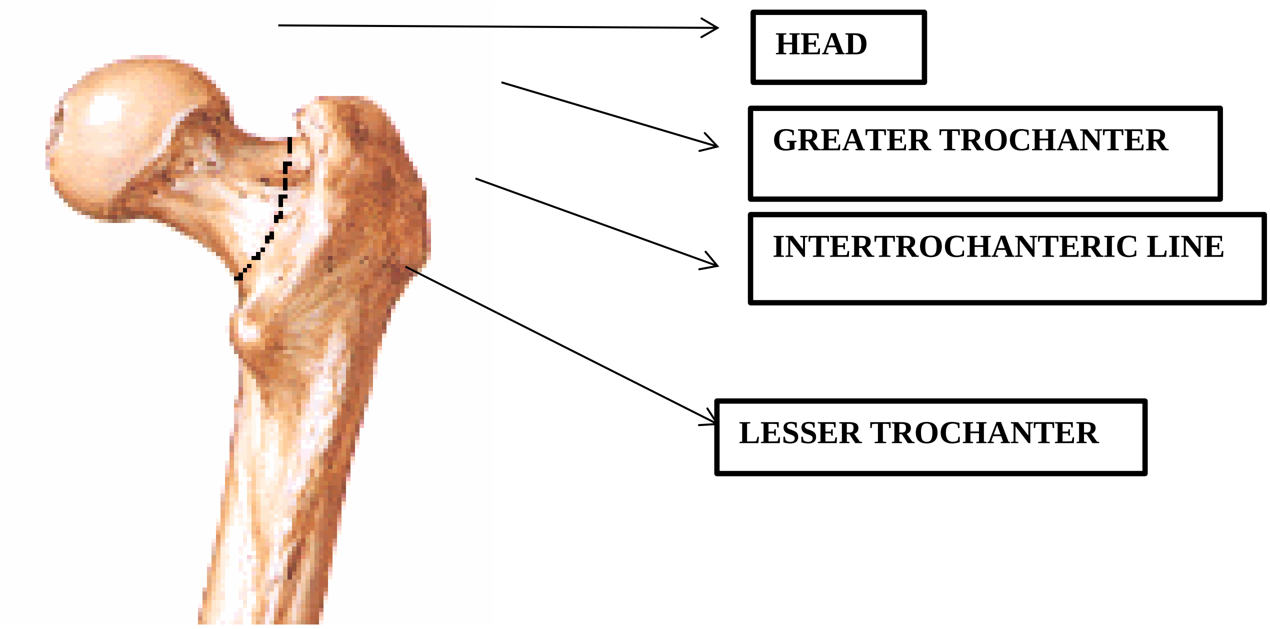

Fig 1. Posterior view anatomy of proximal femur

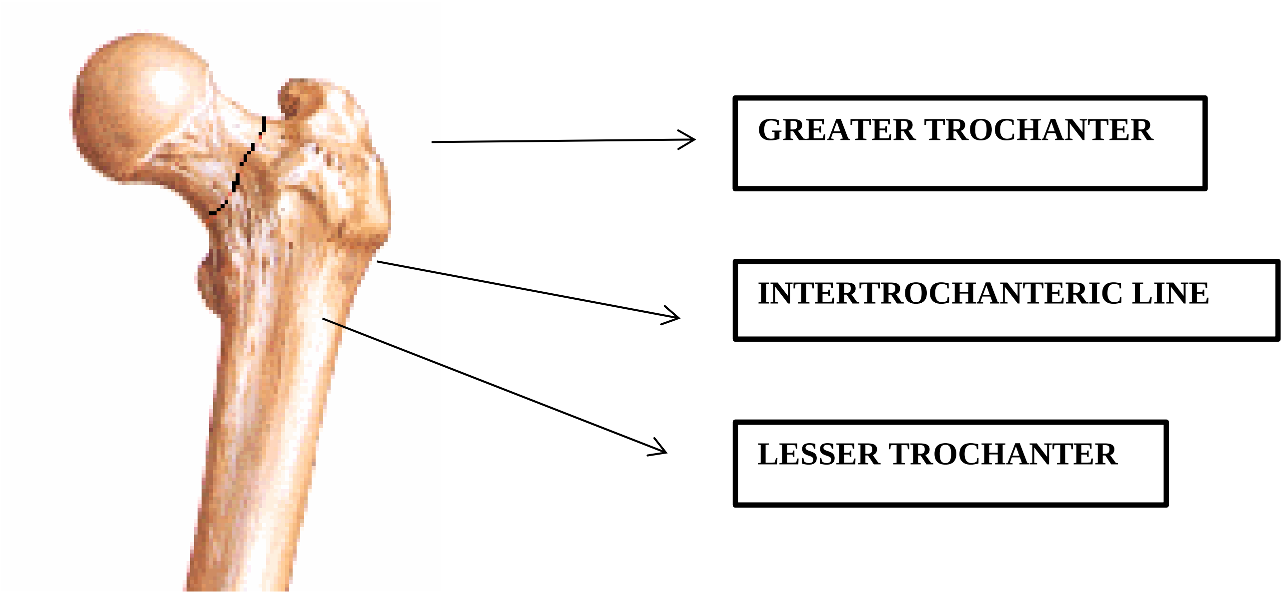

Fig 2. Anterior view anatomy of proximal femur

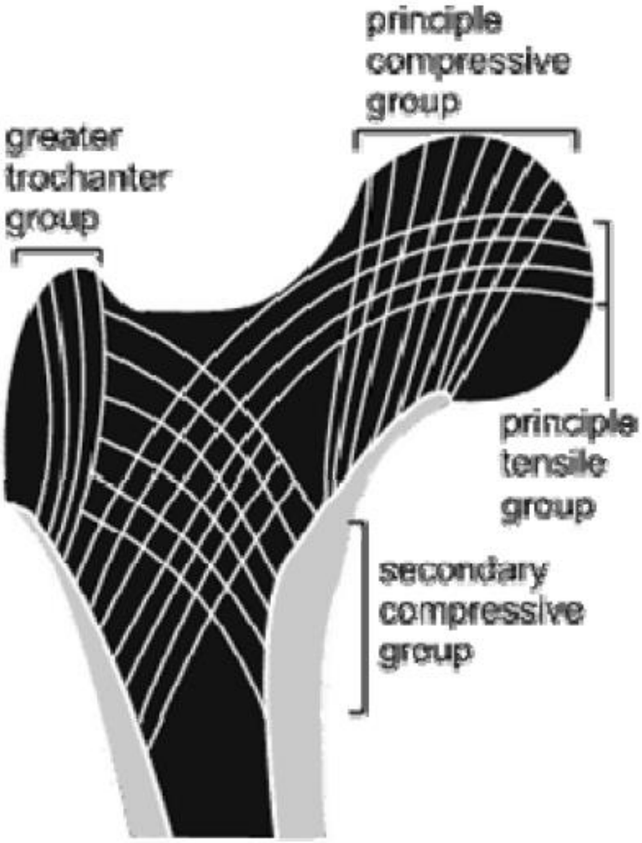

Fig: 3 Trabecular pattern

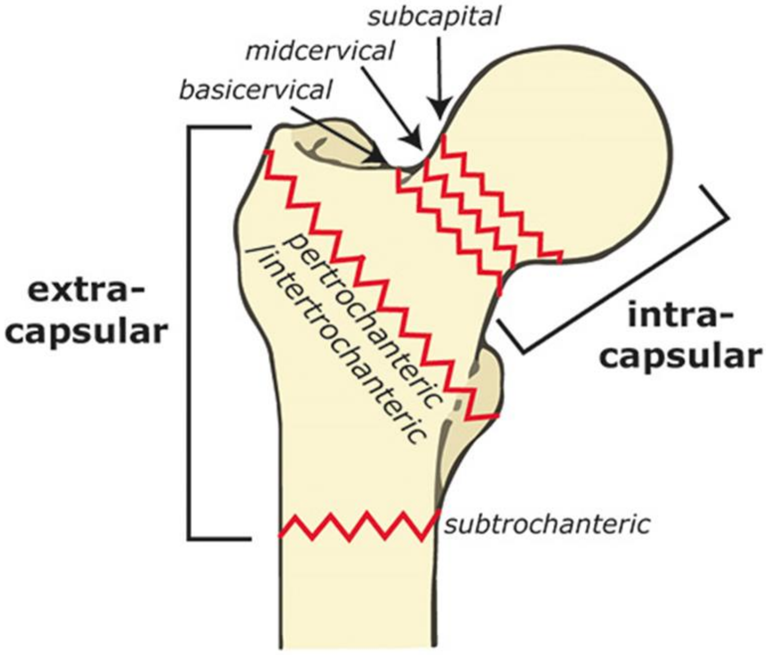

Fig: 4 Regions of the proximal femur

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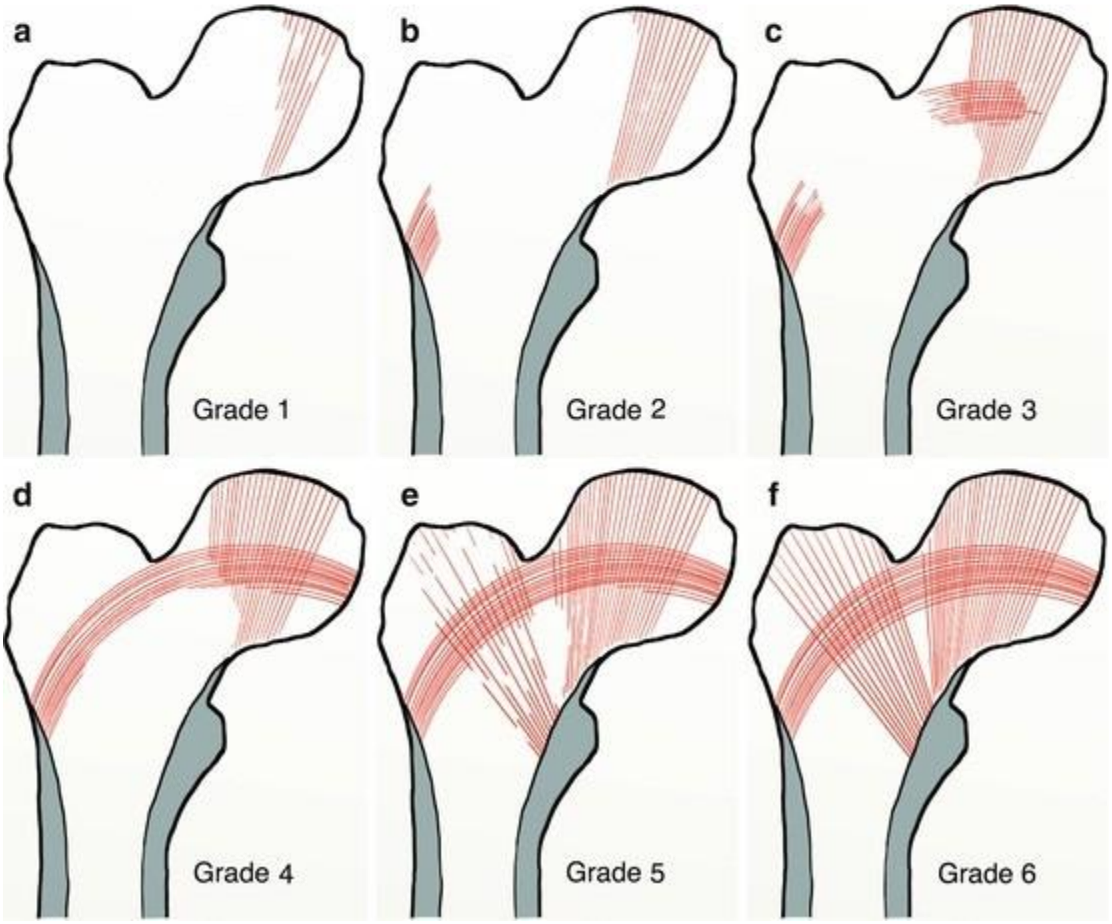

Fig: 5 showing the Singh &Maini index with Gr.1 Representing severe osteoporosis & Gr.6 normal bone.

MUSCLES

There are numerous powerful muscles surrounding the trochanteric region. The muscles can be grouped as follows:

THE ABDUCTORS

These muscles are the *gluteus medius* & *gluteus minimus* they originate from the outer table of the ilium & insert onto the greater tuberosity. The *tensor fascia lata* arises from the outer border of the iliac crest & inserts on the ilio tibial band. The gleuti control the pelvic tilt in the frontal plane.

Hip joint and Muscles around hip

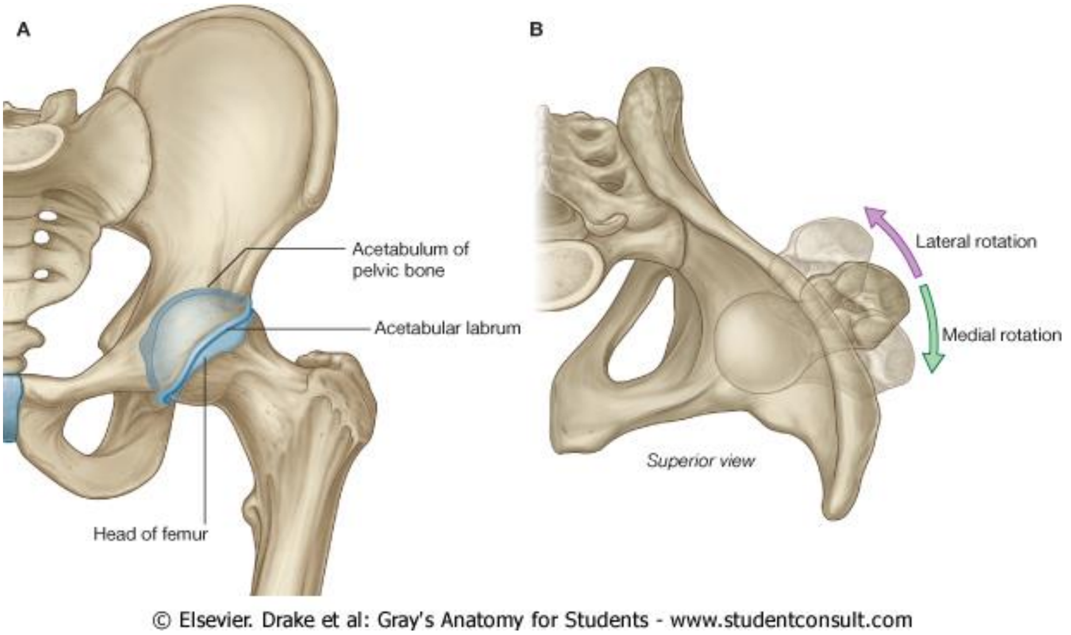

Fig 6

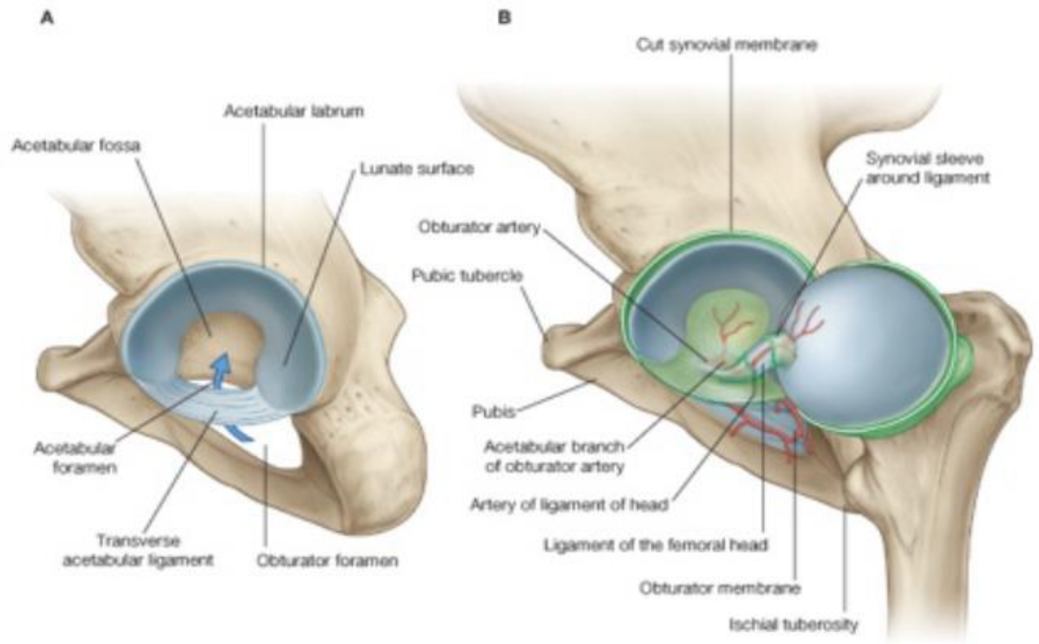

Fig 7

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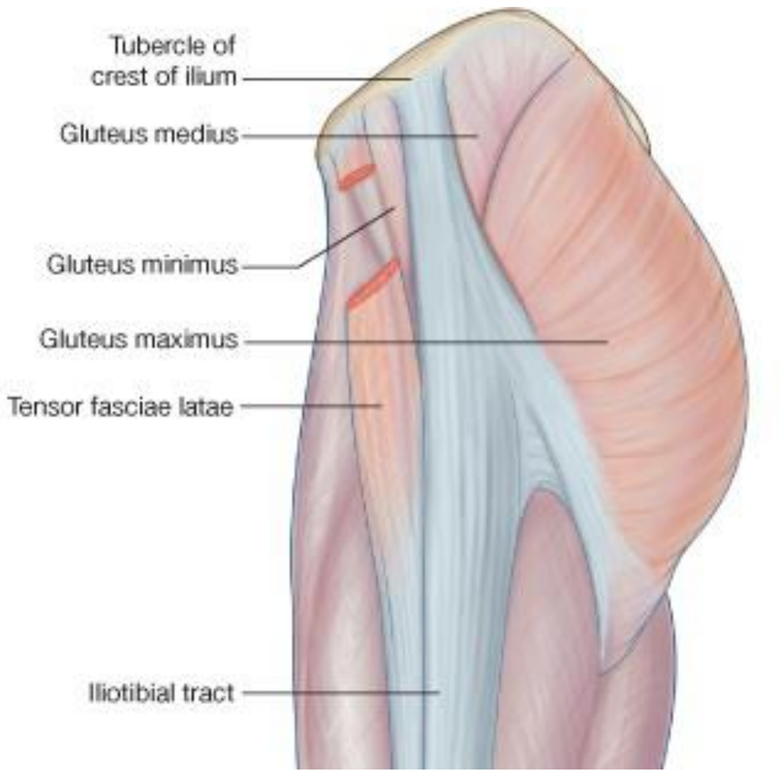

Fig 8 muscles in lateral aspect

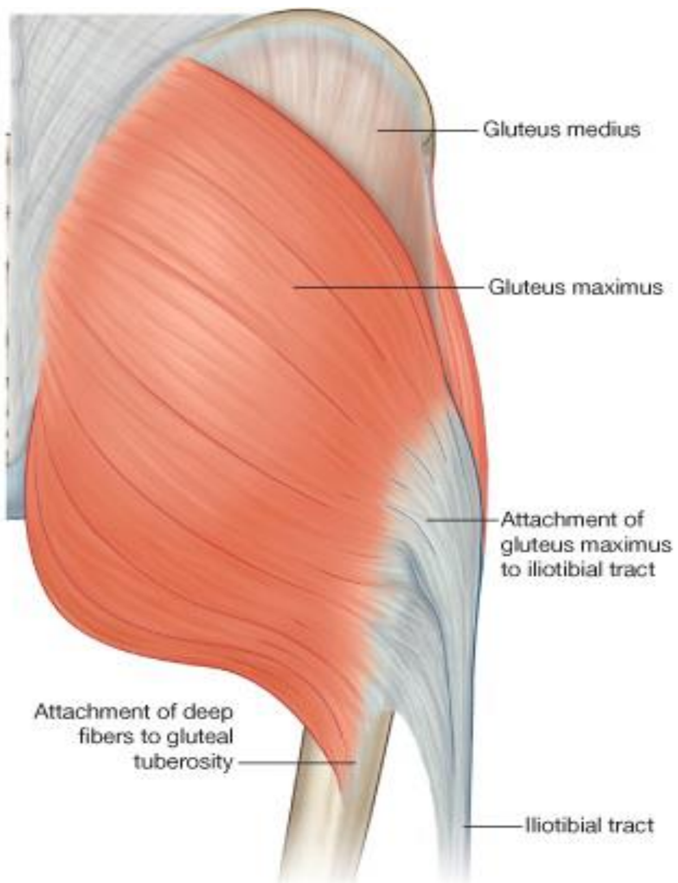

Fig 9 Muscles in Post aspect of hip

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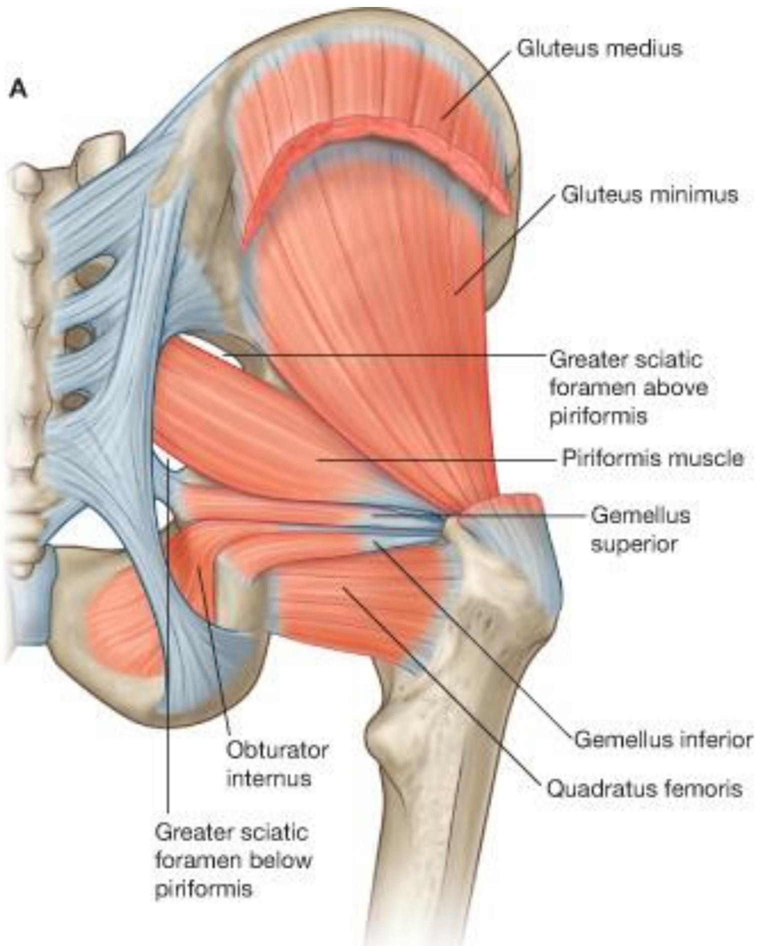

Fig 10 Hip joint and muscles around hip

THE FLEXORS

The *iliopsoas* inserts on the lesser trochanter. It is responsible for the displacement of this fragment in highly unstable fractures.

THE SHORT EXTERNAL ROTATORS

These muscles include the *piriformis*, *obturator internus*, *obturator externus, superior &inferior gemili* & *quadrates femoris.* They insert along the posterior aspect along the intertrochanteric crest.

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GLUTEUS MAXIMUS

This is the largest muscle of the body. It arises from the ilium, sacrum & coccyx & inserts into the iliotibial band & the gluteal tuberosity. It extends thigh, assists in its lateral rotation and assists in raising the trunk from flexed position.

BLOOD SUPPLY OF PROXIMAL FEMUR:

ARTERIAL BLOOD SUPPLY (Fig 11 & 12)

Extra capsular arteries to upper end of femur (entering the trochanters and base of neck) arise from,

1. Medial circumflex femoral artery. (which branch into)
   a. Lateral epiphyseal artery
   b. Superior metaphyseal artery
   c. Inferior metaphyseal artery (supply head derived from metaphysic)
2. Lateral circumflex femoral artery
3. Superior gluteal artery
4. Obturator artery, Medial epiphyseal artery (artery of ligamentum teres branch from acetabular artery).
5. First perforating branch of profunda femoris artery.

Second and third perforating branch of profunda femoris artery (nutrient arteries). Arteries to the head and to major portion of neck are derived from both femoral circumflex arteries and to a variable degree from acetabular branch from Obturator artery. Acetabular branches passes through the acetabular notch to supply soft tissue in acetabular fossa, branches into the hip-bone and gives one or more branches (artery of ligamentum teres or foveolar artery) to the head through ligament to teres. Its supply decreases to head from children to adult. Femoral circumflex arteries

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supply the intracapsular part of head and neck. Their branches have similar courses for they all pierce the fibrous capsule of the joint at the intertrochanteric line anteriorly and neck of femur posteriorly and run up towards the head on the surface of neck (capsular / Retinacular arteries), deep to the synovial

6. membrane in its retinaculae that is reflected upward around the neck from the attachment of fibrous capsule to the rim of cartilage covering the head. Because of this course, they are liable to interruption in any intracapsular fractures. These capsular vessels are divided into :

- Ascending branch
- Metaphyseal branch
- Epiphyseal branch

Lateral epiphyseal arteries supply 2/3rd of femoral head in adult. In sub capital fractures, metaphyseal vessels are torn when head fragment is grossly displaced, which places the head at risk of viability.

Medial epiphyseal vessels alone is left to supply the head, if lateral epiphyseal and metaphyseal vessels are involved, and is usually unable to maintain the viability of head. Vessels to capsule of the hip joint are branches that supply upper end of femur.

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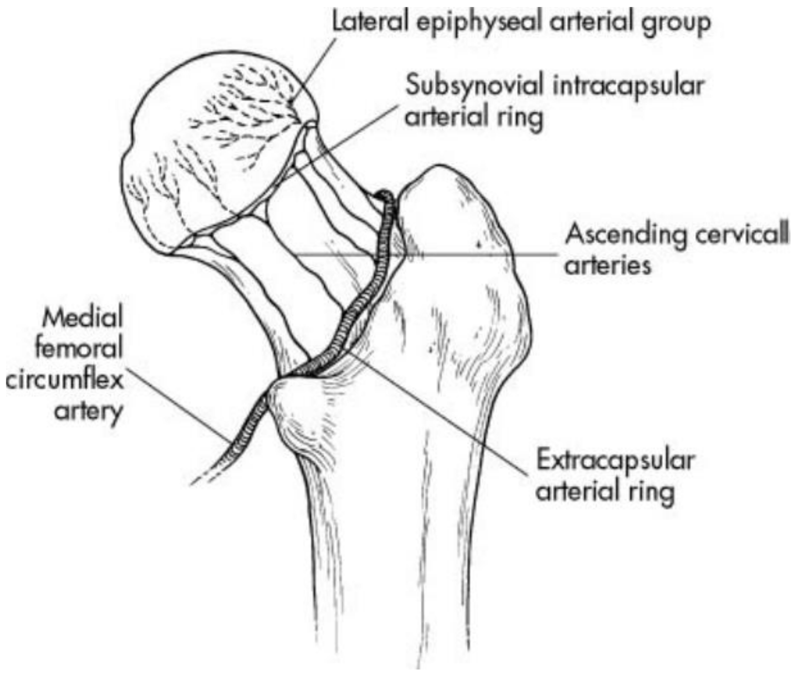

Fig: 11. Vascular supply of the proximal femur

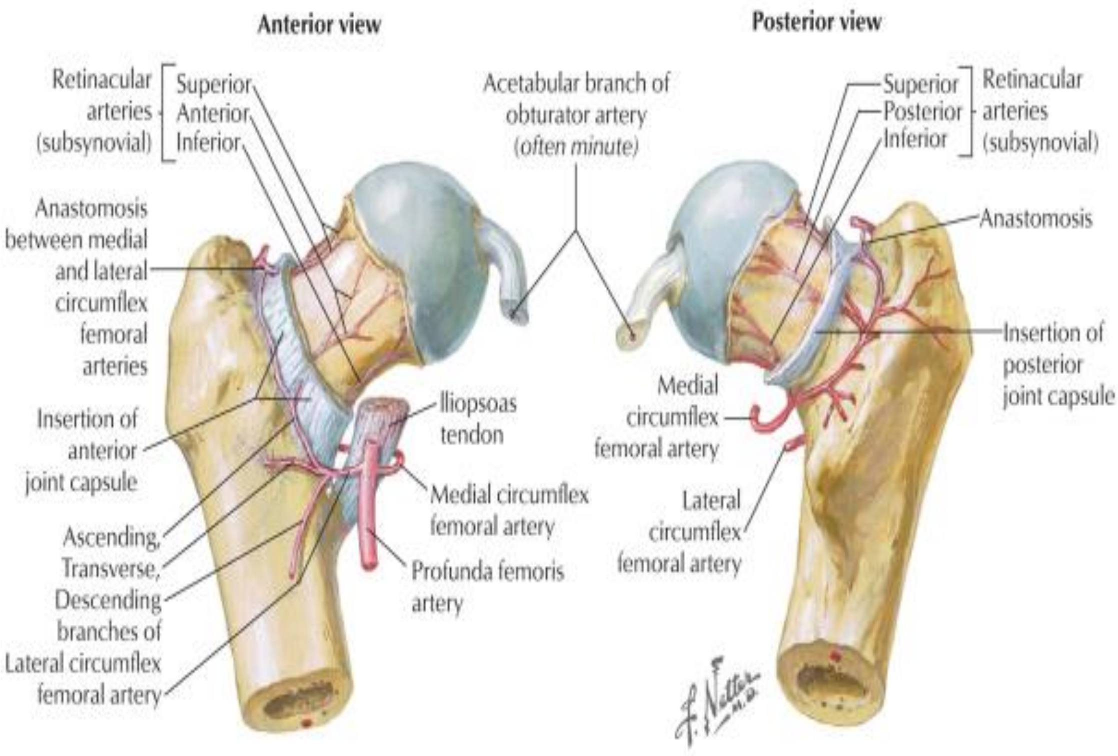

Fig 12. Vascular supply of proximal femur

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VENOUS OUTFLOW:

Capsular veins course inferomedially along trochanteric line, then towards obturator foramen where they drain into obturator vein. Circumflex group of veins is a diffuse plexus in the basal portion of neck and greater trochanter, and leave at the level of lesser trochanter, to enter the femoral vein. Smaller veins on the posterior aspect of neck and greater trochanter, course to plexuses in the region of ischial tuberosity and greater sciatic notch. Minimal venous drainage occurs through veins of linea aspera.

BLOOD SUPPLY TO HIP JOINT

It is from the branches of the most of the vessels in its neighbourhood i.e. medial and lateral femoral circumflex arteries, obturator artery, superior and inferior gluteal arteries and perforating branch of profonda femoris artery.

NERVE SUPPLY TO HIP JOINT

It is innervated by articular branches from different nerves (mixed nerves)

1. **Primary:** direct branches from adjacent nerve trunks.

- Posterior articular nerve, branch of nerve to quadrates femoris, enters posterior capsule of the joint, and is the most important branch.
- Medial articular nerve, a branch from anterior division of obturator nerve through its lateral branch to pectineus and adductor muscles, and supply the anteromedial and inferior aspect of joint capsule.
- Nerve to ligamentum teres, a branch from posterior division of obturator nerve which supplies to obturator externus muscle.

2. **Accessory:** from nerves within muscles related to joint, supply a small portion of hip joint and arise mainly from femoral nerve through nerve to pectineus.

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BIOMECHANICS OF THE HIP JOINT[36, 37]

The hip joint is a ball and socket joint. During weight bearing the forces are transmitted to the head and neck of femur at an angle of 165 degree to 170 degree regardless of the position of pelvis. High loading are sustained by the hip because of the powerful muscles across it. During loading the leverage of the femoral head and neck produces bending of the shaft. This bending forces generates compressive stress medially and tensile stress laterally. The compressive forces are higher than the tensile forces. This is called “Bending Movement”. When the lever arm is longer, the bending movement is greater. The bending movement is one of the important factor of varus deformity, stress fractures of the implant and non-union.

Hip joint moves in all directions. In Saggital plane motion of flexion ranges from 0-140 degrees and 0-15 degree of extension. In frontal plane motion of adduction is 0-30 degrees and abduction 0-45 degrees. In transverse plane motion of internal rotation ranges from 0-30 degree and external rotation 0-40 degrees. The proximal fragment is abducted by abductors (Gluteus medius and minimus), is flexed by ilio psoas and externally rotated by the short external rotators. The adductors pull the distal fragment towards midline.

These muscle forces act upon the fixation device after operation even when patient is in the bed. In the hip joint the fulcrum is the centre of the hip and forces are body weight and abductor muscle tension. The distance from trochanter to the centre of the femoral head is shorter than the distance to the body’s midline, so the abductors must exert more force than body weight to keep the pelvis balanced.

The variation in neck shaft angle will influence the relative ratio of the lever arm distance between the midline and the femoral head and the trochanter and will

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there by influence the efficiency of the abductor muscles, even the hip is in valgus, the short abductor lever arm requires tremendous pull of the hip to balance the pelvis.

In varus position the abductors do not have to work as hard to balance the pelvis. The force at the hip during single limb stance is around 2.5 times body weight. During dynamic activities that requires greater agonist and antagonist activity raises the stresses at the hip joint significantly.

It has been shown that in males an average hip joint reaction force is 4 times of body weight occurs immediately after heel strike with another peak of 7 times body weight at toe off. In females, the magnitudes of joint reaction forces are decreased, with first peak approximately 2.5 times body weight and second peak approximately 4 times body weight.

Rydell showed that standing on one leg generated a force 2.5 times body weight in that hip. At rest with two leg support, there was a force of about half the body weight across each hip joint whereas standing the hip and knee flexed 90 degree increased the force to rear body weight across the flexed hip. Running increases the force to 5 times body weight. Lifting the leg from supine position with the knee straight produces a force of 1.5 times body weight across the hip joint.

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PATHOMECHANICS OF INJURY

CAUSATIVE MECHANISM OF INTERTROCHANTERIC FRACTURES

Intertrochanteric fractures occur as a result of fall, involving both direct and indirect forces.

The suggested two mechanisms of injury are[33]:

1. A blow to the trochanter region due to fall
2. Lateral rotation of the limb with osteoporotic and weakened bone may also be a factor for early and frequent fractures. The severity of the fracture is directly related to the degree of osteoporosis, which results in a weakened bone stock.

A 3rd recently suggested mechanism is the cyclical loading which produces micro and

macro fractures which is commonly seen in osteoporotic and diseased bones.

Mechanism of bone failure[38, 39]

A structure will fail if it suffers an over load situation. An over load situation will occur if the system is unable to absorb the energy that is applied to it. In the hip joint area, this over load situation can occur as a result of number of independent but often inter related factors, the following being important.

1. Falling
2. Impairment of energy absorbing mechanics
3. Bone weakness.

Falling

The body possesses of considerable amount of potential energy in the standing position. In falling, the potential energy changes to kinetic energy, which upon impact with the floor must be absorbed by the structures of the body if a fracture is not to

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occur. There is sufficient potential energy in the standing body which, if unabsorbed at falling could break any bone in the body. In an average sized woman, the amount of potential energy to be observed in a fall would be approximately 4000kg/cm and the energy observing capacity of the upper end of the femur is only 60kg/cm approximately. Thus, if a bony injury is not to occur, the energy absorbing mechanisms must operate.

Impairment of energy absorbing mechanisms

The principal dissipation of energy is performed by active muscle contraction. This dissipation requires time and in the event of high speed trauma, there is not a sufficient period for muscular contraction to absorb energy before overloading of the bone has occurred and leads to failure. In the elderly, the neuromuscular response may be slower, and thus the energy absorption may not be rapid enough to prevent a fracture. In the elderly, the normal protective muscle contraction in the event of slip rather than fall, may lead to an un-inhibited muscle contraction around the hip and produce a force as great a 600kg/cm to fracture the neck of the femur without implicating any other factor.

Bone weakness

In osteoporosis or osteomalacia, bone weakens to about ¼ of the normal healthy young bone and has a lower energy absorbing capacity leading to failure. Falling, impairment of energy absorbing mechanisms and bone weakness, all may contribute fractures of the trochanter. It is mostly due to failure of the bone to withstand sudden bending or twisting forces acting on it when the patient is about to fall from standing position ,impairment of energy absorbing mechanisms particularly in the elderly and in bone weakness, and more so in females leading to the fractures of the trochanter.

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According to **HORN AND WANG**[40] the failure of the stress resistor mechanism to operate either because of muscle weakness or delayed reaction time ,especially in osteoporotic bones, may be an etiological factor in the causation of intertrochanteric fractures.

FRACTURE ANATOMY

The fracture pattern is influenced by the muscles, which are attached to the various parts of the trochanteric region. The forces acting on the fracture and the bone quality influence the fracture pattern. Hence it is imperative to understand the muscles forces acting on this region.

The upper fragment lies in external rotation if the level of the fracture is such that short external rotators remain attached to it.

Fractures proximal to the attachment of short external rotators show external rotation of the distal fragment but not of the proximal fragment & also due to gravity.

Forward angulation occurs in the sagittal plane due to unbalanced muscle action the fracture opens up posteriorly with its apex pointing anteriorly, visible on X-rays as a gap.

FRACTURE GEOMETRY AND INSTABILITY

The fracture stability is largely dependent on the geometry of the fracture. The most commonly encountered patterns of instability are:

- Lesser trochanter communition
- Reverse oblique fracture
- Intertrochanteric fracture with sub- trochanteric extension.

A truly stable Intertrochanteric fracture is one that when reduced has cortical contact without a gap posteriorly & medially. This contact will prevent further

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Displacement into varus & retroversion. In the stable fracture the posterior & medial cortices are not comminuted & there is no displaced fracture of the lesser trochanter.

The importance of the lesser trochanter is the key to evaluating the stability of the fracture. The size & amount of displacement of this fragment are the critical factors in this evaluation. Up to 60% of Intertrochanteric fractures are unstable & hence at a risk of complications.

THE LATERAL WALL

The lateral wall of the trochanteric region has been given little importance in the past. Now it is believed that extensive communition of the lateral wall requires to be repaired thus the development of the trochanteric plate to buttress the lateral wall[41].

REVERSE OBLIQUE FRACTURE

In this type of fracture the fracture line extends from lesser trochanter inferiorly to the lateral cortex. The geometry of the fracture is such that it is inherently unstable .If this fracture is missed & treated with a sliding hip screw with plate it results in medialization of the distal fragment & a day one failure. Such fractures are best treated with a 95 blade plate or an intra-medullary nail[42,43].

INTERTROCHANTERIC FRACTURE WITH SUB-TROCHANTERIC EXTENSION:

These are highly unstable injuries. The marked communition of the posteromedial buttress combined with distal extension of the fracture renders them unstable. The distal extension of this fracture often makes plating difficult & an intramedullary nail is the better option.

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CLASSIFICATIONS

Numerous classifications have been described for intertrochanteric fractures. An ideal classification should be able to describe the fracture, give guidelines regarding the Treatment & also have prognostic value.

The numerous fracture classifications are:

1. EVANS CLASSIFICATION[44] **(**1949)

2. BOHLER'S CLASSIFICATION (1936)

3. BOYD & GRIFFIN CLASSIFICATION[45] (1949)

4. KYLE & GUSTILO CLASSIFICATION[46] **(**1979)

5. TRONZO CLASSIFICATION (1973)[47]

6. J.C.SCOTT'S CLASSIFICATION[48]

7. MURRAY AND FREW (1949)[49]

8. **JENSEN & MICHAELSON CLASSIFICATION**[50] **(**1975)

9. HAFNER'S CLASSIFICATION[51]

10. W.K. MASSIE'S CLASSIFICATION[52] (1963)

11. A.O. & O.T.A. (MULLER) CLASSIFICATION [33,53](1990)

1. EVAN'S CLASSIFICATION (Fig. 13)

Evans in 1949, made an important step in understanding the stability of the intertrochanteric fractures. He observed that the key to a stable reduction is the restoration of the posteromedial cortical continuity. In the stable group the posteromedial cortex is intact or is minimally comminuted, making it possible to obtain a stable reduction. Unstable fractures on the other hand have extensive posteromedial communition & displacement they are inherently unstable. Stability can be restored by obtaining opposition of the posteromedial cortex. The

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reverse oblique fracture is inherently unstable because of the tendency of the shaft to displace medially.

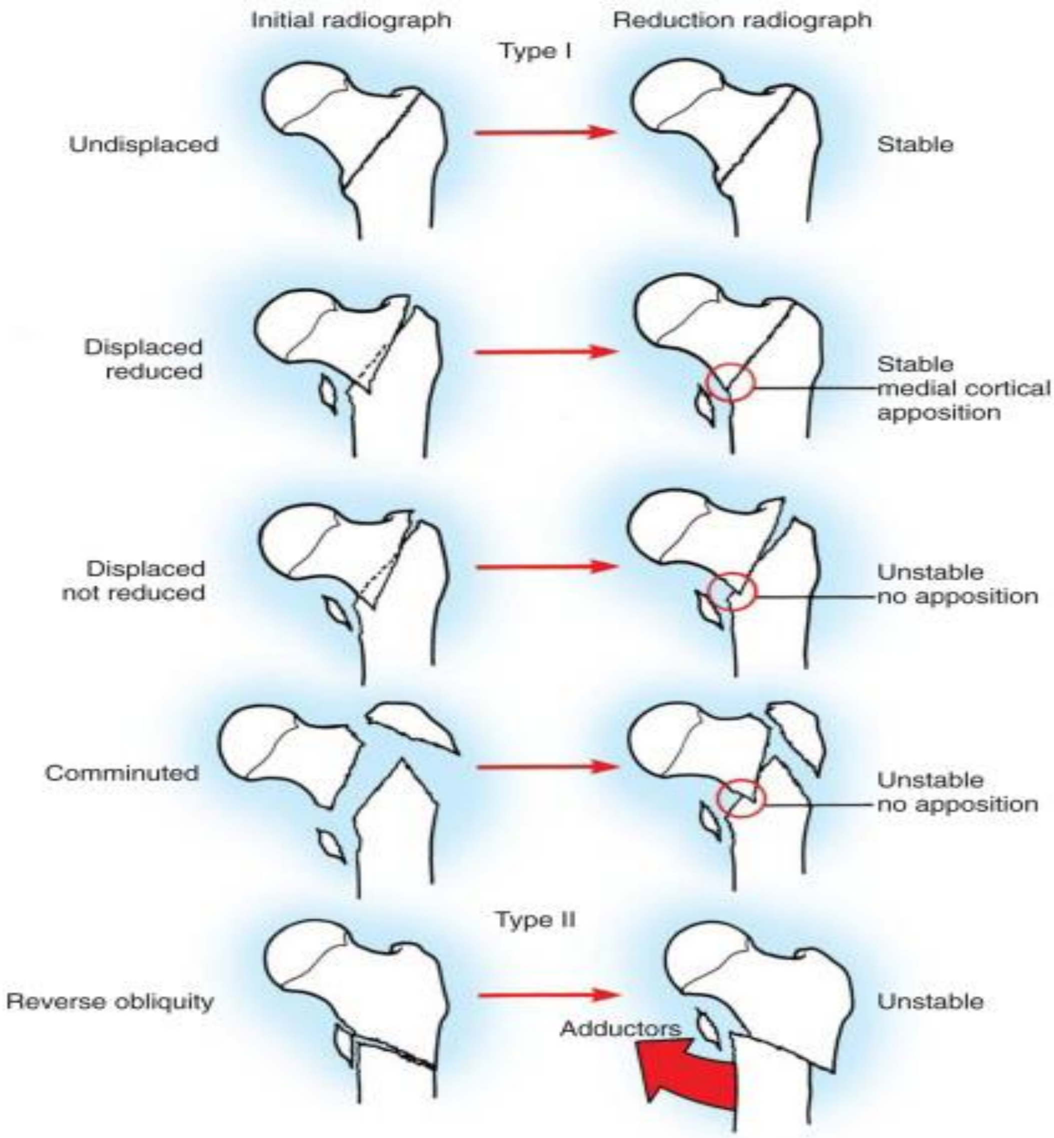

Fig.13. Evan's Classification

2. BOHLER'S CLASSIFICATION: (1936)

TYPE I:

Fracture through the base of the neck of femur with minimal displacement.

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TYPE II:

Fracture through the trochanter and wide gap occurs between the two fragments of bone, an angle opening upwards.

TYPE III:

This is the commonest variety where the base of the neck is deeply driven into the spongy mass of the trochanters. The lesser trochanter is frequently broken off.

TYPE IV:

Fracture through the trochanter with comminution. Here the neck is impacted but the shaft of the femur is displaced upwards parallel to the main fragment. Bohler recommends that TYPE I and II fractures should be treated by continuous traction and plaster spica for atleast ten weeks. In TYPE III the limb should be kept in extreme abduction and moderate internal rotation and maintained for at least 14 weeks. In type IV traction is applied along the long axis of the body because abduction produces coxa valga.

3. BOYD AND GRIFFIN'S CLASSIFICATION: (1949)

Their classification included all fractures from the extra capsular part of the neck to a point 5cms distal to the lesser trochanter

TYPE I:

Fractures extending along the Intertrochanteric line, from greater trochanter to the lesser trochanter.

TYPE II:

Comminuted fractures, the main fracture being along the inter trochanteric line, but with multiple fractures in the cortex.

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TYPE III:

Fractures that are subtrochanteric with at least one fracture line passing across the proximal end of the shaft from just distal to the lesser trochanter, with varying degrees of comminution.

TYPE IV:

Fractures of the trochanteric region and the proximal shaft with fracture in at least two planes.

Reduction of TYPE I fractures are simple & can be maintained with little difficulty TYPE II, III & IV fractures are increasingly more difficult to reduce & to maintain reduction & are associated with more complications.

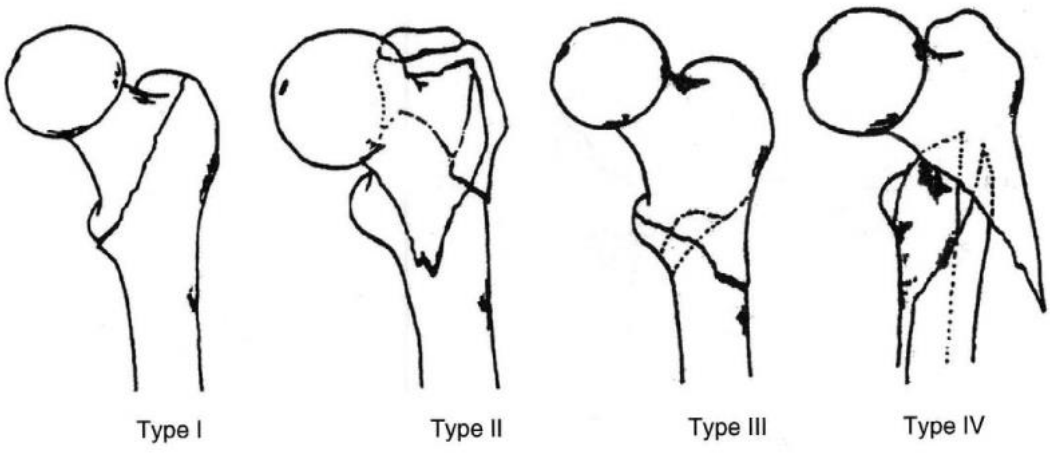

Fig. 14. Boyd and Griffin Classification

4. KYLE, GUSTILO & PRIMER'S CLASSIFICATION:

TYPE I:

Stable, undisplaced intertrochanteric fractures

TYPE II

Stable, displaced fractures with fracture of the lesser trochanter & a varus deformity.

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TYPE III:

Intertrocanteric fracture, in which the lesser trochanter fragment is large. The posterior Wall is exploded with the break of the inferior neck already displaced into the medullary Cavity of the shaft of femur. A variant of this type has in addition the greater trochanter fractured off and separated.

TYPE IV:

Comminuted unstable fracture with disengagement of the two main fragments, these are unstable with the posterior wall exploded, but the spike of the neck fragment is displaced outside or medial to the shaft.

TYPE V:

Trochanteric fractures with reverse obliquity of the fracture line. These are uncommon.

Tronzo recommends fixation for TYPE I & II fractures. In TYPE III since the medial spike is impacted, not medial displacement is required. TYPE IV fractures require medial displacement of the distal fragment and then fixation. TYPE V fractures are stabilized by notching the shaft fragment and jamming it in the neck for stability.

5. TRONZO'S CLASSIFICATION (1973):

Tronzo in 1973 has classified intertrochanteric fractures based on mode of reduction potential in to five types. This classification is also widely used.

Type I

Incomplete trochanteric fractures with only greater trochanter fractured.

Type II

Uncomminuted bitrochanteric fractures with or without displacement with an intact posterior wall and a relatively small lesser trochanteric fragment.

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Type III

Comminuted fractures in which the posterior wall is exploded with the beak of inferior neck already displaced into the medullary cavity of the shaft fragment. The lesser trochanteric fragment is large. These are unstable fractures.

Type IV

Comminuted trochanteric fractures with dis engagement of two main fragments.

Type V

Trochanteric fractures with reverse obliquity to the fracture line.

6. J.C.SCOTTYPE I:

Consists of, oblique basal fractures, involving one or both trochanters with little or no displacement.

TYPE II:

Consists of, oblique basal fractures, with varying degrees of comminution & displacement.

TYPE III:

Consists of, fractures with reversed obliquity, involving the lesser trochanter & less frequently with separation of the greater trochanter. The first two types of fractures do well with any method of treatment. The third group provided most of the problems & whatever method of treatment is employed, the results were uniformly discouraging. The third group of fractures was less troublesome than the second.

7. MURRAY AND FREW (1949):

Based on the presence of the medial comminution.

TYPE I:

Stable, that is no medial comminution.

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TYPE II:

Unstable, that is displaced lesser trochanter or larger femoral-arch fragment.This classification emphasizes the importance of the calcar femorale and the medial cortical buttress. This classification does not take into account the posterolateral instability caused by the difficulty in obtaining sufficient reduction of fractures in the lateral plane.

8. Modified EVAN'S by JENSEN AND MICHAELSON (1975):

Type I

Undisplaced, two fragment fractures

Type II

Displaced, two fragment fractures

Type III

Three fragment fractures without posterolateral support due to displaced greater trochanter

TYPE IV

Three fragment fractures without medial support due to displaced lesser trochanter or femoral arch fragments

TYPE V

Four fragment fractures without medial or postero-lateral support. The classification of EVAN'S is rather simple & based on the presence of mechanical instability as related to detachments of the lesser & greater trochanters. This classification has been used in numerous publications. The Evan's classification has been slightly modified based on their assessment of stability of the fracture on the primary radiographs after the injury and after reduction during surgery.

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9. BASED ON PRIMARY DISPLACEMENT: (HAFNER, 1951):

TYPE I: Undisplaced

TYPE II: Displaced

The simplest possible method of classifying trochanteric fractures is to divide them into displaced & undisplaced. This leads to fairly reliable information about the reduction but does not give sufficient grading.

10. W.K. MASSIE'S CLASSIFICATION (1963):

TYPE I: Stable, undisplaced

TYPE II: Stable, displaced

TYPE III: Unstable, displaced.

11. A.O. (MÜLLER) CLASSIFICATION:

The classification system devised by Müller & the A.O. group is extremely comprehensive & complete. Each region of the skeleton is assigned an alpha-numerical.

Value & is further classified into a type & a sub group. Schatzker[49] has noted an inter- & intra- observer concordance of close to 100% for fracture type, 80-85 % for fracture group, 50-60 % for fracture sub-type. The inter trochanteric fractures have been assigned the number -**31 A**

They are further classified as:

- 31-A1- Proximal trochanteric
- 31-A2- Pertrochanteric multi fragmentary
- 31-A3- Intertrochanteric

Each group is then further classified into three subgroups:

- 31-A-1

31-A1.1-Along intertrochanteric line

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31-A1.2-Through greater trochanter

31-A1.3-Below lesser trochanter

• 31-A2

31-A2.1-With one intermediate fragment

31-A2.2-With several intermediate fragments

31-A2.3-Extending more than 1cm below lesser trochanter

• 31-A3

31-A3.1 Simple oblique

31-A3.2 Simple transverse

31-A3.3 Multifragmentary

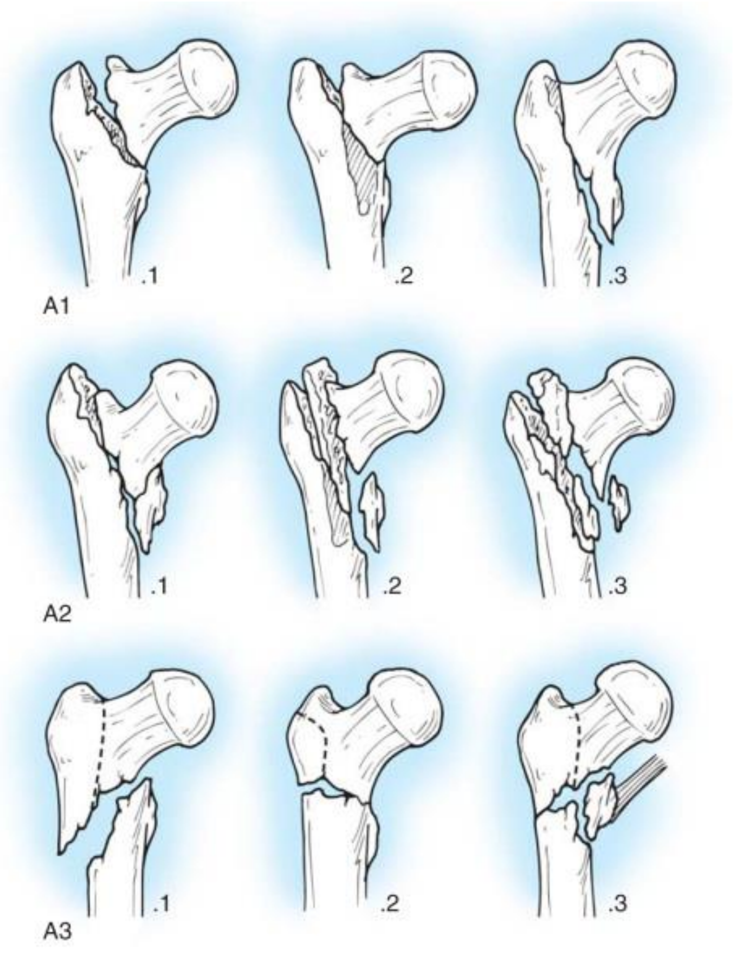

Fig 15 . AO Classification of Intertrochanteric fractures

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CLINICAL FEATURES:

A history of trivial trauma, usually a slip in the bathroom or while walking, inability to stand up after the fall and pain around the hip joint in an elderly is the usual presentation.

CLINICAL FEATURES:

1. The limb is usually markedly shortened with external rotation deformity. The external rotation is usually greater than that seen in patients with intracapsular fractures of the neck of femur, lateral border of the foot touching the bed.
2. There may be swelling in the hip region, and ecchymosis over the greater trochanter may be seen later.
3. Tenderness over greater trochanter
4. Broadening and irregularity of greater trochanter
5. Supratrochanteric shortening

INVESTIGATION

1. Standard radiographic examination
    a. Antero posterior view of the pelvis with both hip joints
    b. Cross table lateral view of the involved proximal femur

Antero posterior view is useful to know the fracture pattern and extent, quality of the bone, and allows comparison with the contra lateral side to identify undisplaced and impacted fracture. AP view in 10-15deg of internal rotation will give the true view of the proximal femur. In severe comminuted fractures, x rays taken with traction help in understanding the fracture geometry better.

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AP view of the contra lateral side helps in measurement of neck shaft angle and for preoperative planning.

The lateral view helps to assess size, location and comminution of posterior fragment and helps to determine the fracture stability.

2) M.R.I. and bone scans are use full in the diagnosis of occult fractures.

TREATMENT

Intertrochanteric fractures can be treated both by conservative &operative methods.

TYPES OF CONSERVATIVE TREATMENTS

The various conservative methods used in a patient who is unfit for surgery or unwilling for surgery are[54]:

1. De-rotation boot.
2. Buck’s extension skin traction.
3. Skeletal traction.
4. Hamilton Russell traction.
5. Modified Russell’s traction.
6. Fisk’s and Perkin’s method.

1) De-rotation boot: A below knee plaster cast is applied from tibial tuberosity up to the base of the toes with a wooden bar attached to the heel to prevent lateral rotation. After clinical and radiological union of fracture (10-12 wks), it is removed and physiotherapy is begun. This is an old form of treatment.

2) Buck’s extension skin traction: adhesive plaster is applied to skin below knee of the affected limb with a spreader bar and light weight.

3) Skeletal traction: this is the commonest method used in conservatively treated cases. Heavy skeletal traction is used through the upper tibial skeletal pin over a

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BÖHLER BROWN splint. About 10% of the body weight is used for the traction; patient is advised to do the quadriceps exercise for the five minutes every one hourly. After 10-12weeks traction is removed and patient is gradually mobilized and walking aids are used initially till consolidation of the fracture.

4) Hamilton Russell traction: Continuous traction is obtained in the line of the femur by the traction weight suspended through several pulleys. Since no splint is used the patient is more comfortable. The knee is flexed over a pillow and the limb is also supported while on traction, it is claimed that this controls both angulatory and rotational deformity.

5) Modified Russell's traction: Modification made here is the usage of a below knee plaster cast with one pulley incorporated.

6) Fisk's and Perkin's method: Continuous traction method over a complicated system of pulleys. There are many disadvantages of the conservative method of treatment. They are mainly knee joint stiffness, pin tract infections, deep vein thrombosis, pneumonia, prolonged hospital stay, bed sores etc. Coxa vara deformity, shortening, limitation of the hip movements are the complications encountered around the hip. Mortality & the morbidity rates are very high in conservative line of treatment.

TYPES OF OPERATIVE METHODS[55, 56]

Intertrochanteric fracture, an injury of the elderly has a high mortality rate. Rapid patient mobilization following surgical stabilization of the fracture lessens the frequency of life threatening complications such as cardio-pulmonary failure & thrombo-embolic diseases. It also minimizes the incidence of decubitus ulcers and limb contractures. Most intertrochanteric fractures are four part injuries, with secondary comminution of greater and lesser trochanters. The presence of the large

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posteromedial fragment defines an unstable pattern. Restoration of the bone opposition and stability by closed reduction on a fracture table is not possible in such cases with medial comminution. Successful reduction restores the osseous stability by achieving medial cortical abutment and impaction of the major fracture fragments in a normal or slight valgus alignment. An ideal fixation device should permit controlled intraoperative compression of the fracture and should allow the fracture to settle in a stable position and prevent nail protrusion through the femoral head. The device should act as an internal splint. Complications arise when the surgical construct is inadequate to with stand the major forces to which the proximal femur is subjected.

Some of these complications are:

- Varus settling of the fracture.
- Cutting out or protrusion of the nail or screw.
- Fatigue failure of the implant.

Relative contraindications to the surgery are:

- Contaminated wound at the operative site.
- Septicemia
- Delay in the treatment more than 3 wks
- Other associated conditions e.g. cardiopulmonary diseases, thromboembolic diseases etc.

Reconstitutions of the medial buttress of unstable fractures by inter fragmentary compression a screw decreases the likely hood of limb shortening and abductor insufficiency. Most patients under 65 years of age and active patients over 65 years of age benefit from this additional surgery. Severe medial comminution or advance osteoporosis may preclude successful inter fragmentary fixation. Cancellous bone grafting of medial cortical defects is occasionally necessary in young patients

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with unstable fractures. Elderly osteoporotic patients may be managed by one of the two techniques.

The major head/neck and shaft fragment may be aligned on the fracture table, so that femoral length is restored without concern for the trochanteric fractures.

A sliding nail or screw plate implant allows post-operative settling and stabilization of the fractures as necessary.

Intra operative medial bony contact and stability can be obtained by medial displacement of the femoral shaft or valgus osteotomy.

Although these procedures do obviate the need for anatomically nailed fractures to migrate in to stable position, they do shorten limb and abductor mechanism. A variety of internal fixation devices are available. They are mainly two types:

Extra medullary devices:

- Fixed angle nail plates
- Smith Peterson's nail and plate
- Jewett nail and plate
- Thompson nail and plate
- Holt nail and plate
- McKee nail and plate
- Liverpool nail and plate
- Northampton nail and plate
- McLaughlin nail and plate
- Neufeld nail and plate
- Sarmiento nail and plate
- A. O. blade plate

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- Compression screws nail plates
- Richard's
- Zimmer
- Calandruccio
- Depuy
- Medoff plate
- Dynamic hip screw
- Deyerle assembly
- Massie and Pugh nail plates

Intramedullary devices:

- Cephalomedullary
- Ender's nail
- Kuntschercondylocephalic Y nail
- Harris condylocephalic nail
- Russell-Taylor interlocking nail
- Zickle nail
- Gamma nail
- Intramedullary hip screw
- Proximal femoral nail (AO)
- Trochanteric femoral nail
- Proximal femoral nail asia (AO)
- Short recon nail
- External fixation devices

Prosthetic replacement:

- Thompson's prosthesis

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- Bipolar prosthesis
- Total hip replacement

NAIL PLATE DEVICES:

The fixed angle nail plate device was first developed by Thornton later modified by Holt, Jewett, Sarmiento, McLaughin etc. These devices were widely used in the past before invention of sliding screw plate devices. This nail does not allow control collapse.But with this, penetration of the nail in to the femoral head and in to the joint occurred with the collapse of the fracture. So a stable reduction before nail insertion is essential to prevent this complication. But this gives a poor grip in the proximal fragment increasing the chances of re angulation and migration of the nail within the femoral head. Later modification was “Holt nail”, in which the plate is fixed to the femur by bolts rather than screws. It is much stronger than Jewett nail plate device.

SLIDING NAIL PLATE DEVICES:

In 1950’s this device was introduced by Schumpelick and Jantzen, Pugh and Massie. These nails are very widely used and more technically demanding. It is available in 120 -150° barrel plate.

PRINCIPLE:

To allow control impaction (collapse) were the shearing force on the femoral head is transferred to the axis of the sliding screw to produce a compression force (act as a lag screw) when fragments collapse the stem will back out within the barrel of the device. Clawson pointed out that to ensure impaction the barrel of the hip screw should not cross the fracture site. The screw has either sharp end or blunt end, the

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later prevents the head penetration. Dynamic hip screw has been shown to be superior to nail plate. Screw threads of the nail enhance the purchase in the osteoporotic bone and the groove in the barrel plate prevents rotation. Jamming, bending or failure to slide the screw acts as fixed angle nail plate.

Advantages of the Dynamic hip screw:

- Decreases the penetration of the nail into the acetabulum.
- Improves post-operative mobility.
- Less residual pain.
- Decreases the re operative rate.
- Decreases the incidence of the breakage.
- Decreases the incidence of the non-union.

Failures of the dynamic hip screw:

- Cutting out of the screw from the femoral head.
- Pulling of the slide plate from the femoral shaft.
- Disengagement of sliding compression hip screw from the barrel.
- Breakage of the hip screw.
- More bigger incision and trauma to the abductor mechanism.
- More blood loss.
- Fracture hematoma is lost as the site is opened.
- Need of an osteotomy in an unstable fracture.
- Delay weight bearing.

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INTRA MEDULLARY DEVICES:

The intramedullary nails have gained popularity after 1970's. Ender first reported in 1970's the use of multiple flexible condyle cephalic nail that were introduced through the distal femur without opening the fracture site. These are indicated in the peritrochanteric fractures in elderly patients. After which several intramedullary devices has been introduced. They have several advantages over the traditional Dynamic hip screw. They are:

- Decreases the operative time and mortality.
- Decreases blood loss.
- Minimal surgical trauma.
- Decreases the radiation exposure.
- Medialization of the implant so more effective lever causing less stress on the implant.
- Decreasing the hospital stay of the patient.
- Effectively used in the unstable fractures so no need for bone loosing osteotomies.

There are several disadvantages with intramedullary devices. Here are some

- They are costly compare to D.H.S.
- Technically demanding procedure and requires good quality instruments as well as good image control by C-arm.
- Due to its proximal portion greater trochanter can splinter while inserting the nail. Hence the newer trochanteric femoral nails having smaller 14mm diameter of the tip proximally.It prevents the splintering of greater trochanter. Periprosthetic fractures though less due to its narrow tip compare to other intramedullary devices can still occur.

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- "Z" effect- in this the cervical screw penetrates into the joint while the hip screw backs out. It can be prevented by delayed weight bearing in the unstable or osteoporotic bones, and by putting the correct size of both the screws (usually the cervical screw is 10mm shorter than the hip screw). Reverse "Z" effect if when opposite occurs. Both can be also prevented intra-operatively by putting a wire around both the screws, this is done mainly in unstable fractures or lateral cortex comminution.

BIOMECHANICS OF THE INTERNAL FIXATION

The understanding of the biomechanical properties of implants used in intertrochanteric fractures is vital in knowing how implant failure & nonunion occur, especially in the unstable variety of intertrochanteric fractures. Several biomechanical & clinical studies have been done to study the way in which these implants behave in the body[57, 58, 59]

IMPLANT DESIGN

Main implants used in the treatment of intertrochanteric fractures are:

1. Dynamic hip screw (extramedull ary devices)

2. Proximal Femoral Nail (intramedullary devices)

The dimensions of the Dynamic hip screw are :

Plate	:	Thickness	–	5.8 mm
		Width	–	10 mm
		Hole spacing	–	16 mm
		Barrel diam.	–	12.5 mm
		Barrel angle	–	130,135,140, 145 & 150.
		Barrel length	–	long 32 mm , Short 25 mm.
• Screw	:	Shaft diam.	–	8mm

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Thread diam. – 12mm

Thread length – 16mm & 32 mm

Screw length – 60 to 130 mm (in 5mm increments)

The dimensions of the Proximal Femoral Nail (P.F.N) are:

- Diameter : Proximal – 15 mm

  Distal – 9,10, 11 & 12 mm
- Valgus bend : 6 degrees
- Length : 240 mm to 420mm
- Screw diam. : Proximal – 6.4 mm (hip pin) & 8mm (neck screw)

  Distal – 4.9 mm
- Screw angle : 130 & 135 degrees.

The dimensions of the Trochanteric Femoral Nail (T.F.N) are:

- Diameter : Proximal – 14mm

  Distal – 9, 10, 11 & 12 mm
- Valgus bend: 6 degrees
- Length : 180mm
- Screw diameter: Proximal – 6.4 mm (hip pin) & 8mm (neck screw)

  Distal – 4.9mm
- Screw angle : 130 & 135 degrees.

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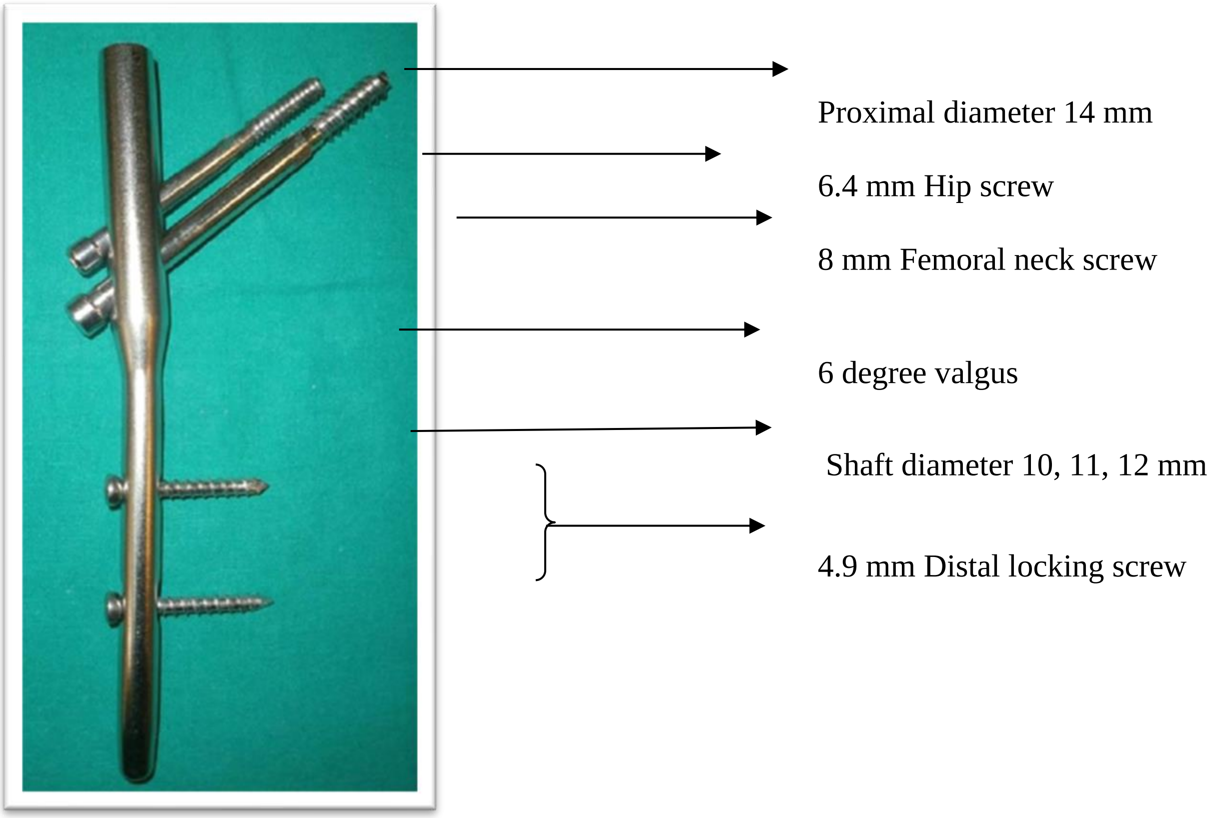

Fig 16. Trochanteric femoral nail

BIOMECHANICAL ADVANTAGE OF THE INTRA MEDULLARY DEVICE

Lindsey[60], in his study has pointed out the numerous advantages of the intramedullary device with sliding screw:

1. To provide fixation of the head & neck.
2. To allow femoral head & neck collapse & subsequent impaction of the fracture site.
3. To lie within the intra medullary canal thus reducing the lever arm.
4. The implant itself serves as a buttress against lateral translation of the proximal fragment
5. To provide bone graft from the reamed products

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SLIDING PROPERTIES

The sliding properties of both implants vary considerably. Sliding is an essential principle in the management of intertrochanteric fractures. Sliding permits impaction of the fracture fragments thus promoting healing.

Kyle[61] in his extensive study of the biomechanical principles of the sliding hip Screw has identified key factors that promote sliding, A reduction in the bending forces is Vital since bending forces reduce slide & cause jamming of the implant. The bending forces are increased by:

1. Longer extension of the screw.
2. Smaller screw angle.
3. Heavier patients.

In his subsequent studies on the sliding in second generation locked nails, Kyle[62] observed that sliding hip screw with plate needs less forces to initiate sliding as compared to initiate sliding in intra medullary devices. Amongst all intra medullary devices the Gamma nail requires the largest force. The explanation lies in the barrel of the side plate, the barrel provides a free passage for the screw to slide, thus the longer the barrel length the less the forces required to initiate sliding.

BARREL PLATE ANGLE

The most routinely used barrel plate angle in most studies is 135 degrees; this is because of the ease of insertion & the more anatomical restoration of femoral neck angle.

However the 150 degree side plate has several advantages, since the forces are acting. More in line with the screw, less bending forces act across the screw so relatively less.

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Force is required to initiate sliding resulting in more impaction [57,59]. Valgus hips are However more prone to develop early O. A.

SLIDING LENGTH

Gundle[60] has noted a positive correlation between sliding length & union. In his study he found that fractures fixed with a sliding length (i.e. the distance from proximal tip of the barrel to the distal thread of the screw) of less than 10 mm had 3 times higher rate of failure than those with sliding length more than 10 mm. This is particularly true in devices that have a 32mm threaded screw length with a 32 mm barrel. He thus recommends a short barrel for screws with less than 85 mm screw length.

FAILURE OF THE SLIDING HIP SCREW

Spivak[61] has noted 4 models of failure of the sliding hip screw:

1. Cutting out of the screw head (most common).
2. Jamming of the screw in the barrel.
3. Disengagement of the screw from the barrel.
4. Pulling out of the screw

Cut out of the screw from the head is by far the most common mechanism of failure of the sliding hip screw. Screw cut out occurs as a result of:

1. Improper position.
2. Failure to achieve T.A.D.
3. Poor bone quality.

The above two factors are in the hands of the surgeon & can easily be prevented.

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SCREW POSITION

The ideal position of the screw in the head is a debatable issue. Most authors recommend a central placement in the head in both views while some accept a posterior & inferior placement. However all authors strongly condemn an anterior & superior placement.

TIP APEX DISTANCE

Baumgaertner[64] described the T.A.D as the distance from the tip of the screw to the subchondral bone in both the A.P. & lateral views .In his series of 120 cases he noted that not a single case screw cut out occurred if the T.A.D was maintained less than 25mm as compared to a historical control rate of 8 %.

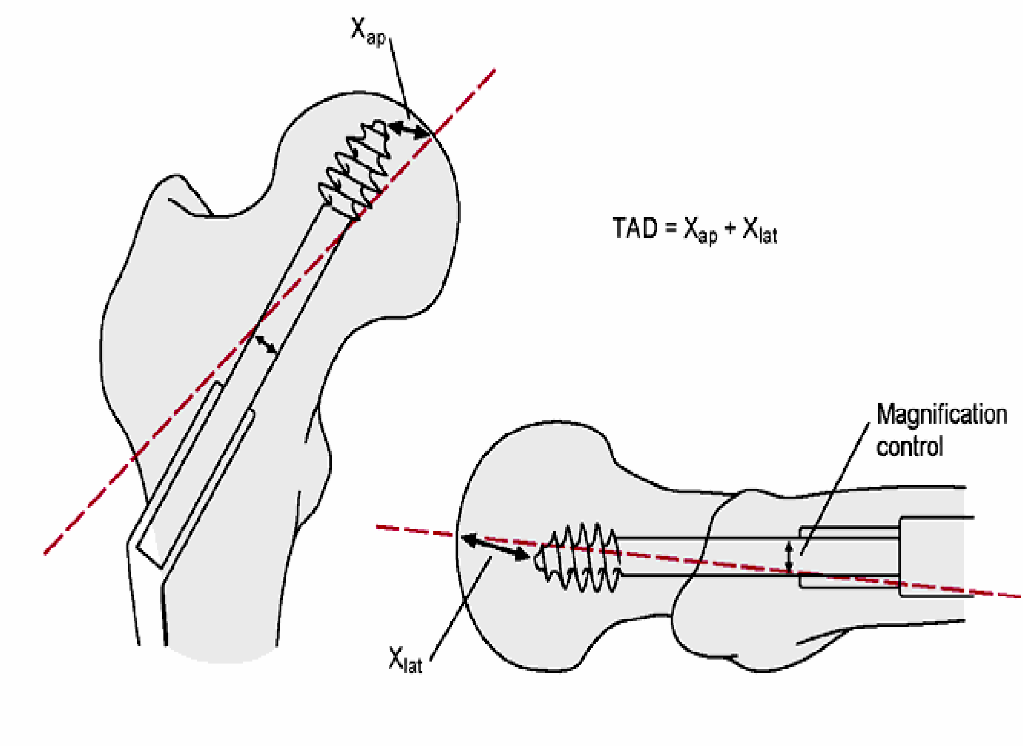

Fig: 17 Tip Apex Distance

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JAMMING OF THE SCREW

Kyle in his study[61] noted that jamming of the screw within the barrel will occur if the bending forces exceed the compressive forces & the screw will impact against the barrel. This situation is avoided by:

1. Maximum engagement of the screw in the barrel.

2. Use of valgus angle devices.

Jamming results in failure of the implant to slide & the device behaving as a fixed angle device.

STRAIN PATTERN

Rosenblum[57] in his biomechanical study of 10 cadeveric femoral noted that the Gamma nail had an increasing stiffness. This stiffness was a result of :

- ➢ The large proximal diameter (17 mm) of the proximal end
- ➢ Larger compression screw diameter 12 mm as compared to 8 mm in the sliding hip screw.
- The maximum deflection at the tip of the nail is inversely proportional to its movement of insertion & directly proportional to its length.
- Thus the Gamma nail was stiffer than the sliding hip screw, making it more resilient to bending forces preventing compression at the fracture site.
- The increased stiffness of the implant would transmit more force to the tip of the nail making the nail behave similar to a femoral prosthesis. This is the probable reason for the high incidence of fractures of the femoral shaft. Rosenblum, also noted an inversion in the stress pattern, with more load being borne at the tip of the nail than the medial femoral cortex, He observed that in the stable intertrochanteric fractures the unlocked & the locked nails had similar strain patterns.

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TFN was designed with this in mind making it less stiff because it has:

1. Proximal diameter of 14mm.
2. Entry point is through GT and not pyriformis fossa (more valgus).
3. Smaller diameter tip causing less stress concentration and less chance of fracture.
4. Hip screw and Antirotation screw provide good compression at fracture site with adequate bone stock for revision.

In addition it has several other favourable characteristics

1. The presence of two proximal screws provides better rotational control of proximal fracture fragment.
2. It allows length and rotational control even when the lesser trochanter is not intact
3. It can be dynamically locked.

The main advantages of TFN over its precursor gamma nail are Since the 2 proximal screws are smaller in diameter , it is not necessary for the nail to be stout unlike gamma nail and hence theoretically induces less comminution of proximal segment and less disruption of abductor insertion.

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MATERIAL AND METHODS

The material for the present study was obtained from the patients admitted in B.L.D.E.A.S' Shri B.M.Patil Medical college hospital and research centre, Department of Orthopaedics with diagnosis of Intertrochanteric fracture from September 2018 to May 2020.

A minimum of 43 cases were taken and the patients were informed about the study in all respects and informed consent was obtained from each patient.

METHOD OF COLLECTION OF DATA

- By interview
- By follow up at intervals of 6wks, 3months, and 6months
- By clinical examination
- By analyzing case papers

Following inclusion and exclusion criteria were used.

Inclusion criteria:

1. Patient aged 40 years and above.
2. Intertrochanteric fractures of femur (stable and unstable).
3. Age of the fractures less than 2 weeks.
4. Patients willing for treatment and giving informed and written consent.

Exclusion criteria:

1. Pathological fractures.
2. Associated neurovascular injury.
3. Patients medically unfit for surgery.
4. Non-union or mal union.
5. Open fracture of intertrochanteric fracture.

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6. Previously operated or failure case of intertrochanteric fracture.

Patients admitted with Intertrochanteric fracture were examined and investigated with X-ray pelvis with both hips AP and Lateral view. Skin traction was applied to all cases. Blood and urine examinations were ordered as follows:

INVESTIGATIONS

- Blood – Hb%, Total count, Differential count, E.S.R.
- Urine – Albumin, Sugar, microscopy.
- Blood grouping and Rh type
- Bleeding time and Clotting time.
- HIV, HbsAg.
- Blood urea.
- Blood sugar Level.
- ECG.

SPECIAL INVESTIGATIONS (In patients with age more than 40years and as adviced by an anesthetist)

- 2 D Echocardiography.
- Chest X –ray.

Physician opinions were taken as to the fitness of patient before surgery as & when necessary. X-ray were reviewed again and classified with using Orthopaedic Trauma Association (OTA) classification. All fractures were treated using a Trochanteric femoral nail. All patients were assessed by using the modified Harris Hip Score and visual analogue score for the functional assessment at the follow-ups. Proforma specially made for the study was used. Data collected at the end of the study was statistically compared and analyzed with the similar studies done before.

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PREOPERATIVE PREPARATION

- The patients were taken up for surgery after obtaining written and informed risk consent of the nature and complications of the surgery. The operative site (lateral aspect of the thigh) was shaved and prepared with betadine scrub, a day prior to the surgery.
- Xylocaine test dose & tetanus toxoid injections were given preoperatively.
- All patients were started on antibiotics prophylactically. A third generation Cephalosporin was administered via IV route prior to induction of anaesthesia, and continued at 12hourly intervals for 3-5days, and switched over to oral form till the 12th day post-operatively, i.e .until suture removal**.**

PREOPERATIVE PLANNING

1. **Assessment of neck shaft angle:** Neck shaft angle was measured on the unaffected side on an AP x-ray using a goniometer**.**
2. **Assessment of nail diameter:** Nail diameter was determined by measuring diameter of the proximal femur on an AP x-ray.
3. **Determination of proximal screw sizes:** Approximate sizes of the compression and antirotation screws were measured in the head neck region. A 15mm smaller screw than compression screw was chosen for the Antirotation screw to prevent Z- Effect.
4. **Length of the nail:**A Short TFN nail 180mm was used in all our cases.

IMPLANTDETAILS

A short trochanteric femoral nail (Fig.30) has length of 180 mm and proximal diameter of 14mm. The narrow proximal diameter enables easy insertion and reduces the risk of femoral fracture. Distally, it is available in 9, 10, 11 and 12mm diameters. The nail has a 6º medio-lateral angle for easy insertion and a flexible distal tip to

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avoid stress generation and refracture. This nail is available in femoral neck angles of 130 and 135 degrees. It has a 8mm compression screw and a 6.4mm antirotation / stabilizing screw proximal to it. Distally, It has 4.9mm both static and dynamic locking bolts. The nail has a longitudinal slot throughout, so as to accelerate regeneration of the endosteal bone. The nail is made up of 316L stainless steel.

Fig18: INSTRUMENTS AND IMPLANT SET

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SURGICAL STEPS

Patient were given spinal or epidural anesthesia and shifted to a radiolucent fracture table in a supine position. Operative leg was put on traction. Opposite limb was put in a full abduction as to give space for the C-arm in between the legs. Reduction was achieved by traction and internal rotation primarily and adduction or abduction as required. Reduction was checked in a C-arm with anterior-posterior and lateral view. Limb was scrubbed, then painted and draped under sterile condition. A 5cm incision was taken above the tip of the greater trochanter and deepened to the gluteus medius muscle. Tip of the greater trochanter palpated and minimal muscle attachment was cleared off.After this TFN was fixed in a following manner:

1. Entry point

Insertion of the guide pin: It should be just medial to tip of the greater trochanter at the virtual meeting point of the line drawn in the center of the neck and a line drawn in the femoral shaft 6º lateral.

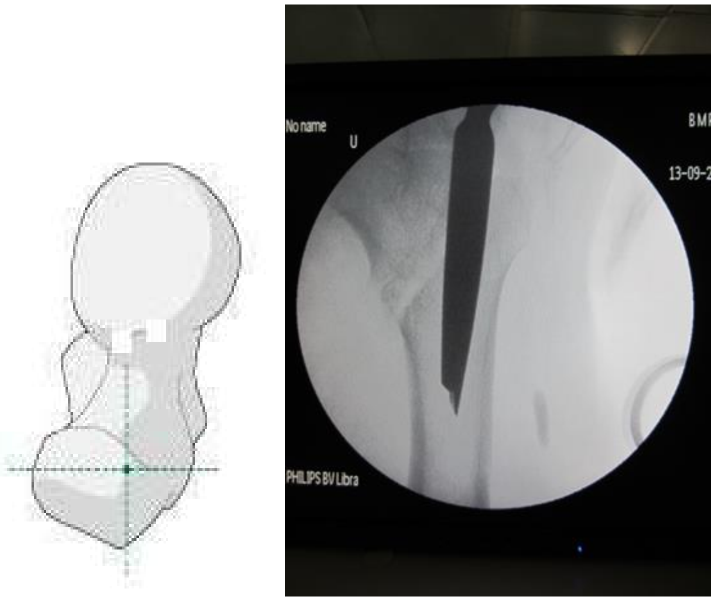

Fig no 19 entry point and confirmation by C-Arm

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3. Reaming of the proximal femur

Reaming: Reaming of the proximal femur is done with the reamer provided with the set.

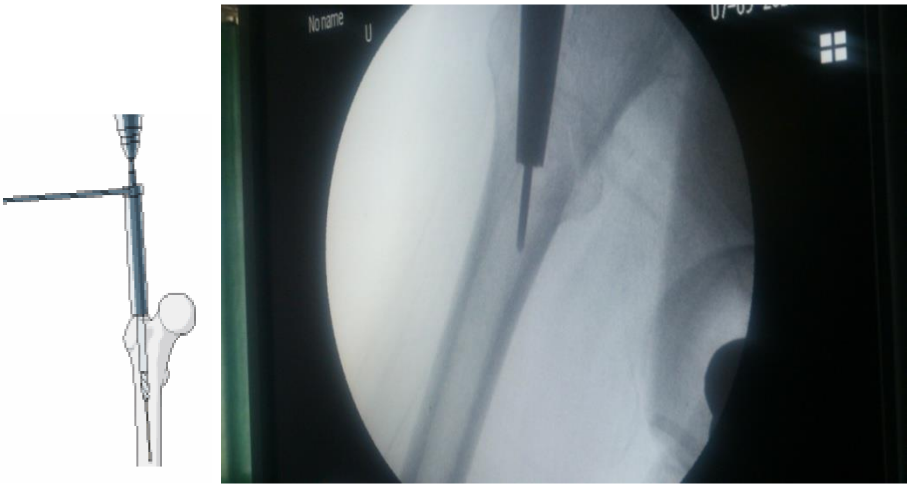

Fig no. 20 Reaming

4. Nail insertion

Nail insertion: Nail is fixed on the jig and the alignment is checked. Then the nail is inserted into the femur. The position of the holes for the hip screws is checked in the C-arm for the depth of the nail.

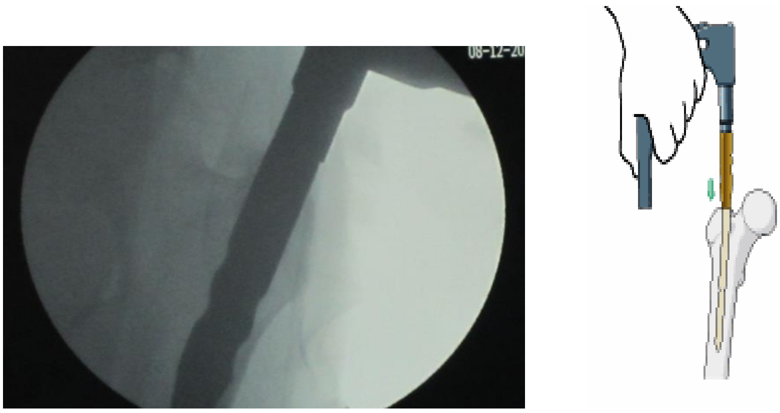

Fig no 21 Nail insertion with Zig attached

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5. Placing the guide wire pins

Guide wire for the screws: Guide wires for the screws are inserted via the jig and the drill sleeve. The ideal position of the guide wires is parallel and in the lower half of the neck in AP views, in a single line in the center of the neck in the lateral views. The proximal wire is 10mm from the sub-chondral bone and the distal wire 5mm from the sub-chondral bone.

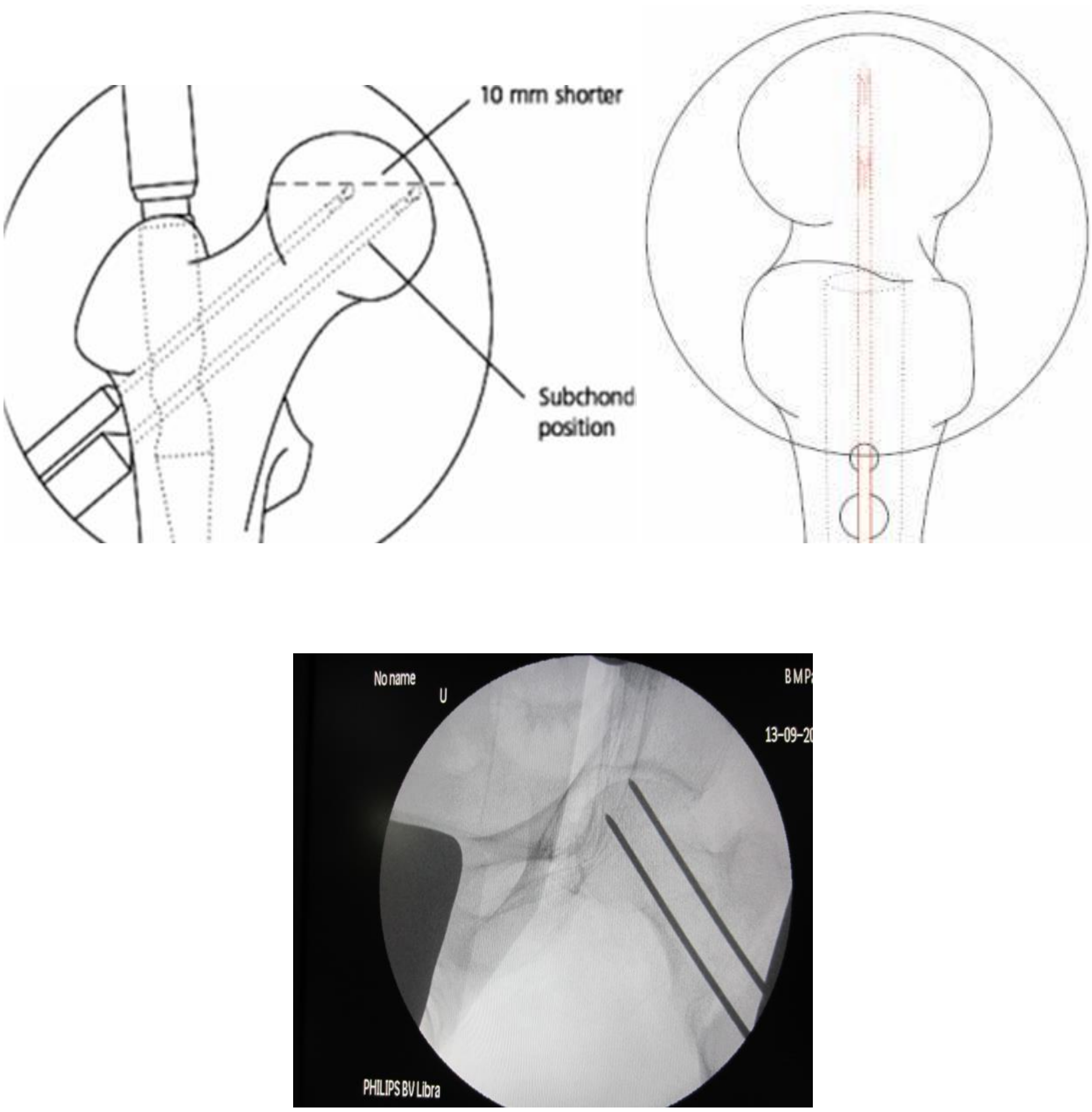

Fig no 22 Placing guide wire pins and confirmation under C-Arm

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6. Inserting the screws after the final setting

Insertion of the screw: First the 8mm hip screw is inserted after reaming over the distal wire and then the 6.4mm cervical screw. The hip screw should be 5mm away from the sub-chondral bone and the cervical screw 10mm away from the sub-chondral bone or both the screw tip should make one horizontal line when joined.

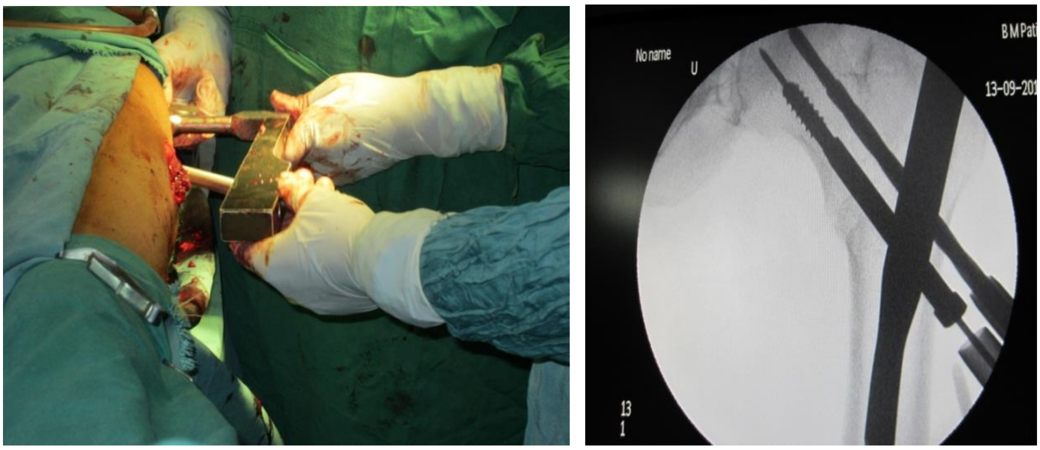

Fig no 23 Insertion of Proximal screws and confirmation under C-Arm

Distal screws: one or two static or dynamic 4.9mm interlocking bolts are inserted via the jig in to the distal part of the nail. Out of which one is a static and another is a dynamic hole. It should be done after removing the traction along with the tightening of the proximal screws.

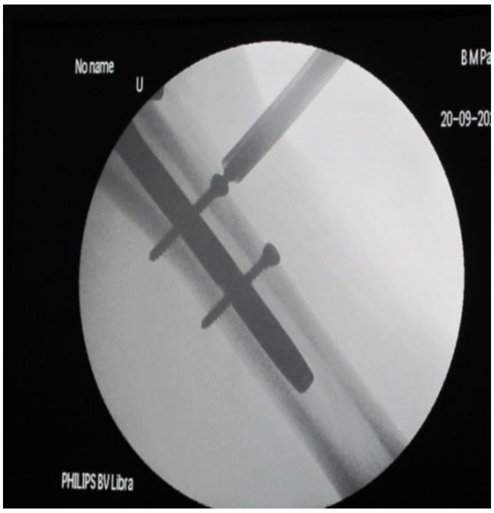

Fig no 24 Distal screw insertion

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The final position of the nail was checked in the C-arm in both views and the wound was closed in layers without putting the drain. Patient was given the IV broad spectrum cephalosporin one dose pre-operatively and followed BID dose till 48 hrs depending on the condition of the wound and patient.

Following parameters were recorded intra-operatively:

1. Total time of the surgery
2. Type of reduction: Closed/Joystick/Limited Open
3. Length of incision
4. Implant details
5. Radiation duration
6. Intra operative complications
7. Quality of reduction

After treatment:

1) Post operatively, patient's pulse, blood pressure, respiration, temperature were monitored.

2) Foot end elevation was given depending on blood pressure.

3) IV third generation Cephalosporin were administered 12 hourly for 3-5 days, and switched over to oral form till the 12th day post-operatively, i.e. until suture removal**.**

4) Analgesics were given as per patient compliance.

5) Blood transfusion was given depending on the requirement.

6) Suction drainage was removed after 48hours, if it is inserted.

7) Dressing was done on 2^{nd}, 5^{th} and 8^{th} postoperative day.

8) Sutures removed on 12^{th} postoperative day.

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PHYSIOTHEAPRY

1. Patients were encouraged to sit in the bed after 24 hours after surgery.
2. Active isometric and isotonic quadriceps exercises were started from day 2.
3. Non weight bearing ambulation was started from 2nd week.
4. Partial weight bearing ambulation was started from 6th week.
5. Full weight bearing ambulation was started after radiological signs of union.

POST OPERATIVE EVALUATION

Follow up:

Follow up at outpatient level at regular intervals at 6wks, 3months, and 6months for serial clinical and radiological evaluation was done. If possible, further follow up was done. At every visit, patient was assessed clinically regarding pain, limp, hip movements, walking ability, deformity and shortening.

Clinical assessment:

All patients were clinically assessed by using the **MODIFIED HARRIS HIP SCORE** and **VISUAL ANALOGUE SCORE** for the assessment of pain at greater trochanter on abduction**.**

Radiological evaluation – Check X-RAY Pelvis with both hips AP views

Check X-Ray of affected side Hip AP and lateral views.

The tip apex distance on AP view of both Compression screw and antirotation screw were measured according to **Baumgaertner MR et al**[64] and also the measurement of nail protrusion height over the greater trochanter of the femur was measured according to **Chang S et. Al**[65] and on lateral view we have measured the tip apex distance of compression screw.

Also on AP view the head–neck interface line (L1) is a connecting line between the two curving points where the convexity of the femur head contour turns into the

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femur neck concavity. The centre neck line (L2) is a line perpendicular to the head–neck interface line in its mid-length. The apex is the point where the centre neck line crosses the femur head cortex. D1 = the length of the head–neck interface line. D2 = the distance to the centre of lag screw. D3 = the distance to the upper part of the antirotation screw according to the study conducted by **Amir Herman et. al.**[66] (figure given below) with the help of software Digimizer and keeping the compression screw width constant as 8mm.

Complaints:

- Deformity
- Shortening
- Range of motion – Flexion
  - Extension
  - Abduction
  - Adduction
  - External Rotation
  - Internal Rotation
- Pain
- Swelling

TABLE NO 1: MODIFIED HARRIS HIP SCORING FOR FUNCTIONAL EVALUATION OF HIP.[67]

Point scale with maximum of 100 points distributed as follows:-

Pain	44
Function	47
Range of motion	05

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Absence of deformity 04

Total 100

	PAIN	44
1	Totally disabled, crippled, pain in bed, bedridden	00
2	Marked pain, serious limitation of activities	10
3	Moderate plain, tolerable but makes concession to plain	20
4	Mild pain, no effect on average activities	30
5	Slight, occasional, no compromise in activity	40
6	None, or ignores it	44
Total		
II	Function	47
A	Distance walked	
1	Bed and chair only	00
2	Two or three blocks	05
3	Six blocks	08
4	Unlimited	11
B	Activities	
Shoes & Socks		
1	Unable to fit or tie	00
2	With difficulty	02
3	With ease	04
Public transportation		
1	Unable to use public transportation (bus)	00
2	Able to use transportation (bus)	01
Limp		
1	Severe or unable to walk	00
2	Moderate	05
3	Slight	08
4	None	11
Support		

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1	Two crutches or not able to walk	00
2	Two canes	02
3	One crutch	03
4	Cane most of the time	05
5	Cane for long walks	07
6	None	11
Stairs		
1	Unable to do stairs	00
2	In any manner	01
3	Normally using a railing	02
4	Normally without using a railing	04
Sitting		
1	Unable to sit in any chair comfortably	00
2	On a high chair for 30 min	03
3	Comfortably on a ordinary chair for one hour	05
Total		
III	Motions Flexion+ Abduction + Adduction+ External rotation + internal rotation=	05
1	00 to 29°	00
2	30 to 59°	01
3	60 to 99°	02
4	100 to 159°	03
5	160 to 209°	04
6	210 to 300°	05
Total		
IV	Deformity	04
1	Flexion deformity 30° of more	00
2	Flexion deformity less than 30°	01
1	Fixed adduction 10° more	00
2	Fixed adduction less than 10°	01
1	Fixed internal rotation(in extension) 10°or	00

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	more	
2	Fixed internal rotation(inextension) less than 10°	0
1	Limb length discrepancy more than or equal to 3.2 cms	00
2	Limb length discrepancy less than 3.2cms	01
	Total	
	Total of I+II+III+IV	100

The score is reported as follows:-

HHS between 90 to 100- Excellent results

HHS between 80 to 89- Good

HHS between 70 to 79- Fair

HHS between 60 to 69-Poor, and

HHS below 60:- as a failed result.

* HHS: - Harris Hip Score.

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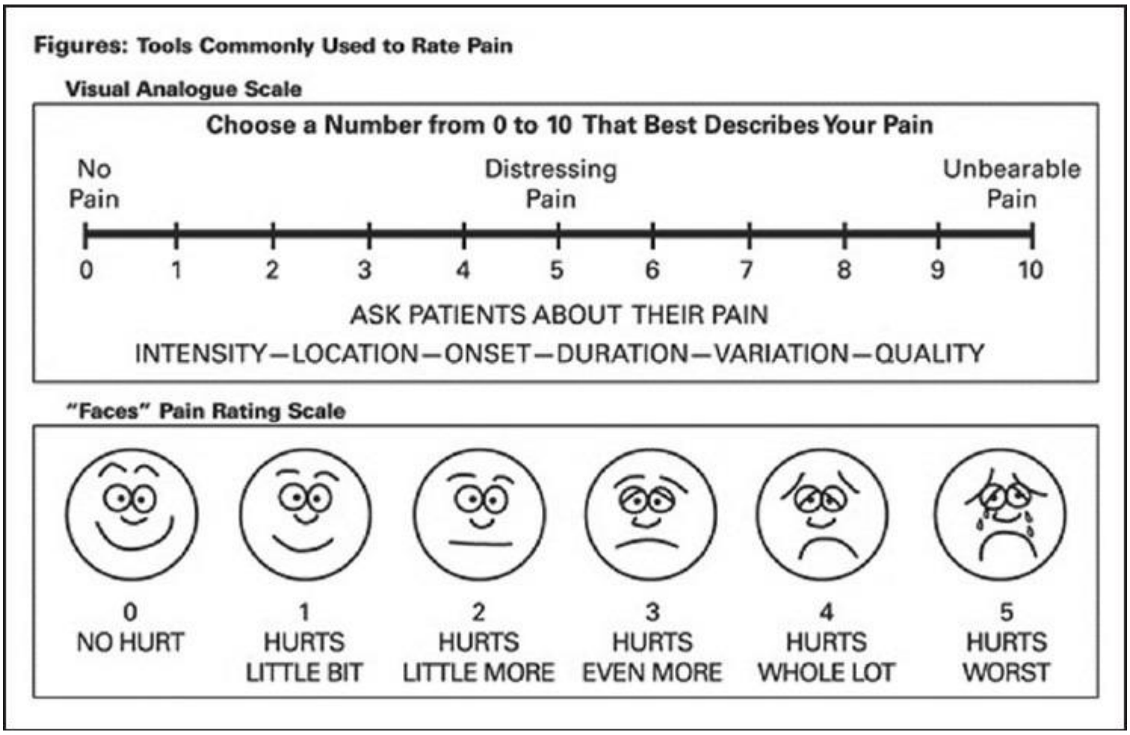
TABLE NO. 2: VISUAL ANALOGUE

EVALUATION OF PAIN



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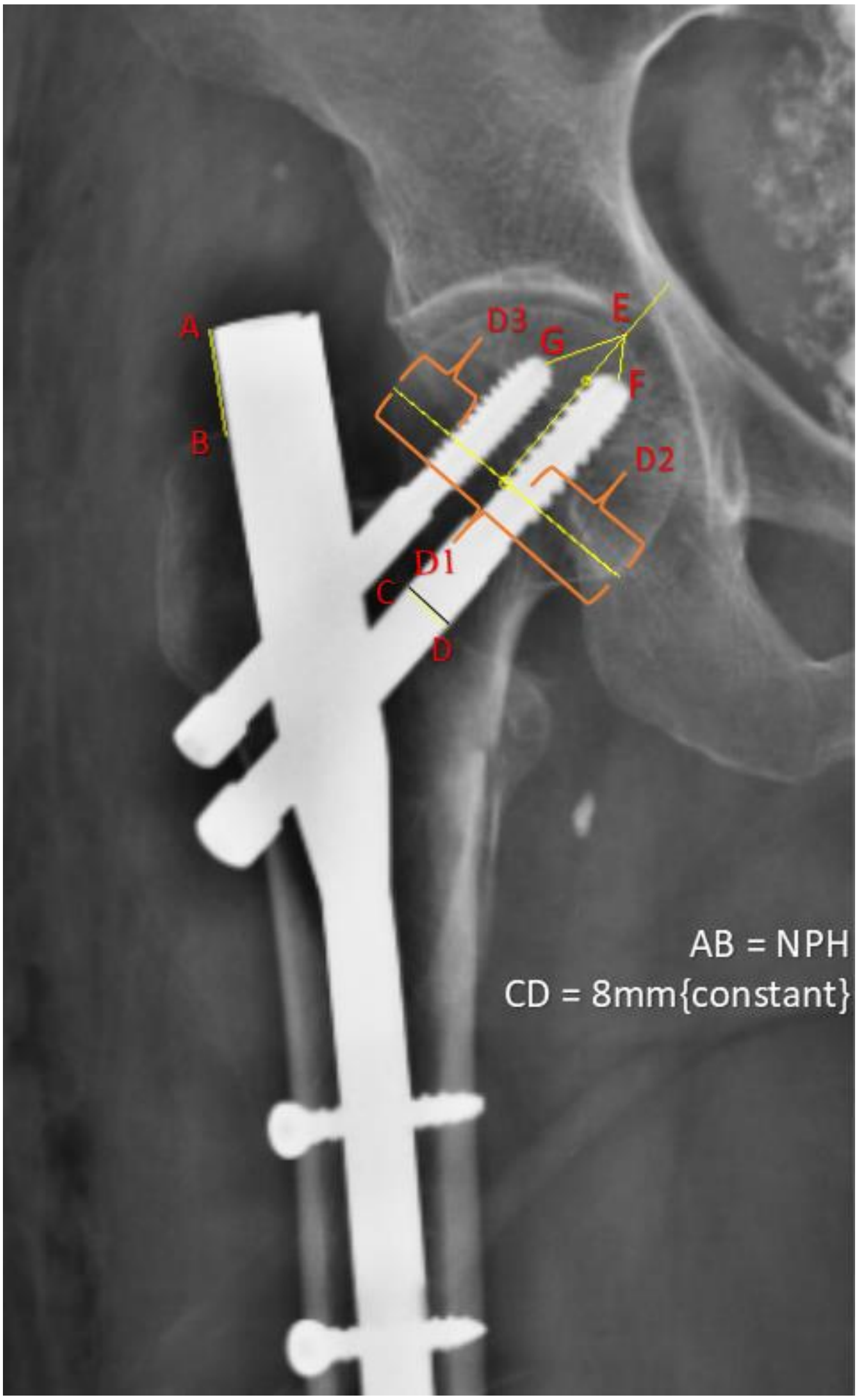

FIG NO. 25 Radiological Measurements by using Digimizer software keeping

CD = 8mm(width of the compression screw)

AB = Nail Protrusion Height

EF = TAD of compression screw

EG = TAD of antirotation screw

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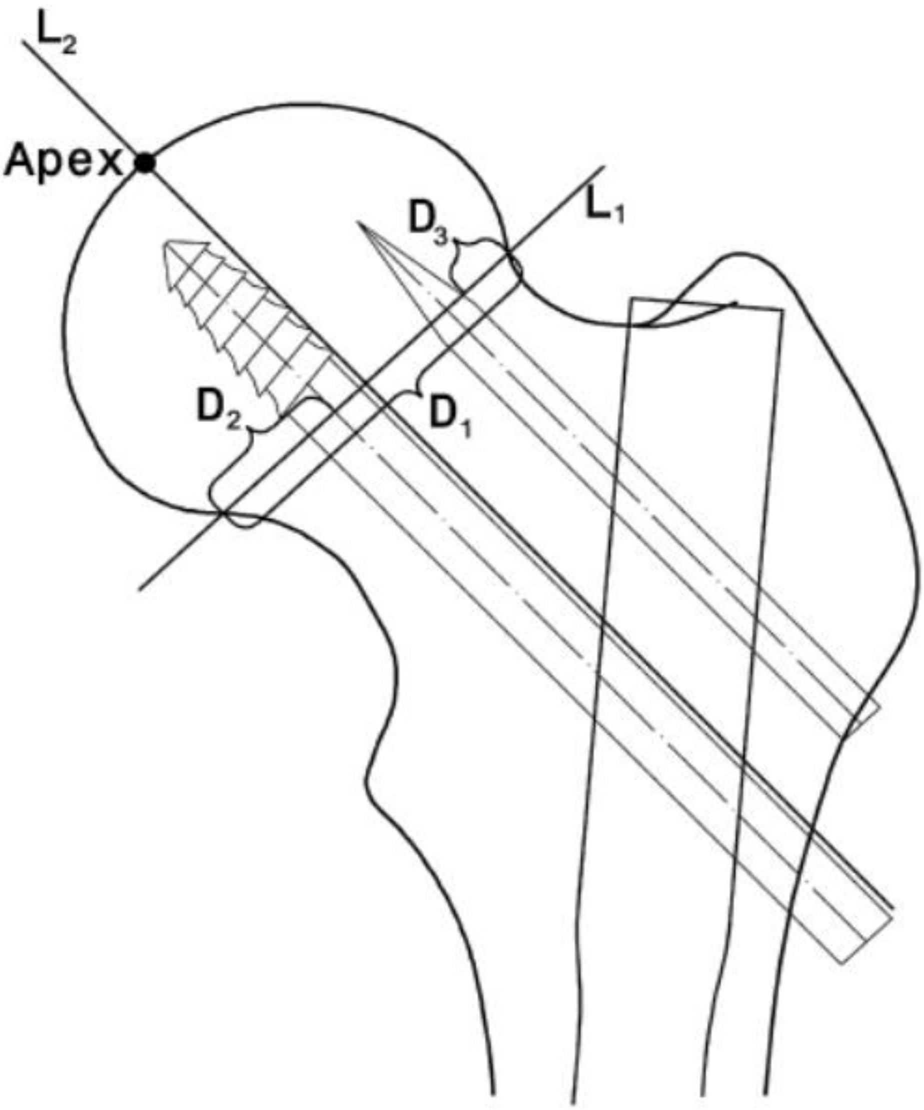

Femur neck measurements. The head–neck interface line (L1) is a connecting line between the two curving points where the convexity of the femur head contour turns into the femur neck concavity. The centre neck line (L2) is a line perpendicular to the head–neck interface line in its mid-length. The apex is the point where the centre neck line crosses the femur head cortex. D1 = the length of the head–neck interface line. D2 = the distance to the centre of lag screw. D3 = the distance to the upper part of the antirotation screw.

FIG NO. 26 Radiological measurements of neck of femur

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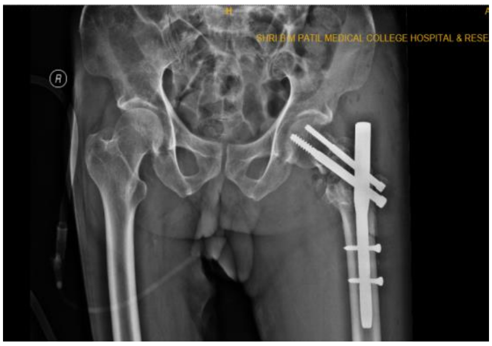
CASE NO. 1

Pre op Xray



Post op Xray

6 week follow up Xray

Able to squat

Active flexion

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CASE NO. 2

Pre op Xray

Immediate Post Op Xray

Follow up months

Squatting position

Active flexion

Active abduction

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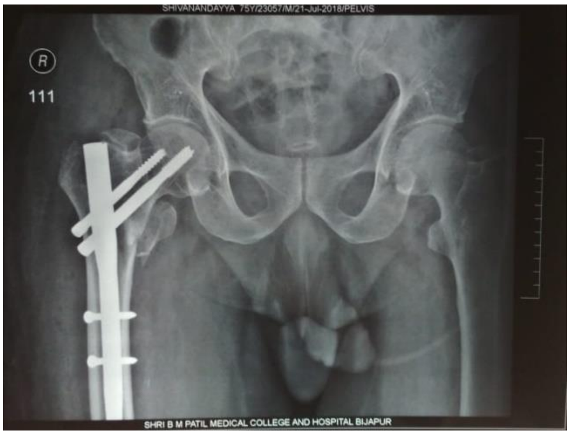
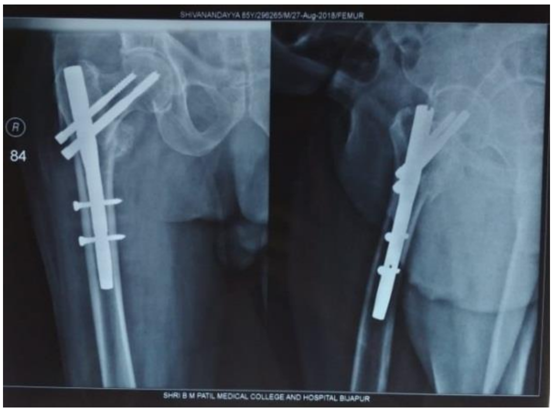
CASE NO. 3

Pre op X ray



Immediate Post Op Xray



Three Months follow up

Six months follow up

CASE NO. 4

Pre Op X Ray

Six weeks follow up

Three months follow up

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RESULTS

The study involved 43 confirmed cases of Intertrochanteric fractures of either sex from June 2018- March 2020. All the cases were treated with Intramedullary fixation “Trochanteric femoral nail”. The analysis of the patient data, intraoperative data & postoperative outcome is as follows:

AGE

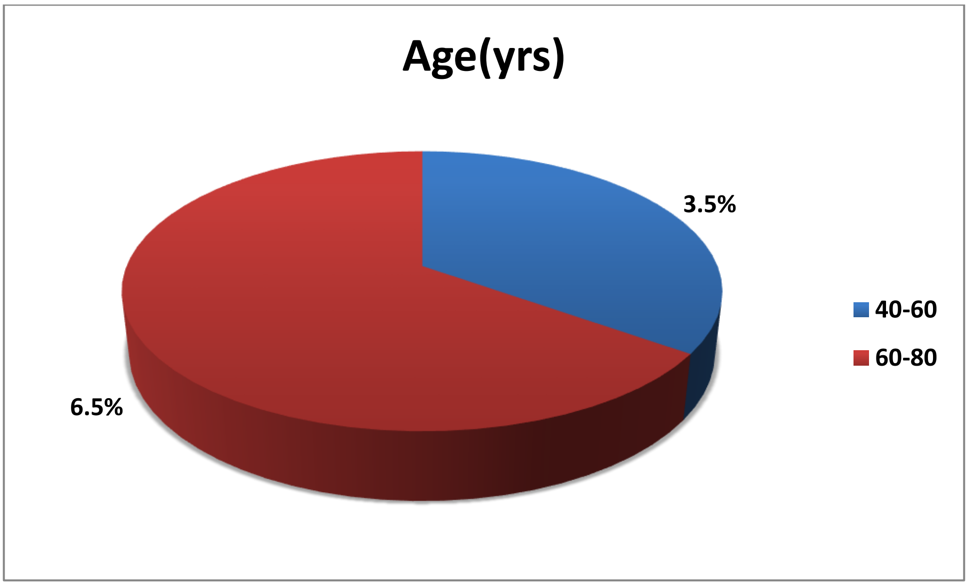
The study involved patients above 40 years of age. The age distribution was from 40 and above. The average age was 65 years and the largest group of patients being from 60 to 80 years.

Table No. 3 : Distribution of Cases according to Age

Age(yrs)	N	Percent
40-60	15	34.9
60-80	28	65.1
Total	43	100

Descriptive Statistics	Min	Max	Mean	SD
Age(yrs)	43	85	65.7	11.6

Figure No. 27: Distribution of Cases according to Age



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SEX

There were 24 males and 19 females in the study.

Table No. 4 : Distribution of Cases according to Sex

Sex	N	Percent
Male	24	55.8
Female	19	44.2
Total	43	100

Figure No.28: Distribution of Cases according to Sex

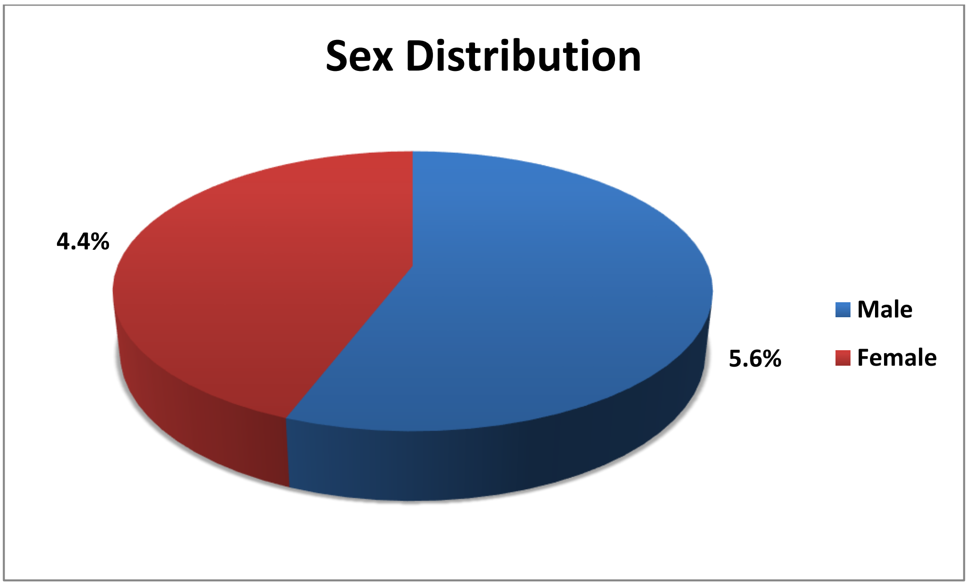
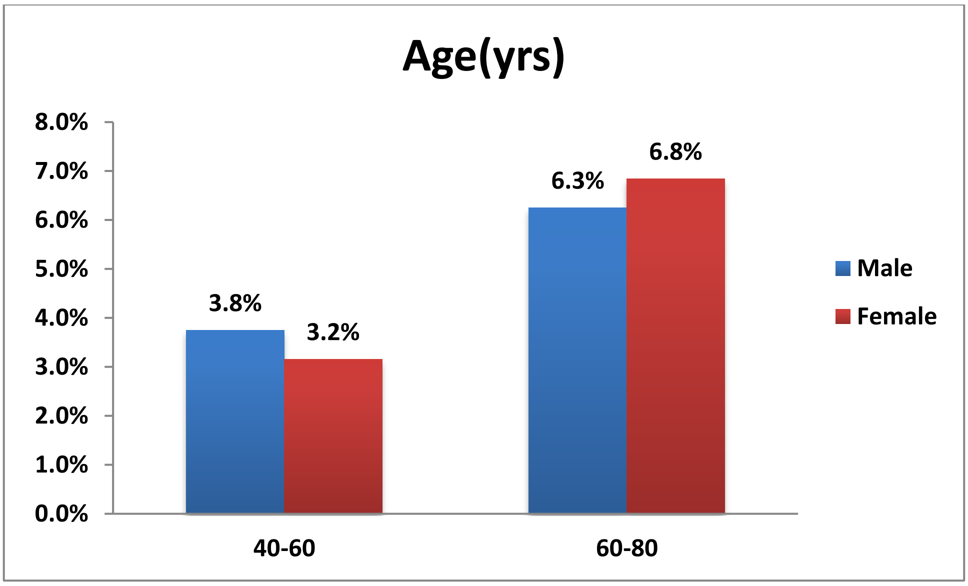


Table No.5: Association of Age and Sex

Age(yrs)	Male		Female		p value
	N	%	N	%	
40-60	9	37.5%	6	31.6%	0.686
60-80	15	62.5%	13	68.4%	
Total	24	100.0%	19	100.0%	

Figure No.29: Association of Age and Sex



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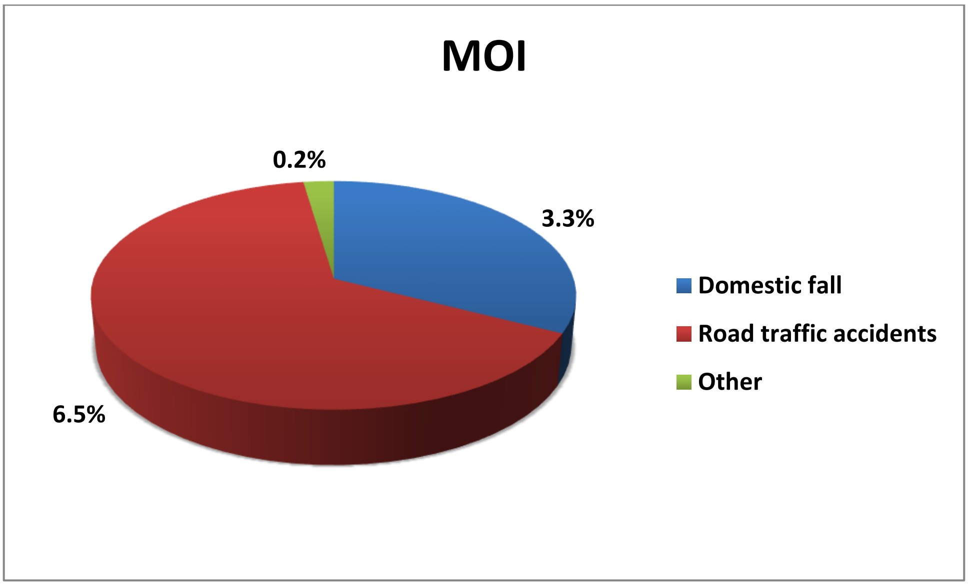
Mode of Injury

In the study out of 43 patients 14 had domestic fall, 28 patients had road traffic accident and others 1 patient.

Table No.6: Distribution of Cases according to MOI

MOI	N	Percent
Domestic fall	14	32.6
Road traffic accidents	28	65.1
Other	1	2.3
Total	43	100

Figure No.30: Distribution of Cases according to MOI



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Singh's Index

Table No.7: Distribution of Cases according to Singh's Index

Singh's Index	N	Percent
Grade II	7	16.3
Grade III	17	39.5
Grade IV	19	44.2
Total	43	100

Figure No.31: Distribution of Cases according to Singh's Index

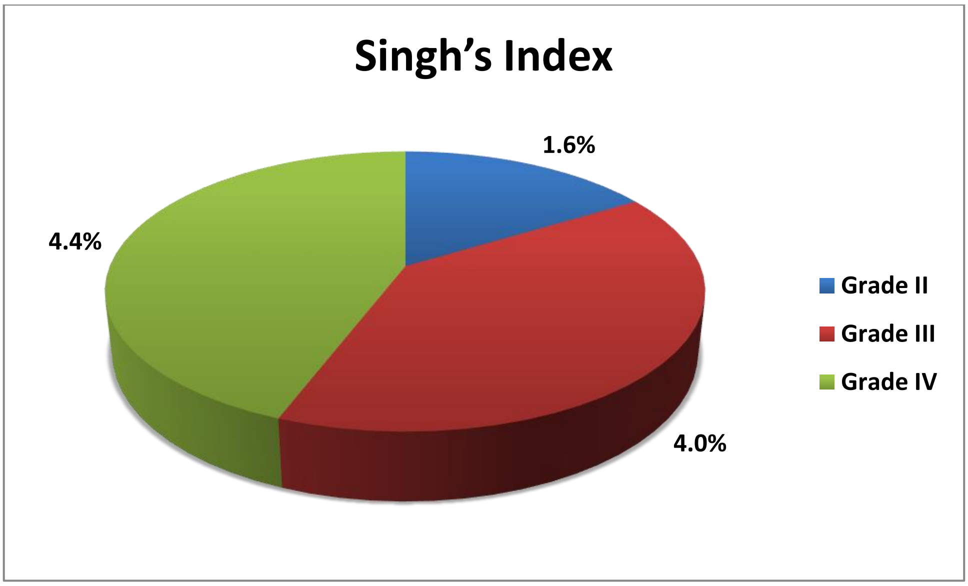
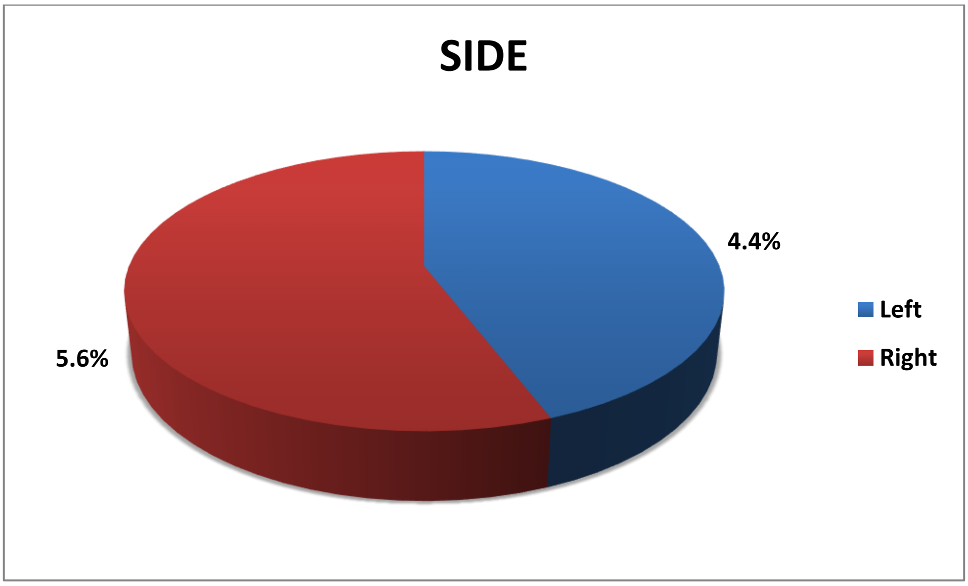


Table No.8: Distribution of Cases according to Side

SIDE	N	Percent
Left	19	44.2
Right	24	55.8
Total	43	100

Figure No.32: Distribution of Cases according to Side



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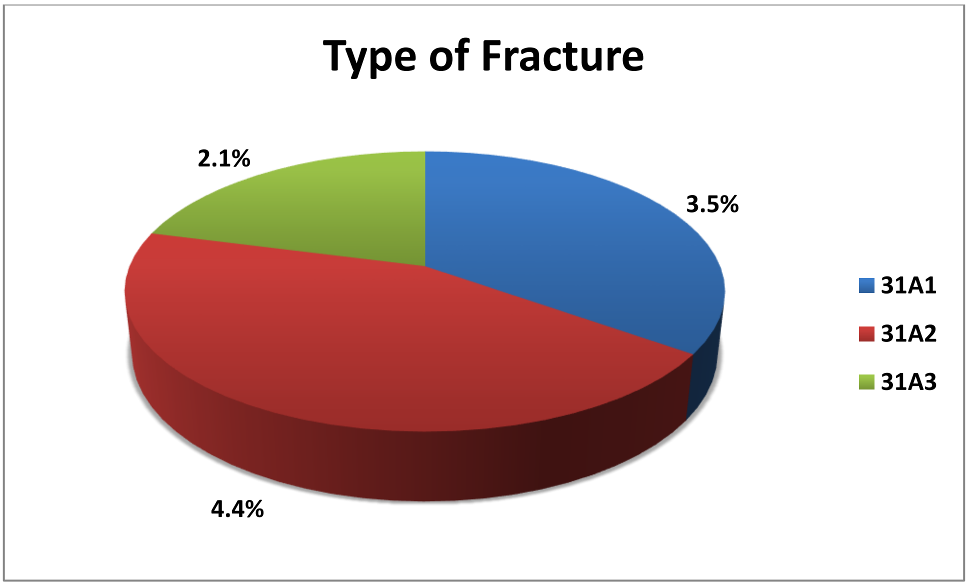
FRACTURE PATTERN

All the fractures were classified as per Orthopaedic Trauma Association (OTA) classification. In which 31A1 were considered stable fractures. 31A2 and 31A3 were unstable fractures.

Table No.9: Distribution of Cases according to Type of fracture

Type of Fracture	N	Percent
31A1	15	34.9
31A2	19	44.2
31A3	9	20.9
Total	43	100

Figure No.33: Distribution of Cases according to Type of fracture



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ASSOCIATED MEDICAL PROBLEMS:

Eight patients (18.6%) were suffering from Hypertension , nine patients (6.7) suffering from Diabetes mellitus and three patients(10%) were having both Diabetes mellitus and Hypertension

Table No.10: Distribution of Cases according to Med Problems

Med Problems	N	Percent
DM	8	18.6
HTN	9	20.9

Figure: Distribution of Cases according to Med Problems

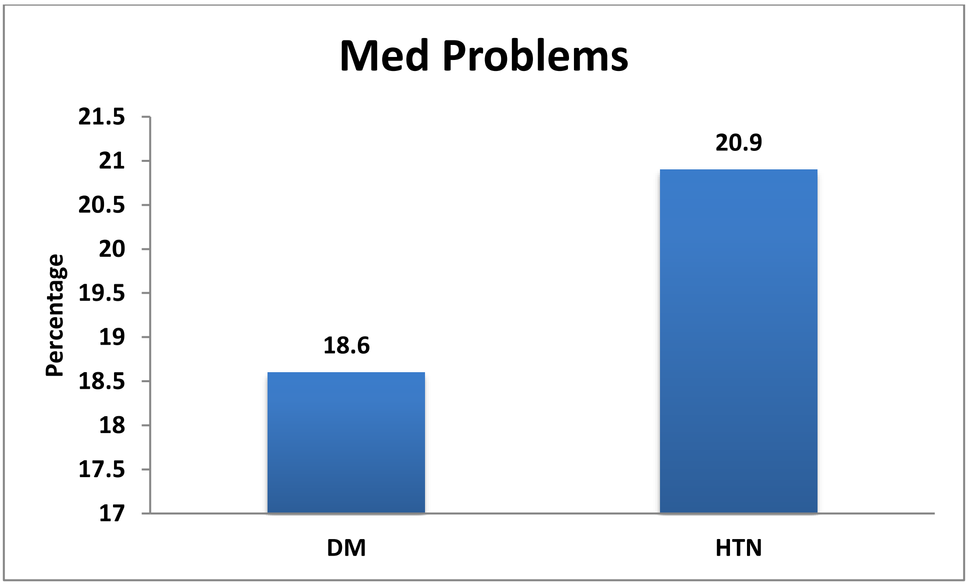
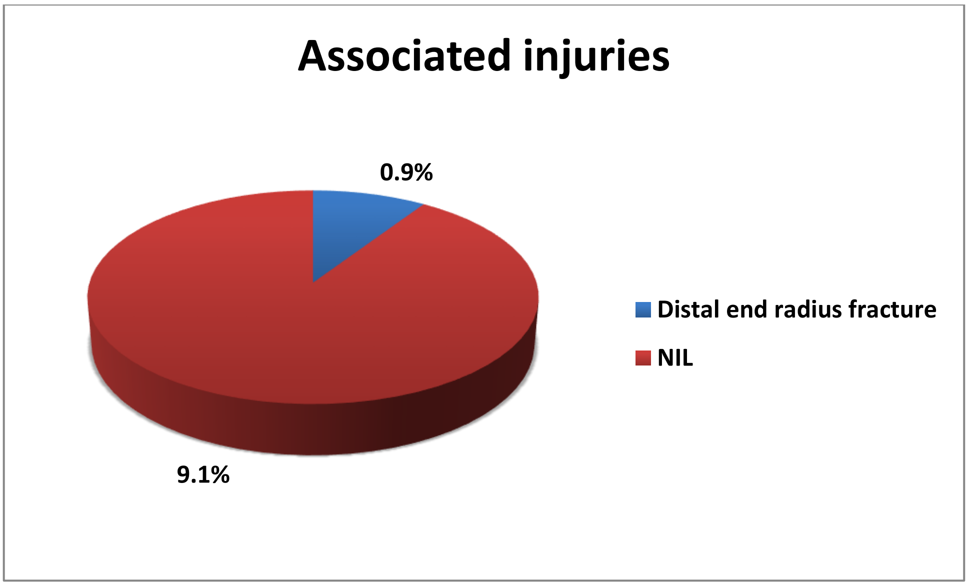


Table No.11: Distribution of Cases according to Associated injuries

Associated injuries	N	Percent
Distal end radius fracture	4	9.3
NIL	39	90.7
Total	43	100

Figure No.34: Distribution of Cases according to Associated injuries



Complications

Post operative complication:

Early :

- Shortening of 2mm is seen in 4 patient.
- No Rotation deformity seen.
- .In 4 patient Superficial infection was seen.
- No cases of Deep infection.
- None suffered from Bed sores.
- No Mortality.

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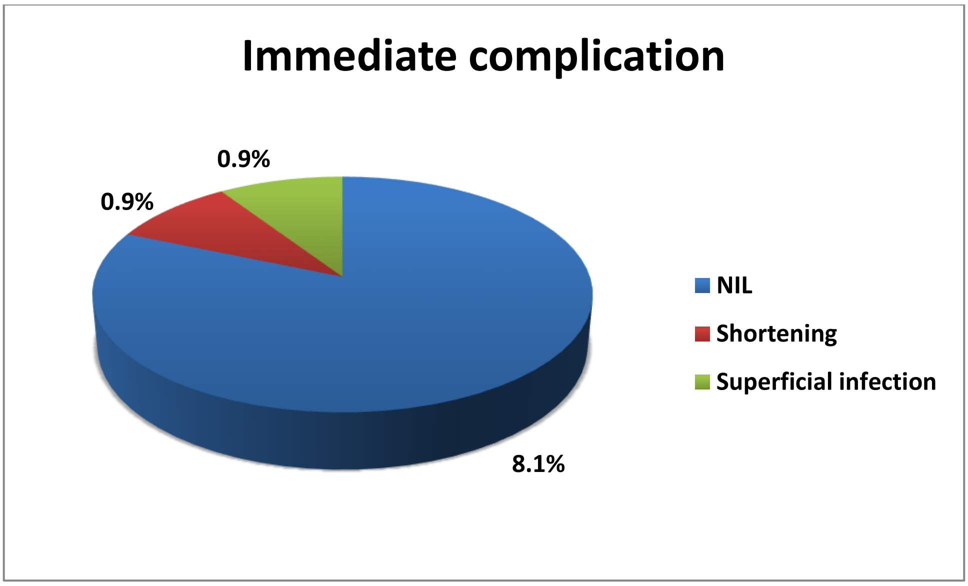
Table No.12: Distribution of Cases according to immediate complication

Immediate complication	N	Percent
Nil	35	81.4
Shortening	4	9.3
Superficial infection	4	9.3
Total	43	100

Figure No.35: Distribution of Cases according to immediate complication



Late complications:

1. Implant failure

In 1 case the ‘Z’- effect of implant failure was seen. Early weight bearing, improper screw placement, stress risers were the causes of this failure.

2. Non - Union

There were no cases of non-union in my study.

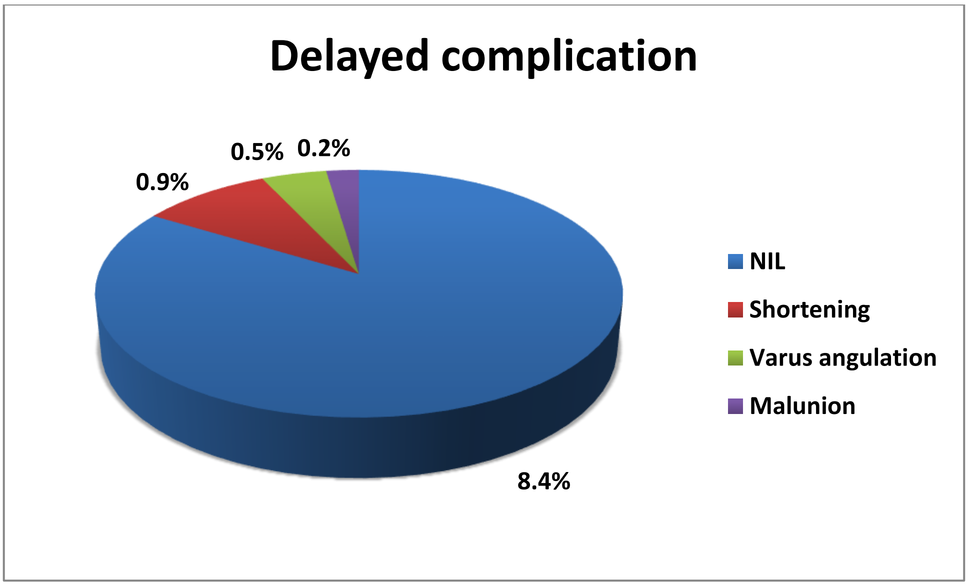
3. Varus Mal-Union.

Two patients had Varus Mal union in my study

Table No.13: Distribution of Cases according to Delayed complication

Delayed complication	N	Percent
NIL	36	83.7
Shortening	4	9.3
Varus angulation	2	4.7
Malunion	1	2.3
Total	43	100

Figure No.36: Distribution of Cases according to Delayed complication



CRITERIA FOR EVALUATION AND RESULTS (HARRIS HIP SCORE)

Table No.14: Distribution of Cases according to Result

Result	N	Percent
EXCELLENT	13	30.2
GOOD	21	48.8
FAIR	7	16.3
POOR	2	4.7
Total	43	100

Figure No.37: Distribution of Cases according to Result

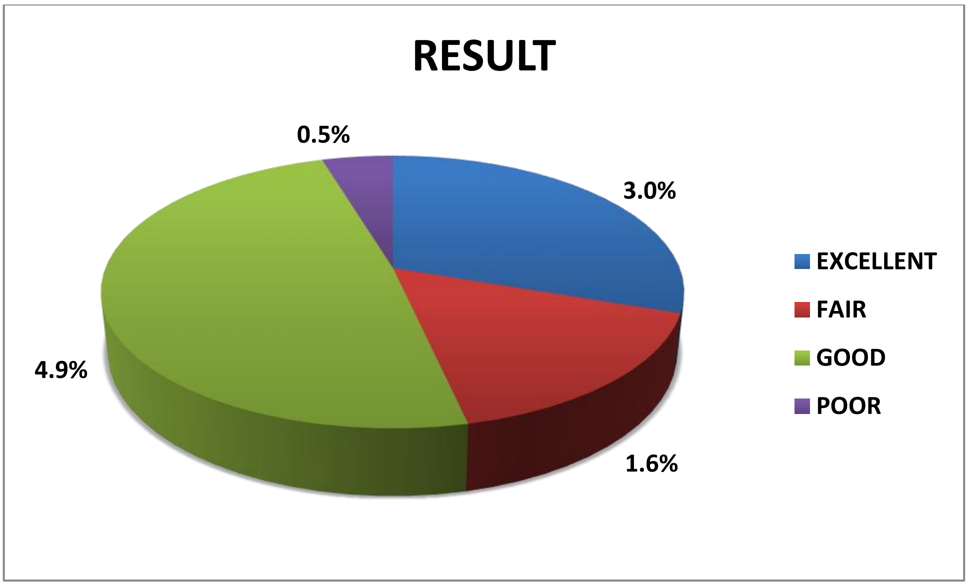


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Table No.15: Descriptive Statistics of Study parameters

Descriptive Statistics	Min	Max	Mean	SD
NPH	0.6	13.5	6.02	3.1
D1	30	51	41.0	4.6
D2	12	24	15.8	2.6
D3	5	19	9.6	2.6
TADC(AP)	5	13	10.4	2.1
TADA(AP)	7	27	15.9	4.4
TADC(LAT)	8	15	10.7	1.6

Table No.16: Distribution of Cases according to NPH

NPH	N	%
<5	11	25.6
>5	32	74.4
Total	43	100

Figure No.38: Distribution of Cases according to NPH

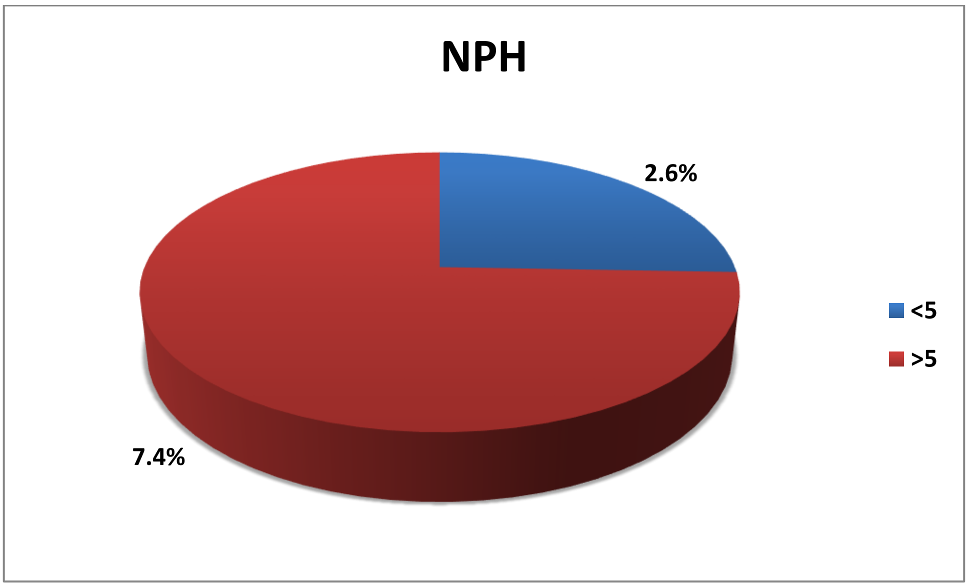

Table No.17: Mean Study parameters according to NPH categories

Parameters	NPH<5		NPH>5		p value
	Mean	SD	Mean	SD	
D1	42.0	3.8	40.6	4.9	0.392
D2	16.2	3.0	15.6	2.4	0.542
D3	10.2	2.1	9.3	2.7	0.362
TADC(AP)	9.9	1.8	10.6	2.2	0.353
TADA(AP)	16.9	3.9	15.6	4.5	0.385
TADC(LAT)	11.5	1.8	10.4	1.5	0.036*

Note: * significant at 5% level of significance ($p<0.05$)

Figure No.39: Mean Study parameters according to NPH categories

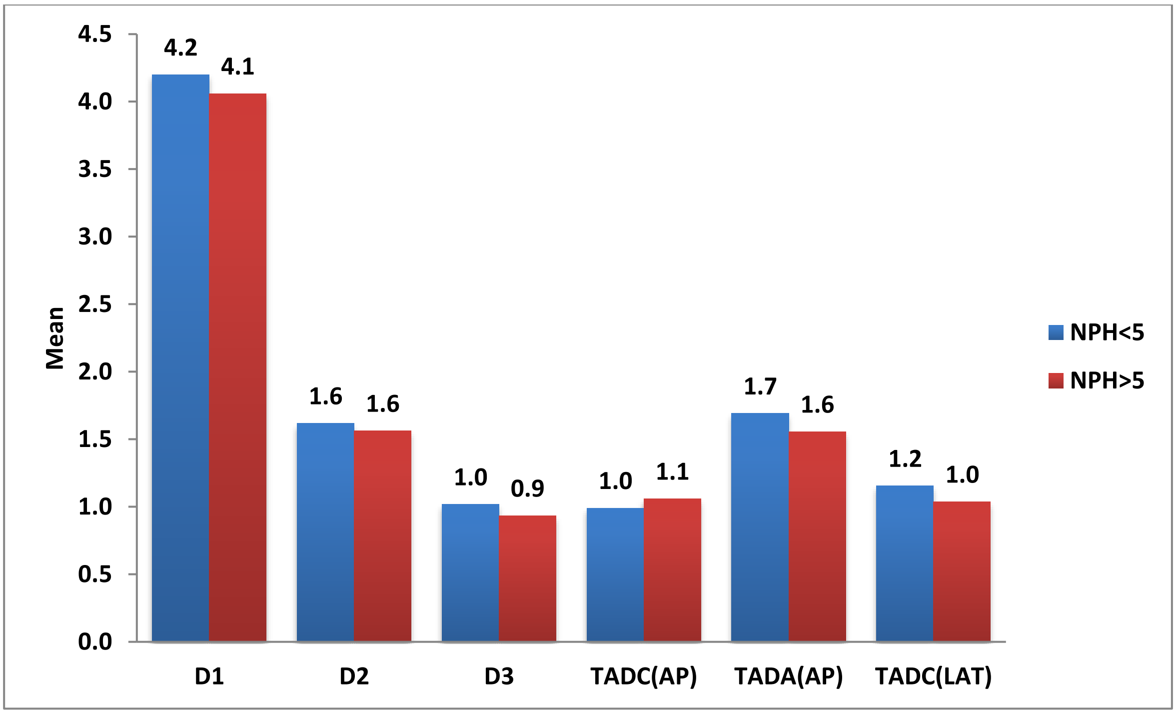

Table No18: Distribution of Age according to NPH categories

Age(yrs)	NPH<5		NPH>5		p value
	N	%	N	%	
40-60	7	63.6%	8	25.0%	0.020*
60-80	4	36.4%	24	75.0%	
Total	11	100.0%	32	100.0%	

Note: * significant at 5% level of significance (p<0.05)

Figure No.40: Distribution of Age according to NPH categories

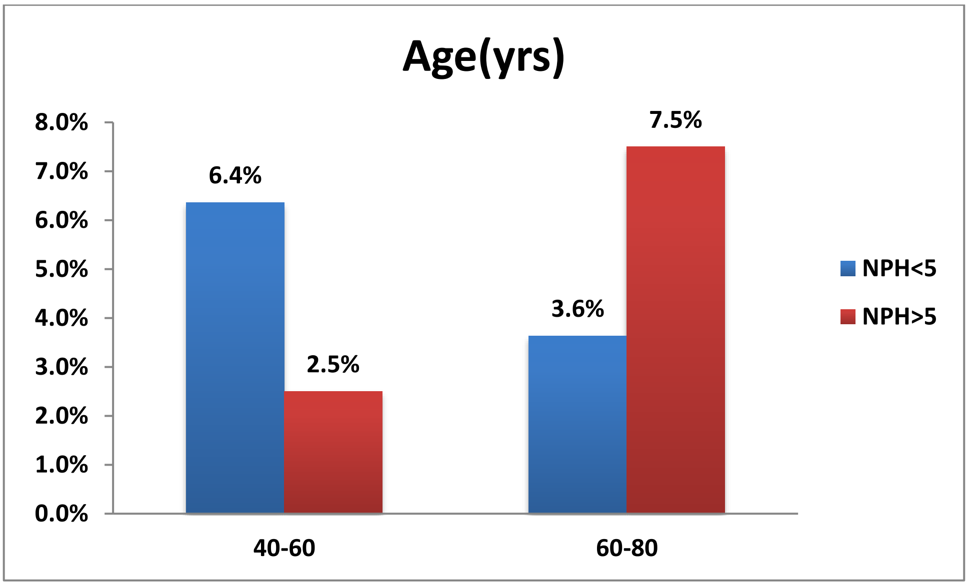

Table No.19: Distribution of Sex according to NPH categories

Sex	NPH<5		NPH>5		p value
	N	%	N	%	
Male	8	72.7%	16	50.0%	0.190
Female	3	27.3%	16	50.0%	
Total	11	100.0%	32	100.0%	

Figure No.41: Distribution of Sex according to NPH categories

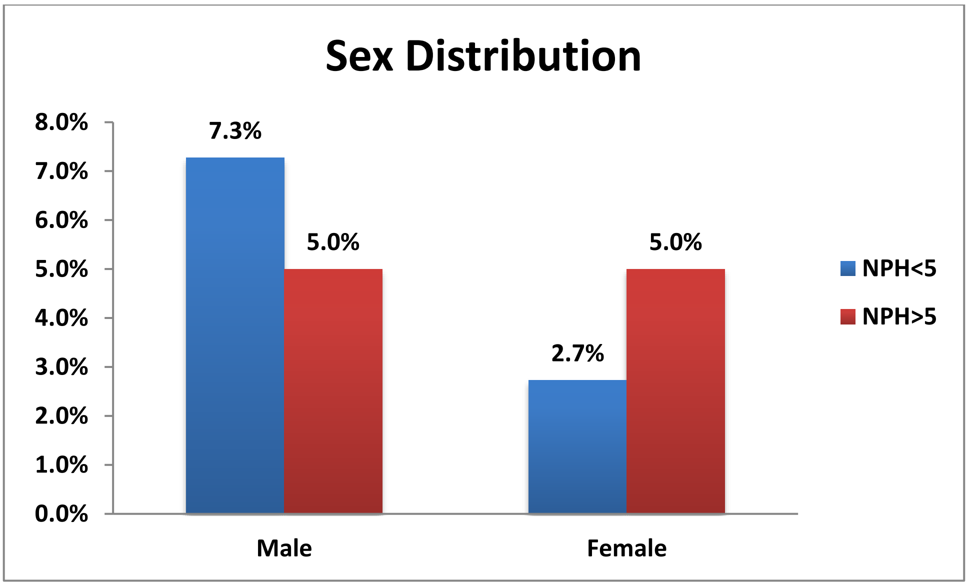

Table No.20: Distribution of Type of fracture according to NPH categories

Type of fracture	NPH<5		NPH>5		p value
	N	%	N	%	
31A1	5	45.5%	10	31.3%	0.424
31A2	3	27.3%	16	50.0%	
31A3	3	27.3%	6	18.8%	
Total	11	100.0%	32	100.0%	

Figure No.42: Distribution of Type of fracture according to NPH categories

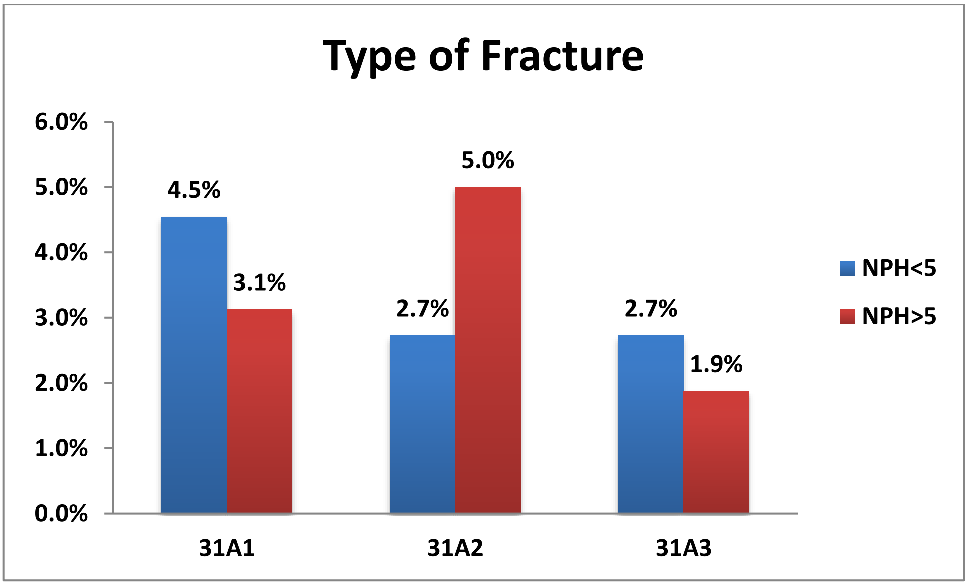

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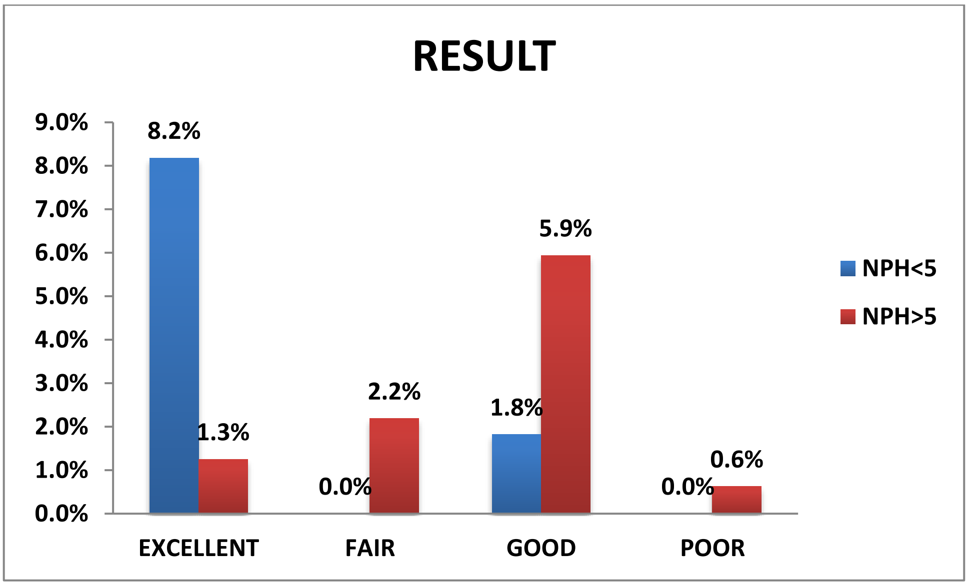
Table No.21: Distribution of Result according to NPH categories

RESULT	NPH<5		NPH>5		p value
	N	%	N	%	
EXCELLENT	9	81.8%	4	12.5%	<0.001*
GOOD	2	18.2%	19	59.4%	
FAIR	0	0.0%	7	21.9%	
POOR	0	0.0%	2	6.3%	
Total	11	100.0%	32	100.0%	

Note: * significant at 5% level of significance (p<0.05)

Figure No.43: Distribution of Result according to NPH categories



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DISCUSSION

The successful treatment of Intertrochanteric fractures depends on many factors like[68]:

- Age of the patient
- Patients general health
- Time from fracture to treatment
- The adequacy of treatment
- Concurrent medical illness
- Stability of the fixation

At present it is generally believed that all Intertrochanteric fractures should be internally fixed to reduce the morbidity and the mortality of the patient. But the appropriate method and the ideal implant by which to fix the Intertrochanteric fracture is still in a debate. Because each method having its own advantages and the disadvantages.

In the present study 43 patients of Intertrochanteric fractures were studied.

In our study the average age was 64 years which was comparable to Indian as well as western authors with similar study.

We had an 24 male patients and 19 female patients, this resembles many Indian studies. The most common mode of injury in our study was road traffic accident which was 65.1%.

In our study 34.9% were stable fracture pattern and 65.1% were unstable.

Osteoporosis was measured by the Singh's index. More osteoporosis was present in the older patient and post-menopausal females. In our study 39.5% had a grade – III osteoporosis whereas grade IV was 44.2%.

The average intra operative blood loss was minimal. The average was 100ml and it was more in patients who required a limited open reduction. Radiation exposure was calculated in seconds, it was 599.11 seconds by the C-arm. Stable fractures

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required less exposure than the unstable fractures. This is far below the toxic levels of the radiation.

The average operating time was 55 mins from the incision to closure.

There was no case of non-union. Infection was present in 9.3% of the patient it was superficial which was treated with antibiotics and dressing in the ward, none required debridement or revision and healed well.

Results were evaluated by modified Harris hip score in our series we had 30.2% excellent, 48.8% good, 16.3 % fair and 4.7% poor results. It was similar to W.M.Gadegone et al[30] & pavelka et al[23] that the use of TFN may have a positive effect on the speed at which walking is restored.

In the series of 295 patients with trochanteric fractures treated with TFN by Domingo et al[63] the average age of the patient was 80 years, which possibly accounted for 27% of the patients developed complications in the immediate postoperative period. The success of Trochanter femoral nail depended on good surgical technique, proper instrumentation and good C-arm visualization. All the patients were operated on fracture table. We found following advantages

- Reduction with traction is easier.
- Less assistance is required.
- Manipulation of the patient is reduced to minimum.
- Trauma to patient is decreased.
- Better use of C-arm with better visibility.

Placement of the patient on the fracture table is important, for better access to the greater trochanter the upper body is abducted away 10-15°. Position of the C-arm should be such that proximal femur is seen properly in AP and lateral view.

The anatomical reduction and secure fixation of the patient on the operating table are absolutely vital for easy handling and good surgical result. If reduction was

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not achieved by traction and manipulation then nail reduction was done, in which nail was introduced in the proximal fragment and reduction was tried by rotational movements and compression by the nail. If still reduction was a problem, then it was achieved by limited open reduction at the fracture site. The entry point of the nail was taken on the tip or the lateral part of the greater trochanter. As the nail has 6° of valgus angle medial entry point cause more distraction of the fracture.

The hip pin is inserted 5mm away from the subchondral bone in the lower half in the AP view and center on the neck in the lateral view. The cervical pin is placed parallel to the hip pin in AP view and overlapping it in the lateral view. It should be 10mm shorter than the hip pin from the subchondral bone. This ensures that the cervical screw will not take the weight load but only fulfill the anti-rotational function. The position of the compression screw and antiroation screw were measured which was comparable to the study of **Amir Herman et.al**[66]. Distal locking was done with the interlocking bolt and both static and dynamic holes were locked in all the nails in our study.

Dynamic hip screw introduced by clawson in 1964 remains the implant of choice due to its favourable results and low rate of complications. It provides control compression at the fracture site. Its use has been supported by its biomechanical properties which have been assumed to improve the healing of the fracture[20].

But Dynamic hip screw requires a relatively larger exposure, more tissue trauma and anatomical reduction. All these increase the morbidity, probability of infection and significant blood loss. It also causes varus collapse leading to shortening and inability of the implant to survive until the fracture union.

The plate and screw device will weaken the bone mechanically. The common causes of fixation failure are instability of the fractures, osteoporosis, lack of

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anatomical reduction, failure of fixation device and incorrect placement of the screw.[69]

We found Trochanteric femoral nail to be more useful in unstable and reverse oblique patterns due to the fact that it has better axial telescoping and rotational stability. It has shown to be more biomechanically stronger because they can withstand higher static and several fold higher cyclical loading than dynamic hip screw. So the fracture heals without the primary restoration of the medial support. The implant compensates for the function of the medial column.[23]

Despite the wide use of trochanteric femoral nail and satisfactory outcomes with low major complication rates, lateral cortex impingement in Indian patients has been reported.

We speculated that the long standing lateral hip pain may be a result of soft tissue irritation caused by nail protrusion over the greater trochanter, which is a cause for the greater trochanter pain syndrome. In this study, protrusions >5 mm occurred in 74.4% of cases; the mean protrusion height was 6.01 mm, and 70% patients had lateral trochanter pain after an average of 15 months followup which is comparable to the study done by **Sun-Jun Hu et. al.**[65] In this study eventhough there is proper placement of the screws in neck as well as head of the femur there is nail protrusion over the greater trochanter which causes pain on abduction in Indian population.

As both the length of the proximal segment and the screw angles were fixed, several factors may have influenced the extent of the nail protrusion such as ethnicity, position of the screws and fracture freduction quality. In our practice, anatomic or slightly valgus reduction is preferred, and both the screws are consistently placed in correct position in both the AP and the lateral view.

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CONCLUSION

Literature suggests that Dynamic hip screw is the Gold standard for treatment of stable type of intertrochanteric fractures as well as unstable types. According to our study and use of Trochanteric femoral nail in Intertrochanteric fractures we can say that:

Trochanteric Femoral Nail can be considered the most judicious and rational method of treating intertrochanteric fractures , especially the unstable type.

The data was assessed, analyzed, evaluated and the following conclusions were made:

- Intertrochanteric fracture of the femur is common in the elderly, due to osteoporosis and in young due to high velocity trauma.
- It can be used in all configurations of proximal femoral fractures.
- It is a closed method thus preserves the fracture hematoma and yields early healing and early union.
- It can be used with good results in all grades of osteoporosis.
- It is a quick procedure with a small incision and with significantly less amount of blood loss.
- Post-operatively early mobilization can be begun as the fixation is rigid and because of the implant design
- With the experience gained from each case the operative time, radiation exposure, blood loss and intraoperative complications can be reduced drastically.
- Also we have observed the nail protrusion height over 5 mm will cause greater trochanteric pain on abduction in indian population.

Thus we can conclude that the TROCHANTERIC FEMORAL NAIL is after proper training and technique a safe and easy implant option for treatment of

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intertrochanteric fractures, but it we recommend a modification to the Trochanteric femoral nail that would further shorten the proximal nail end 5–10 mm for the Indian population, so as to avoid soft tissue irritation on lateral trochanter. A suitable tail cap (0 mm, 5 mm, 10 mm, and 15 mm in height) could be used if the proximal tip of the nail is embedded in the greater trochanter.

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ANNEXURES-I

ETHICAL CERTIFICATE

B.L.D.E.Us, SHRI.B.M.PATIL MEDICAL COLLEGE, VIJAYAPUR – 586103

INSTITUTIONAL ETHICAL COMMITTEE, Date : 13/11/18

1. Name of UG/PG Student/Researcher : Dr. Kulkarni Onkar Sathe
2. Department : of orthopaedics
3. Title : A Prospective study of functional Intertrochanteric fractures
4. Guide/Co-Guide/Principal Researcher : Dr. Ramanagouda. B.B.
5. Date of Admission (PG Only) : 2nd May. 2018

Observation:

OK

I.E.C. Remarks: Ethical clearance accorded/be chairman after corrected revised version is submitted by stipulated time.

1. Any alternation in Synopsis protocol should be intimated to E.C. in writing for review and approval.
2. Any adverse effects to subject of the study should be intimated in writing to E.C.
3. If study is stopped or an included patient is out of study inform E.C. the same with reason.

Signature of the Committee Members:

1. DR RAGHAVENDRA KULKARNI
2. DR TEJASWINI VALLABHA
3. DR.B.R.YELIKAR
4. DR P.B.JAJU
5. DR CHANDRASHEKHAR BHUYYAR
6. DR PRANESH JAHAGIRDAR
7. SHRI.SURESH HAKKI
8. DR G V KUKARNI
9. DR.MOHD SHANNAWAZ
10. DR RAGHAVENDRA RAO

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ANNEXURES-II

INFORMED CONSENT FOR PARTICIPATION IN DISSERTATION/RESEARCH

I, the undersigned,________________ , S/O D/O W/O _________________, aged ____years, ordinarily resident of _____________ do hereby state/declare that **Dr. Kulkarni Onkar Satish** of Shri. B. M. Patil Medical College Hospital and Research Centre has examined me thoroughly on _______________ at _______________ (place) and it has been explained to me in my own language that I am suffering from _________________ disease (condition) and this disease/condition mimic following diseases. Further **Dr. Kulkarni Onkar Satish** informed me that he/she is conducting dissertation/research titled "A Prospective study of functional outcomes and complications of Trochanteric femoral nail used in Intertrochanteric fractures of femur." under the guidance of **Dr. Ramanagouda B.B.** requesting my participation in the study. Apart from routine treatment procedure, the pre-operative, operative, post-operative and follow-up observations will be utilized for the study as reference data.

Doctor has also informed me that during conduct of this procedure like adverse results may be encountered. Among the above complications most of them are treatable but are not anticipated hence there is chance of aggravation of my condition and in rare circumstances it may prove fatal in spite of anticipated diagnosis and best treatment made available. Further Doctor has informed me that my participation in this study help in evaluation of the results of the study which is useful reference to treatment of other similar cases in near future, and also I may be benefited in getting relieved of suffering or cure of the disease I am suffering.

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The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person other than me or my legal hirer except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on information given by me, I can ask any clarification during the course of treatment / study related to diagnosis, procedure of treatment, result of treatment or prognosis. At the same time I have been informed that I can withdraw from my participation in this study at any time if I want or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment, I the undersigned Shri/Smt ______________________________ under my full conscious state of mind agree to participate in the said research/dissertation.

Signature of patient:

Signature of doctor:

Witness: 1.

2.

Date:

Place

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ANNEXURES-III

PROFORMA

CASE NO. :

NAME :

AGE/SEX :

I P NO :

DATE OF ADMISSION :

DATE OF SURGERY :

DATE OF DISCHARGE :

OCCUPATION :

RESIDENCE :

Presenting complaints with duration :

History of presenting complaints :

Family History :

Personal History :

Past History :

General Physical Examination

Pallor: present/absent

Icterus: present/absent

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Clubbing:	present/absent
Generalized lymphadenopathy:	present/absent
Built:	poor/moderate/well
Nourishment:	poor/moderate/well

Vitals

PR: RR:

BP: TEMP:

Other Systemic Examination:

Local examination:

Right/ Left Leg

Gait:

<u>Inspection</u>:

a) Attitude/ deformity

b) Abnormal swelling

- Site
- Size
- Shape
- Extent

c) Shortening

d) Skin

e) Compound injury if any

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Palpation:

a) Local tenderness

b) Bony irregularity

c) Abnormal movement

d) Crepitus

e) Swelling

Movements:		Active	Passive
Hip Joint:	Flexion		
	Extension		
	Abduction		
	Adduction		
	External Rotation		
	Internal Rotation		

TIP- APEX DISTANCE: Tip apex distance of Compression screw and antirotaion screw on AP view and tip apex distance of compression screw.

VISUAL ANALOGUE SCORE

HARRIS HIP SCORE

DISTANCES OF NECK OF FEMUR

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KEY TO MASTER CHART

1. Name :
2. IP. No : Hospital number of the patients
3. Sex : Sex of the patient
4. D.O.S: Date of surgery
5. MOI : Mode of the injury

a. Domestic fall =D

b. Road traffic accidents =R

c. Other =O

6. SI : Singh's Index Grade I,II,III ,IV, V and VI
7. Side : Side of the injury Lt = Left , Rt = Right
8. Type of # : Type of fracture according to the AO Classification

a. A1=31A1.

b. A2=31A2.

c. A3=31A3.

9. Ass Med problems : Associated medical problems.

a. DM : Diabetes Mellitus.

b. HTN : Hypertension.

10. Ass injuries : Associated injuries.

a. D R # : Distal end radius fracture.

b. Humerus # : Humerus fracture.

11. BL : Blood Loss occurred during surgery , according to number of mops used

    1 mop= 50ml blood loss, 2 mops =100ml blood loss and 3 mops = 150 ml

12. RD : Radiaton by C-Arm at 63 gy rads in seconds
13. Imm Compl: Immediate complication

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a. OR : Open reduction

b. Jamm: Jamming.

c. VA : Varus angulation.

d. DL : Failure to insert distal screw

14. D Compl : Delayed complication.

a. SI : Superficial infection.

b. BS : Bed sore.

c. IF : Implant failure.

d. GTS : Greater trochanter splintering.

e. Short : Shortening

f. MU : Malunion

15. HS : Duration of the hospital stay in days.

16. Result: Result according to Kyle's Criteria.

a. Excellent : E.

b. Good : G.

c. Fair : F.

d. Poor : P

17. NPH : Nail Protrusion Height

18. Measurements in the neck:

a) D1 : Width of neck of femur at concavoconvex intersection
b) D2 : Distance from inferior border of neck of femur to midpoint of compression screw over D1
c) D3 : Distance from superior border of neck of femur to antirotation screw over D1

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19. Tip apex distance

    a) TADC(AP) : Tip apex distance of compression screw in AP view

    b) TADC(LAT) : Tip apex distance of compression screw in Lateral view

    c) TADA(AP) : Tip apex distance of antirotation screw in AP view

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MASTER CHART

Sl No.	Name	IP No.	Age	Sex	D/O/S	MOI	SI	SIDE	Type of #	Med Problems	Ass Injuries	ImmComp.	D compl	HHS	NPH	RESULT		D2	D3	TADC(AP)	TADA(AP)	TADC(LAT)
1	NOORBA	30313	80	F	09-06-2018	D	IV	L	31A1	HTN	NIL	NIL	NIL	85	5.3	GOOD	30	13	7	10	12	11
2	MASHYATRI	33357	70	F	10-08-2018	D	IV	R	31A2	NIL	NIL	NIL	NIL	83	6.2	GOOD	41	17	8	13	18	12
3	BABU SAHEB	34429	60	M	10-11-2018	R	III	L	31A3	DM	NIL	NIL	NIL	89	5.7	GOOD	37	15	9	12	21	12
4	HANUMANTH	35674	70	M	26/10/2018	R	IV	L	31A1	NIL	NIL	NIL	NIL	78	11.6	FAIR	39	14	7	12	11	10
5	SHIVALINGAPPA	36401	48	M	11-01-2018	R	III	L	31A1	NIL	NIL	NIL	NIL	95	3.6	EXCELLENT	51	24	12	11	27	15
6	SHAKUNTALA	37294	80	F	13/11/2018	R	IV	L	31A2	DM	NIL	NIL	NIL	84	10.8	GOOD	42	21	9	12	17	10
7	NIJALINGAWWA	42304	52	F	17/12/2018	R	III	R	31A3	NIL	NIL	S	S	93	5.3	EXCELLENT	34	15	9	5	9	12
8	AYUB	43568	72	F	19/1/2019	D	IV	R	31A2	HTN	NIL	NIL	NIL	87	5.2	GOOD	38	15	7	11	25	10
9	SUNIL	28471	70	M	22/1/2019	D	II	L	31A1	NIL	NIL	NIL	NIL	77	6.4	FAIR	40	16	8	10	15	11
10	GANGAMMA PATIL	11008	85	F	25/3/2019	R	III	L	31A2	DM	NIL	SI	VM	65	6.8	POOR	34	13	6	8	11	12
11	MAHADEVAPPA	32827	70	M	29/3/2019	R	II	L	31A1	NIL	NIL	NIL	NIL	92	0.6	EXCELLENT	37	14	8	9	13	13
12	NAGAPPA	9841	68	M	04-02-2019	D	III	R	31A2	NIL	NIL	NIL	NIL	86	10.4	GOOD	45	14	13	13	12	11
13	SANGAPPA	35075	65	M	20/4/2019	D	IV	R	31A2	HTN	DR#	S	NIL	84	3.7	GOOD	41	16	9	13	15	11
14	SUTEWWA	11672	80	F	23/4/2019	R	IV	LEFT	31A2	NIL	NIL	NIL	NIL	85	10.5	GOOD	45	14	8	11	14	8
15	SANJU	29405	43	F	24/4/2019	R	III	R	31A2	NIL	NIL	NIL	NIL	97	4.5	EXCELLENT	45	17	10	11	19	9
16	GOPAL	13957	45	M	05-09-2019	R	IV	R	31A1	DM	NIL	NIL	NIL	85	5.3	GOOD	44	18	15	12	17	10
17	KANTAMMA	13715	70	F	05-10-2019	D	III	L	31A3	NIL	NIL	NIL	NIL	75	5.5	FAIR	38	17	10	9	18	9
18	SHARANAPPA	44080	48	M	15/5/2019	R	II	R	31A1	NIL	NIL	S	NIL	83	4.5	GOOD	42	14	11	9	14	10
19	SARASWATHI	14819	70	F	17/5/2019	R	III	R	31A2	HTN	NIL	NIL	NIL	92	5.8	EXCELLENT	40	13	9	11	16	8
20	MALAPPA	21682	56	M	06-12-2019	R	III	R	31A2	NIL	NIL	NIL	NIL	87	4.3	GOOD	48	17	9	13	22	10
21	LAXMAN	19472	75	M	25/6/2019	D	IV	R	31A1	NIL	NIL	SI	Z	79	8.5	FAIR	44	14	8	10	15	12
22	APPASAHEB	22101	52	M	19/7/2019	R	III	R	31A3	NIL	NIL	NIL	NIL	96	1.4	EXCELLENT	39	13	8	8	14	13
23	MALLANGOUDA	22856	83	M	20/7/2019	R	IV	L	31A3	NIL	NIL	NIL	NIL	86	13.5	GOOD	47	14	8	9	17	9
24	TUNGAMASU	25607	60	M	08-09-2019	R	IV	R	31A2	NIL	NIL	NIL	S	84	5.4	GOOD	50	19	11	13	20	9
25	SANGANAGOUDA	25821	70	M	13/08/2019	R	III	L	31A3	NIL	DR#	NIL	NIL	83	0.8	GOOD	44	16	10	11	16	12
26	GOURAMMA	26889	63	F	20/08/2019	L	III	L	31A2	NIL	NIL	NIL	NIL	87	7.5	GOOD	42	14	19	10	14	11
27	ARJUN	27213	65	M	22/8/2019	D	II	L	31A3	DM	NIL	S	NIL	92	5.8	EXCELLENT	38	15	10	7	13	11
28	SRINIVAS	29396	35	M	13/9/2019	R	IV	L	31A2	NIL	NIL	NIL	NIL	95	1.7	EXCELLENT	42	16	14	13	19	10
29	SHANTABAI	30560	70	F	16/9/2019	R	IV	R	31A3	DM/HTN	NIL	NIL	S	88	12.5	GOOD	34	12	10	6	12	9
30	NIJALINGAPPA	33578	70	M	14/10/2019	R	IV	L	31A2	NIL	NIL	NIL	NIL	86	5.8	GOOD	45	13	9	12	19	10
31	BADDU	34633	80	M	19/10/2019	D	IV	R	31A1	DM	NIL	SI	NIL	75	7.1	FAIR	42	22	5	12	25	12
32	BASAMMA	34362	60	F	23/10/2019	R	IV	L	31A2	NIL	DR#	NIL	NIL	83	7.8	GOOD	32	15	5	11	7	9
33	SATAWWA	33594	75	F	24/10/2019	D	III	R	31A1	HTN	NIL	NIL	NIL	94	3.8	EXCELLENT	41	18	8	9	15	11
34	SHANTABAI	43322	60	F	11-05-2019	R	III	R	31A3	HTN	NIL	SI	NIL	91	3.1	EXCELLENT	39	17	9	8	16	12
35	GOURAMMA	41117	70	F	11-08-2019	D	III	R	31A1	NIL	NIL	NIL	NIL	85	4.8	GOOD	48	14	10	11	23	9
36	NIRGAYYA	38834	78	M	23/11/2019	D	II	L	31A2	NIL	NIL	NIL	S	64	10.4	POOR	41	16	12	10	13	10
37	SURESH	38885	45	M	23/11/2019	R	II	R	31A1	NIL	DR#	NIL	NIL	92	2.4	EXCELLENT	40	15	13	8	15	10
38	AMBAVA	37140	55	F	01-08-2020	R	IV	L	31A1	NIL	NIL	NIL	VM	77	10.5	FAIR	39	20	9	7	17	11
39	SANGAMMA	30784	60	F	13/1/2020	D	III	R	31A2	DM	NIL	NIL	NIL	84	5.5	GOOD	47	18	11	13	15	10
40	JAGADEV	26490	75	M	20/2/2020	R	III	R	31A1	NIL	NIL	NIL	NIL	93	3.9	EXCELLENT	38	17	8	11	14	9
41	RAHUTTAPPA	43037	68	M	27/1/2020	R	II	R	31A2	HTN	NIL	NIL	NIL	95	3.3	EXCELLENT	42	14	9	12	18	12
42	KRISHNAPYARI	11463	65	F	20/4/2020	R	IV	R	31A2	NIL	NIL	NIL	NIL	87	5.4	GOOD	37	15	11	13	8	9
43	YAMANAPPA	23189	80	M	20/4/2020	R	IV	R	31A1	HTN	NIL	NIL	NIL	76	5.8	FAIR	39	14	10	9	13	15