A PROSPECTIVE STUDYOF FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURES TREATED WITH TROCHANTERIC FEMORAL NAIL.

By

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Dissertation submitted to

In partial fulfillment for the degree of

MASTER OF SURGERY

IN

ORTHOPAEDICS

Under the guidance of

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DR. RAJENDRA GIRADDI

LIST OF ABBREVIATION

(In alphabetical order)

#	:	Fracture
&	:	And
ANT	:	Anterior
AP	:	Antero Posterior
AO	:	Arbeisgemeinschaft Fur Osteosynthesefragen
ASIF	:	Association For The Study Of Internal Fixation
DEG	:	Degree
DHS	:	Dynamic Hip Screw
DIAM	:	Diameter
FIG	:	Figure
GTS	:	Greater Trochanter Splintering
IT	:	Intertrochanteric
LAT	:	Lateral
MED	:	Medial
OA	:	Osteoarthritis
OTA	:	OrthopaedicTrouma Association
PFN	:	Proximal Femoral Nail
POST	:	Posterior
TAD	:	Tip Apex Distance
TBPP	:	Trochanteric Buttress Plate
TFN	:	Trochanteric Femoral Nail

ABSTRACT

As age increases, fall becomes more often so as intertrochanteric fracture of femur. These intertrochanteric fractures leads to high rates of morbidity and mortality as they need prolonged immobilization, but recent advances in modalities of internal fixation have improved results[4].Because of early mobilisation. The Trochanteric Femoral Nail(TFN) is found effective and suitable in Indian population as it is smaller in size. Here is an effort to study the results of Trochanteric Femoral Nail in the management of intertrochanteric fractures by analyzing the factors which influence the postoperative mobility.

Materials and methods : Study was done in 30 patients with intertrochanteric fractures treated with trochanteric femoral nail.Patients were followed up at 6 wks, 3months,and 6 months. The intraoperative blood loss, duration of surgery, intra operative complications, post operative complication,duration of hospital stay were studied. functional outcome was assessed based on Kyle'scriteria.

Results: In our series of 30 cases there were 22 male and 8 female, maximum age of 90 yrs and minimum age of 20 yrs, most of the patients were between 60 to 70 yrs. Mean age of 58 yrs. 63.3% of cases were admitted due to Domestic fall and 36.7% due to road traffic accidents with common predominance of both sides.AO Type 31A2 fracture accounted for 40 % of cases. Mean duration of hospital stay is 14 days and mean time of full weight bearing is 6 wks. Good to excellent results are seen in 81% cases, Fair in 16%, 3% case with poor results according to kyle'.s criteria.

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

Key words : TFN, Intertrochanteric fractures, functional out come

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INTRODUCTION

As age increases, fall becomes more often so asintertrochanteric fracture of femur. The increased prevalence of osteoporosis increases intertrochanteric fractures(1). Trivial fall accounts for90% of intertrochanteric fractures in elderly due to osteoporotic bone[2,3]. But in young individuals high energy trauma such as motor vehicle accident or fall from height.[3]

Theseintertrochanteric fractures leads to high rates of morbidity and mortality as they need prolonged immobilization, but recent advances in modalities of internal fixation have improved results[4].

The primary goal of treatment is early mobilization, which can be achieved by good reduction and internal fixation .

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

Now fourth generation of intramedullary nails like proximal femoral nails gained popularity.[5]

Proximal femur nail were not found to be very effective in Indianpopulation as there is anthropometric variationof proximal femur which may lead to an increased difficulty in placement of femoral neck screws. The Trochanteric Femoral Nail(TFN) is found effective and suitable in Indian population as itis smaller in size thanProximal Femoral Nail (PFN).[6]

Here is an effort to study the results of Trochanteric Femoral Nail in the management of intertrochanteric fractures by analyzing the factors which influence the postoperative mobility.

OBJECTIVE OF THE STUDY

To clinically evaluate the functional outcome and associated complications of intertrochanteric fracture treated with Trochanteric Femoral Nail.

REVIEW OF LITERATURE

HISTORICAL REVIEW:

Sushrutha the store house of Aryan surgery in 5th century A.D., divided fractures into 12 types and dislocations into 6 types. He has also described the clinical features of fractures. He treated fractures and dislocations with a special splint made of bamboo which was subsequently adopted by the British Army as the “patient ratton cane” splint.

Egyptians also practiced Orthopaedics and have recorded the use of crutches. An Egyptian demonstrated his wisdom in treating a case ofspinal fracture and his treatment is not so different from some recent methods.

Greece then replaced Egypt as a centre of culture as well as medical development.The basis for the scientific study and practice of medicine arises from “Corpus Hippocraticum” the remarkable systematic treatise of medicine and surgery written elaborately lengthily by physician of Alexandrian school between 4th century B.C. and 1st century A.D. and ascribed to Hippocratis. This book is quite modern and includes use of traction manipulation and splints.

The great French surgeon “Ambrose Pare” first described the fracture at the upper end of femur in 1564.

Sir Astley Cooper (1768-1841), the outstanding English surgeon published his book on management of fractures and dislocations (1825). He classified the fractures at the upper end of femur into:

1. Intracapsular fractures
2. Extracapsularfractures
3. Fractures through greater trochanter.

This classification is still valid. He also recognized the difference in prognosis ofintracapsular andextracapsular fractures of proximal femur.

In 1852 AntoniousMathijsen (1803-1875) introduced theplaster ofparis bandage. This was the most importantdevelopment in the management of fractures.

Hugh Owen Thomas (1834-1891) who belongs to an English family of bonesetters, became the foremost British Orthopaedician of the 19th century. He developed the Thomas splint (1876) which is useful even today. He was a firm advocate of the principle of continuous immobilization in the management of fractures.

In 1860 Buck introduced adhesive plaster traction in the treatment of fractures.

In 1895 Roentgen discovered X-rays, An event which has resulted in great advances in diagnosing and treatment of fractures.

In 1895 Kocher classified fractures of the proximalfemur an improvement over Cooper's classification.

In 1902, **Whitman observed** restoration of near normalanatomy of hip in proximal femur fracture by traction,abduction,and internal rotation and stabilization with implants.[7]

The "Balkon frame" devised by the Dutch during theBalkon wars in 1903 proved of the great value in the treatmentof fractures by suspension and traction.

In 1909 Steinmann introduced skeleton traction with the Steinmann pin and Kwire which form the part of conservative management in fractures of proximal femurtreatment.

The internal fixation of fractures with metal plates and screws was reported by Sir Arbuthnol laneof London in 1894 and by Albinlambotteof Belgium.

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.

Inthe1930s,lag screw type of devices are introduced by**Henry,Littman, Henderson**, andothersinsteadofnails.[8,9,10]

In1937,ThonrtonPlate anside plate bolted to the Smith-Petersen nail was introduced by **LawsonThornton**.[11]

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.MervynEvans classified Trochanteric fractures as stable and unstable.

In 1949,BoydandGriffin introduced Trochanteric buttress plate with Neufeld platefor unstable fracturestopreventmedicalization.

In 1950,intertrochanteric fractures management were begins with external fixation, but it became failure due to increased rate of pin-tractinfection, pin loosening, instability, and failure.[12,13,14]

In 1955 SchumpelickW.Jantzenpublished 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.

In1996,AO/ASIF Developedanewdevice**ProximalFemoralNail**whichhasbeen usefull in early mobilization and treatment of unstable intertrochantericfemoral fractures.[15]

In 2000,Gottfrieddevelopedthe **Percutaneous Compression Plate (PCCP) system**,to provide rotational stability to the intertrochanteric fractures fixation, and it minimises the damage to the greatertrochanter(lateral wall ofthefemur).[16]

The**Proximal FemoralNailAntirotation(PFNA) system** wasdeveloped bythe AO/ASIFin2004.Themaindesigncharacteristicofthe implantistheuseofa single bladewith a largesurfacearea. Insertionofthebladecompactsthecancellousbone. These characteristicsprovideoptimalanchoringandstability whentheimplant isinsertedintoosteoporoticbone.[17]

In **June 2004,** the **Short Proximal Femoral Nail** was introduced in India by**GadegoneWM**and**SalphaleYS.**

In**April2010,GadegoneWM,SalphaleYS**concludedafterreviewingoutcomesof 100 Asianpatients who underwent short proximal femoral nailing for stable and unstableintertrochantericfractures.Theyconcludedthat TrochantericNailisa superiorimplantforstableandunstableintertrochanteric fracturesintermsof operating time, surgical exposure, blood loss, and complications, especially forpatientswithrelativelysmallfemur.[18]

ThePFNhasa proximaldiameterof15 cm,expandedtogive additionalstrength.The proximal2 screws areof6.4mmand8mm.Bothscrewsare selftappingandpartiallythreadedtoallowforslidingcompression.Thedistalscrews areof 4.9mmfullythreadedselftappinglockingbolt. The nailhas6 degreesvalgus bendproximally.Itisavailableinshortandlongversionsfrom240to420mmin length.Itisavailablein10to12mmofdistal diameter andneckshaftangleof125 to135deg.

The advantagesof proximal femoral nail over the sliding hip screw[19].

a) AnProximal femoral nail provides more efficient loadtransfer.
b) AnProximal femoral nail have shorter lever arm which decreases tensile strain on the implant so decreasing the risk of implant failure.
c) Because anProximal 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.

G. S. Kulkarniet al[20] reviewed the current concepts of treatment of Intertrochanteric fractures. They concluded that unstable Intertrochanteric fractures can be helped bymedullary 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[21] reviewed 191 patients 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[22]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[23]performed a randomised clinical trial comparing the Dynamic hip screw and Proximal femoral nail in patients with pertrochanteric fractures emphasizing functional outcomes and rehabilitation. At four months review patients treated with proximal femoral nail regained their pre-injury walking ability, Shortening ofthe both femoral neck and shaft was seen in patients treated with Dynamic hip screw, this difference was statistically significant.

Klinger H. M. et al[24] have donea study on Dynamic hip screw and trochanteric buttress plate Vs proximal femoral nail in management of 173 unstableintertrochanteric 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 proximalfemoral 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[25] reviewed 83 patients 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 thatwith 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[26] reviewed 79 patients with ipsilateral fractures of the hip and femoral shaft treated with a long proximal femoral nail. In follow up for at least 12months 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 nailis a high quality implant that increases our options of treatment of all the reconstructionnails.

W.M. Gadegone and Y.S. Salphale[27] in 2006 carried out a study on 100consecutive patients who had suffered an Intertrochanteric or high subtrochantericfractures treated with Proximal femoral nail. Complications occurred in 12 patients. They concluded that Osteosynthesis with the Proximal femoral nail offers the advantage of highrotational stability of the head-neck fragment.

Ramesh Krishna.K[28] 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 thatin 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.[29]

EgolKA,ChangEY,CvitkovicJ,KummerFJ,KovalKJ(2004)[30]didastudyonth emismatchofcurrentintramedullarynailswiththeanteriorbowofthefemur.Theyinferredth at the implant which are developed according to western population were oversize, had theIntra-operativecomplicationssuchas splinteringandfractures.

The available length of proximal femoralnail in India isof240-250 mm.In an average Indian subject.Itpassesthrough the middiaphysis of the femora andoccasionallyabutsagainstthebowedfemora.Thismay causestheintra-operativefemoralshaftfracturesandthighpain,due toimplanttouchestheanteriorcortexofthefemur.

The fixation of intramedullary nail is affected by theanteriorcurvatureofthefemur.

If there is significant difference in the nail and the anterior femoral curvatureleads tocorticalpenetrationor fractureangulation.[31]

The proximal diameter of the gammanailandproximalfemoralnail is 15mm,whichis toolargeforaverageIndianfemora,which maygive rise to wideningofthe trochanterandfractures. In Chinese population a study has done with the modification inthegammanailbyreducingits diameter andlength.[32]

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 postoperative period.

TROCHANTERIC FEMORAL NAIL (TFN)

The TFNhasthefollowingmodificationsfortheIndianpopulation.It ishavingasmallerproximaldiameterof14mm.Theproximal2screwsareof6.4mm and 8mm. The distalbolts are of 4.9mm bolts. The nailhas 6 degrees valgus bend proximally.It is availablein length180mmstandard .Availablein 10,11 and12mmofdistaldiametersandneckshaftangleof130 and135deg.

Theadvantagesofthe TFN as an intramedullarydevice

a) Due to its location inintramedullaryfixationprovidesmoreefficientloadtransferthandoesa slidinghipscrew.

b) It decreases the tensile strength due to its shorter leverarm,thusdecreasingtheriskofimplantfailure.

c) Becauseanintramedullaryfixationdeviceincorporatesaslidinghipscrew,the advantageofcontrolledfractureimpactionismaintained.

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 intramedullaryhipscrewrequiresshorter time.It requireslesssoft tissuedissectionthanaslidinghipscrew,Sodecreasingtheoverallmorbidity.

Inadditionithasseveralother favourable characteristics

1. Thepresenceoftwoproximalscrewsprovidesbetterrotationalcontrolof proximalfracturefragment.
2. Itallowslengthandrotationalcontrolevenwhenthelessertrochanterisnotintact.
3. Itcanbedynamicallylocked.

ThemainadvantagesofTFNoveritsprecursorgammanailareSincethe2proximalscrewsaresmallerindiameter,itisnotnecessaryforthenailto be stoutunlikegammanailandhencetheoreticallyinduceslesscomminutionof proximalsegmentandlessdisruptionofabductorinsertion.

GadegoneWM, SalphaleYS(April 2010)[33]reviewed outcomes of 100 Asian patientswhounderwentTrochanteric Nailingfor stableandunstable 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 forpatientswithrelativelysmallfemora.

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

A study was done by Mandal S, Kundu S, HyamA ,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% patientsHarris hip score was>70 within 10 wks. In 60% cases shows excellent alignment. The complications like neck-screw cut out, and varusmalunion 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.

Intheir Study they concluded that,unstable intertrochanteric fractures treated with TFN has more advantages than the extramedullary implants in terms of biological and biomechanical point of view. It isaminimally invasive intramedullary device and there clinical results were excellent as compared to techniques like gamma-nail and PFN, with less complications.[34]

In Asian population further studies have to conducttoconfirmtheefficacyoftheTrochanteric femoral nail.

SURGICAL ANATOMY[35,36,37,38]

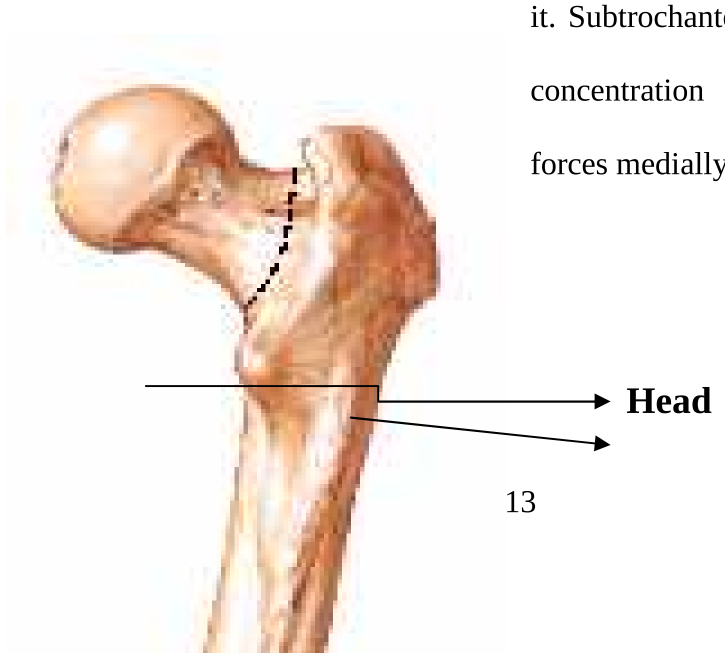
Thehipjointisa**multiaxialsynovialjoint**ofthe**ballandsocketvariety**, formed by the femoral head & the acetabulum.

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.

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 posteriorplane& 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 *Calcarfemorale*, 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 subtrochantericregion, 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.



Greater Trochanter

Neck

Intertrochanteric crest

Lesser trochanter

Fig 1 Ant view anatomy of proximal femur

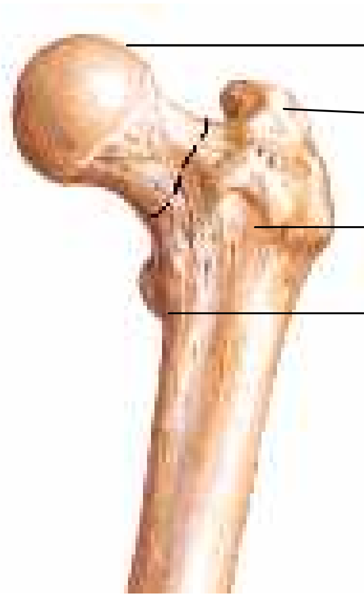


Fig 2 Post view anatomy of proximal femur

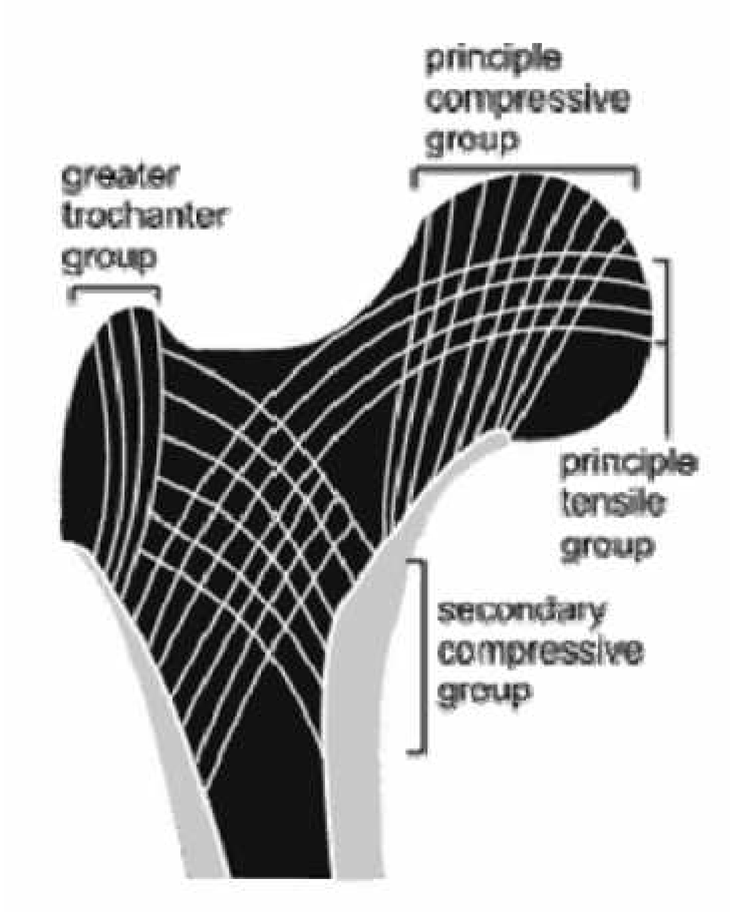


Fig: 3 Trabecular pattern

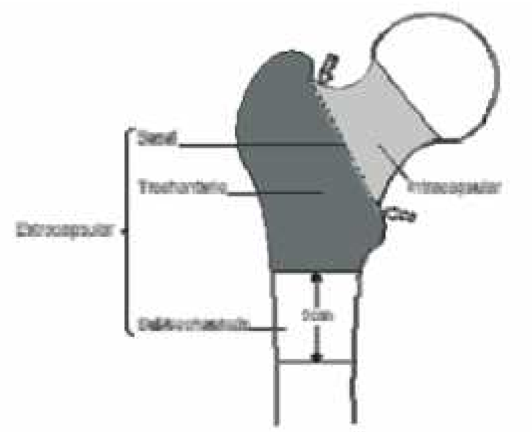


Fig: 4 Regions of the proximal femur

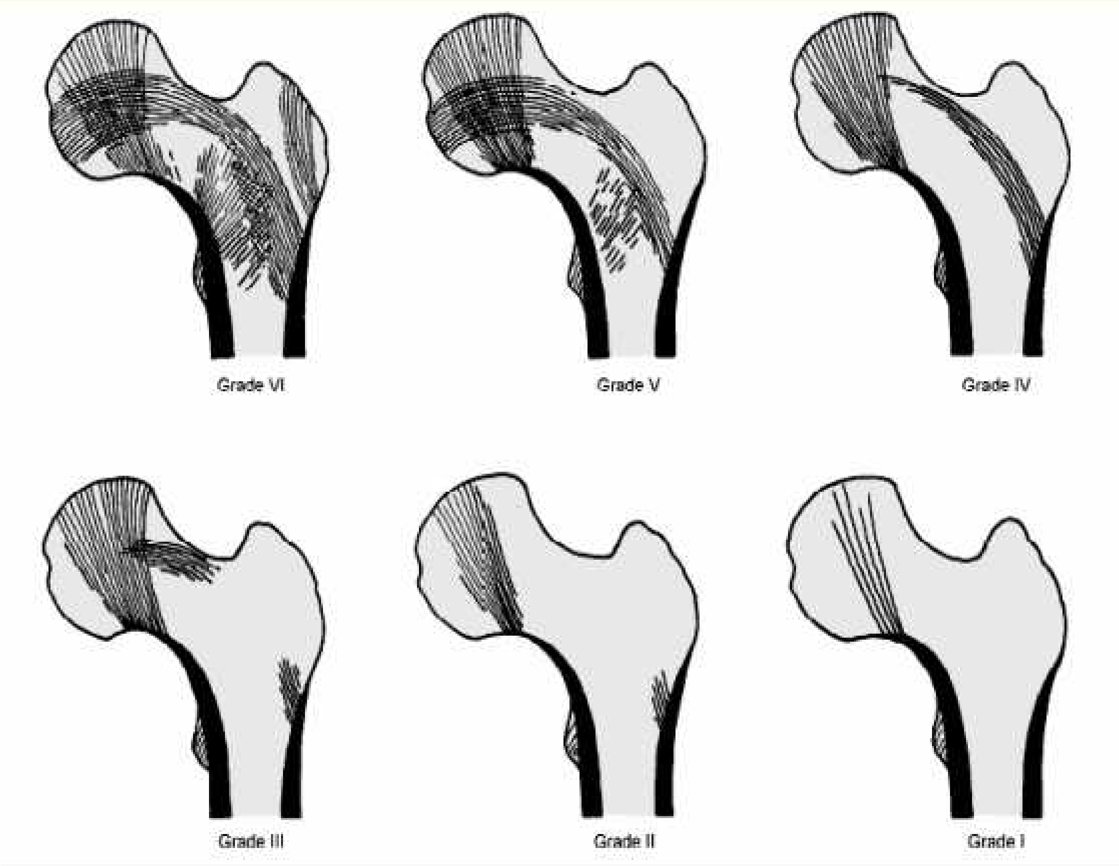


Fig: 5 showing the Singh &Maini index with Gr.1 Representing severe osteoporosis &Gr.6 normal bone.

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*&*gluteusminimus*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 iliotibial band. The gleuti control the pelvic tilt in the frontal plane.

Hip joint and Muscles around hip

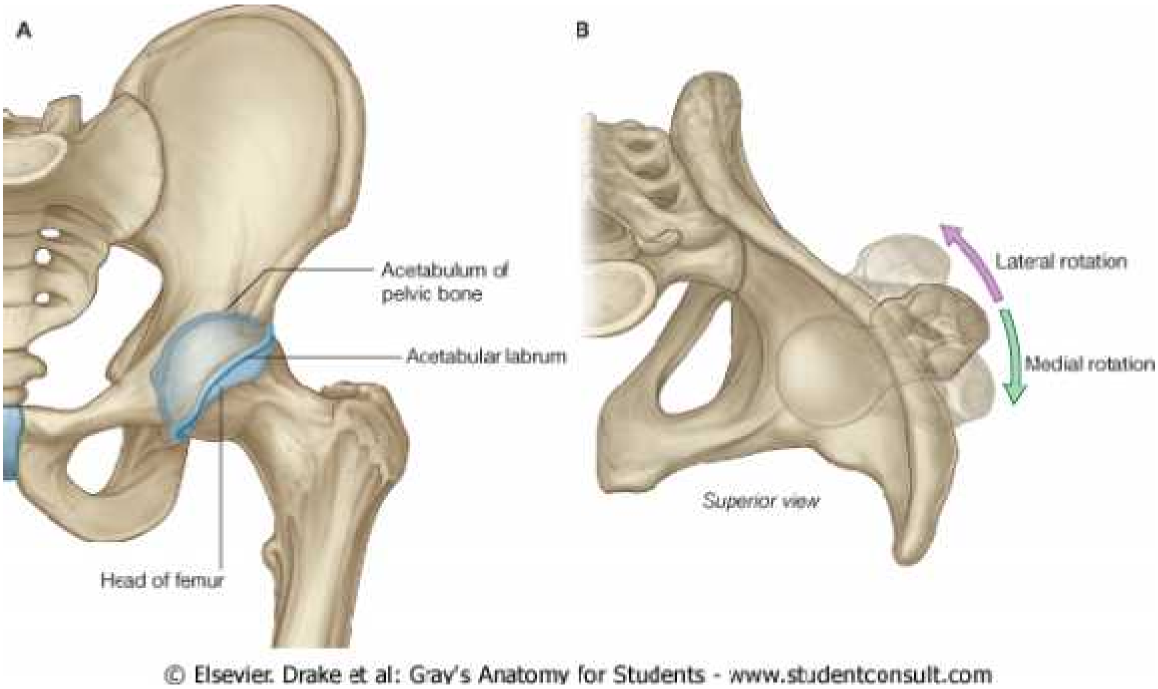


Fig 6

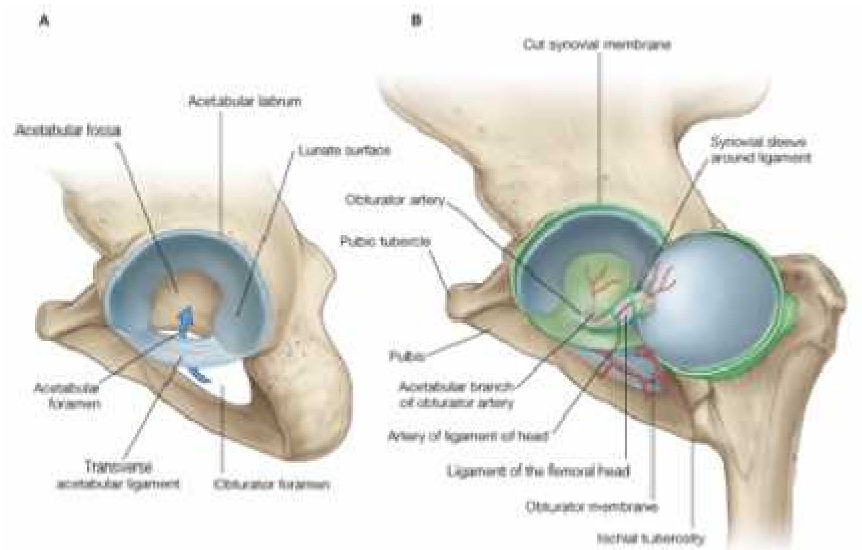


Fig 7

Hip joint and muscles around hip

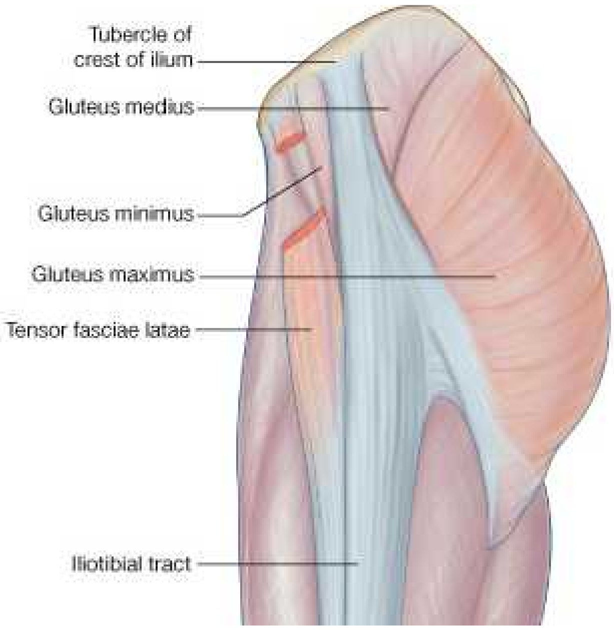


Fig 8 muscles in lateral aspect

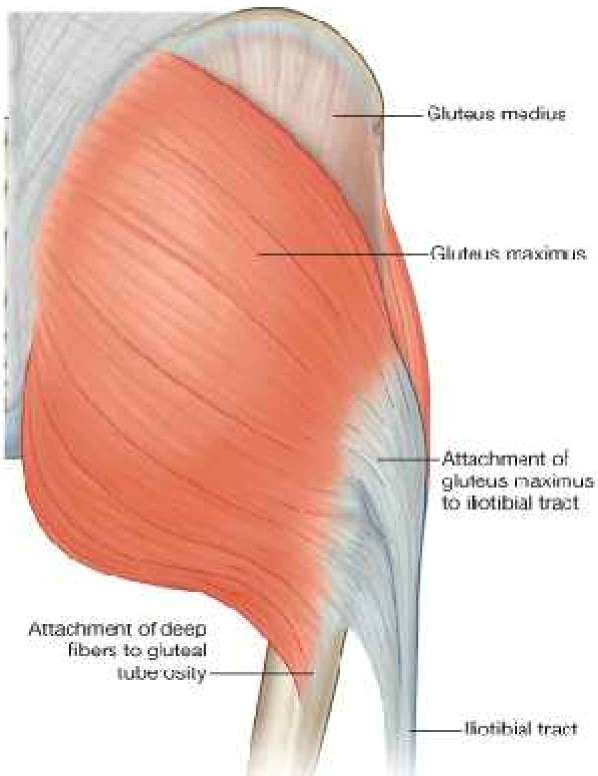


Fig 9 Muscles in Post aspect of hip

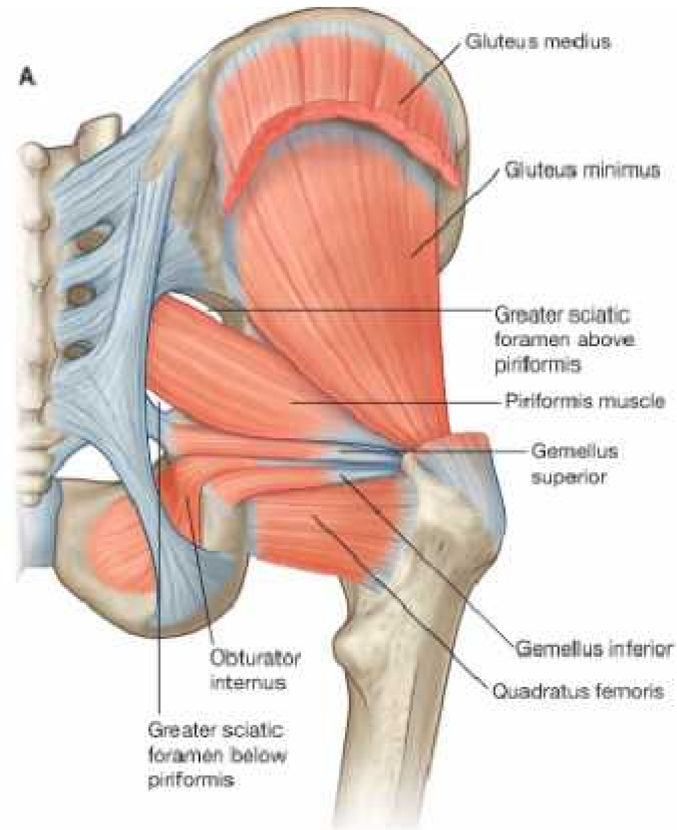


Fig 10Hip joint and muscles around hip

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, obturatorinternus, obturatorexternus, superior &inferior gemili*&*quadrates femoris.* They insert along the posterior aspect along the intertrochanteric crest.

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 OFPROXIMAL 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 ligamentumteres branch from acetabular artery).
5. First perforating branch of profundafemoris artery.
6. Second and third perforating branch of profundafemoris 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 ofligamentumteres or foveolar artery) to the head through ligament to teres. Its supply decreases to head from children to adult. Femoral circumflex arteries 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 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 dividedinto :

- Ascending branch
- Metaphyseal branch
- Epiphyseal branch

Lateral epiphyseal arteries supply 2/3rd of femoral head in adult. In subcapital 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.

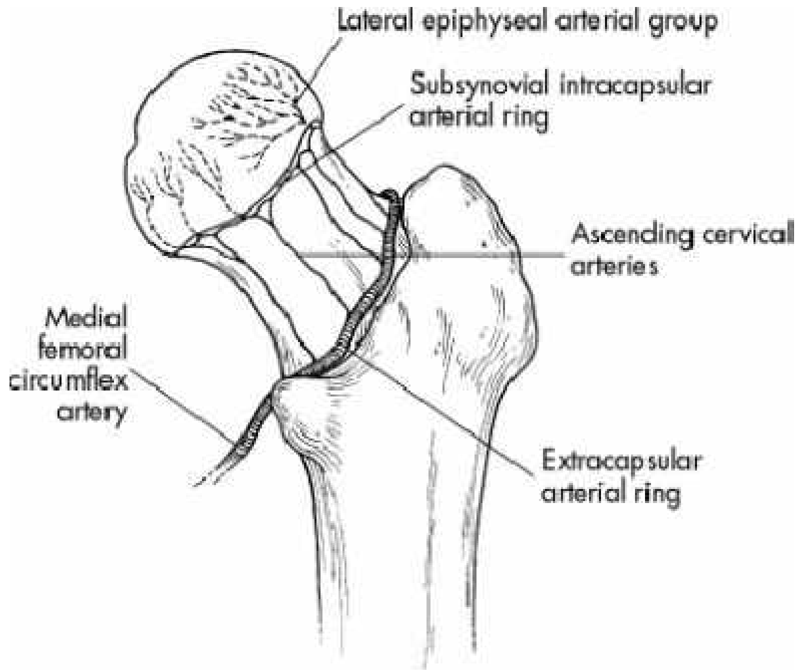


Fig: 11. Vascular supply of the proximal femur

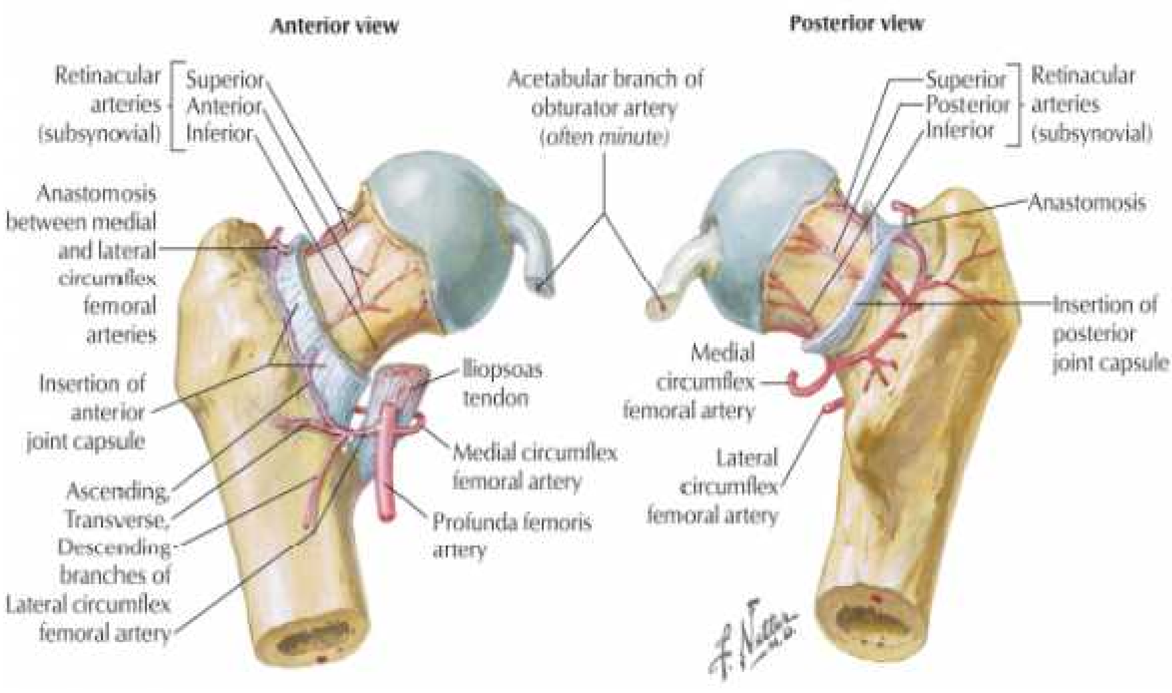


Fig 12. Vascular supply of Proximal femur

VENOUS OUTFLOW:

Capsular veins course inferomedially along trochanteric line, then towardsobturator 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 oflineaaspera.

BLOOD SUPPLY TO HIP JOINT

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

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 ligamentumteres, a branch from posterior division of obturator nerve which supplies to obturatorexternus 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.

BIOMECHANICS OF THE HIP JOINT[39,40]

The hip joint is a ball and socket joint. Duringweightbearing the forces aretransmitted 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, stressfractures 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 iliopsoas 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 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 rises the stresses at the hip joint significantly.

It has been shown that in males an average hip joint reaction force is 4 times of bodyweight 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 where as standing the hip and knee flexed 90 degree increased the force to rear body weight across the flexed hip. Running increases the force to 5times 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.

PATHOMECHANICS OF INJURY

CAUSATIVE MECHANISM OF INTERTROCHANTERIC FRACTURES

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

The suggested two mechanisms of injury are[36]:

1. A blow to the trochanter region due tofall
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.

Mechanismofbonefailure[41,42]

Astructurewillfailifitsuffersanoverloadsituation.Anoverloadsituationwilloccur ifthesystemisunabletoabsorbtheenergythatisappliedtoit.Inthehipjointarea, this overload situation can occur as aresult of number of independent but often interrelatedfactors,thefollowingbeingimportant.

1. Falling
2. Impairmentofenergyabsorbingmechanics
3. Boneweakness.

Falling

The body possesses of considerable amount of potential energyin the standing position.Infalling,thepotentialenergychangesto kineticenergy,whichuponimpact withthefloormustbeabsorbedbythestructuresofthebodyifafractureisnotto occur.Thereissufficientpotentialenergyinthestandingbodywhich,ifunabsorbed at fallingcouldbreakanyboneinthebody.Inanaveragesizedwoman,the amountof potentialenergytobeobservedina fallwouldbeapproximately4000kg/cmandthe 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 mechanismsmustoperate.

Impairmentofenergyabsorbingmechanisms

Theprincipaldissipationofenergyis performedbyactivemusclecontraction.This dissipation requires time and in the event of high speed trauma, there is nota sufficientperiodformuscularcontractionto absorbenergybeforeoverloadingof the bonehasoccurredandleadstofailure.Intheelderly,theneuromuscular responsemaybeslower,andthustheenergyabsorptionmaynotberapidenoughto preventa fracture.In theelderly,thenormalprotectivemusclecontractionintheeventof slip ratherthanfall,mayleadtoanun-inhibited musclecontractionaroundthehipand produce aforce asgreat as600kg/cm tofracturetheneck ofthefemur withoutimplicatinganyotherfactor.

Boneweakness

Inosteoporosisorosteomalacia, bone weakens toabout¼ofthenormal healthyyoungboneandhasalowerenergyabsorbingcapacityleadingtofailure. Falling,impairment ofenergyabsorbing mechanisms andboneweakness, allmaycontribute fracturesofthetrochanter. It ismostlyduetofailureofthebonetowithstandsuddenbendingortwistingforces actingonitwhenthepatientisabouttofallfromstandingposition,impairmentof energyabsorbingmechanismsparticularlyintheelderlyandinboneweakness,and moresoinfemalesleadingtothefracturesofthetrochanter.

AccordingtoHORNANDWANG[43]the failureof the stressresistormechanismto operate eitherbecause ofmuscleweakness ordelayed reaction time,especiallyinosteoporotic bones,maybeanetiologicalfactorinthecausationofintertrochantericfractures.

FRACTURE ANATOMY

The fracture pattern is influenced by the muscles, which are attached to thevarious 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 externalrotation of the distal fragment but not of the proximal fragment & also due to gravity.

Forward angulation occurs in the sagittal planedue 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 corticalcontact without a gap posteriorly& medially. This contact will prevent further 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 tobe repaired thus the development of the trochanteric plate to buttress the lateral wall[44].

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 anintramedullary nail[45,46].

INTERTROCHANTERICFRACTURE WITHSUB-TROCHANTERICEXTENSION :

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.

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[47]**(**1949)

2. BOHLER'S CLASSIFICATION (1936)

3. BOYD & GRIFFIN CLASSIFICATION[48](1949)

4. KYLE & GUSTILO CLASSIFICATION[49]**(**1979)

5. TRONZO CLASSIFICATION(1973)[50]

6. J.C.SCOTT'S CLASSIFICATION[51]

7. MURRAY AND FREW (1949)[52]

8. **JENSEN & MICHAELSON CLASSIFICATION**[53]**(**1975)

9. HAFNER'S CLASSIFICATION[54]

10. W.K. MASSIE'S CLASSIFICATION[55](1963)

11. A.O. & O.T.A. (MULLER) CLASSIFICATION[36,56](1990)

1. EVAN'S CLASSIFICATION (Fig. 13)

Evansin 1949, made an important step in understanding the stability of theintertrochanteric 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 reverse oblique fracture is inherently unstable because of the tendency of the shaft to displace medially.

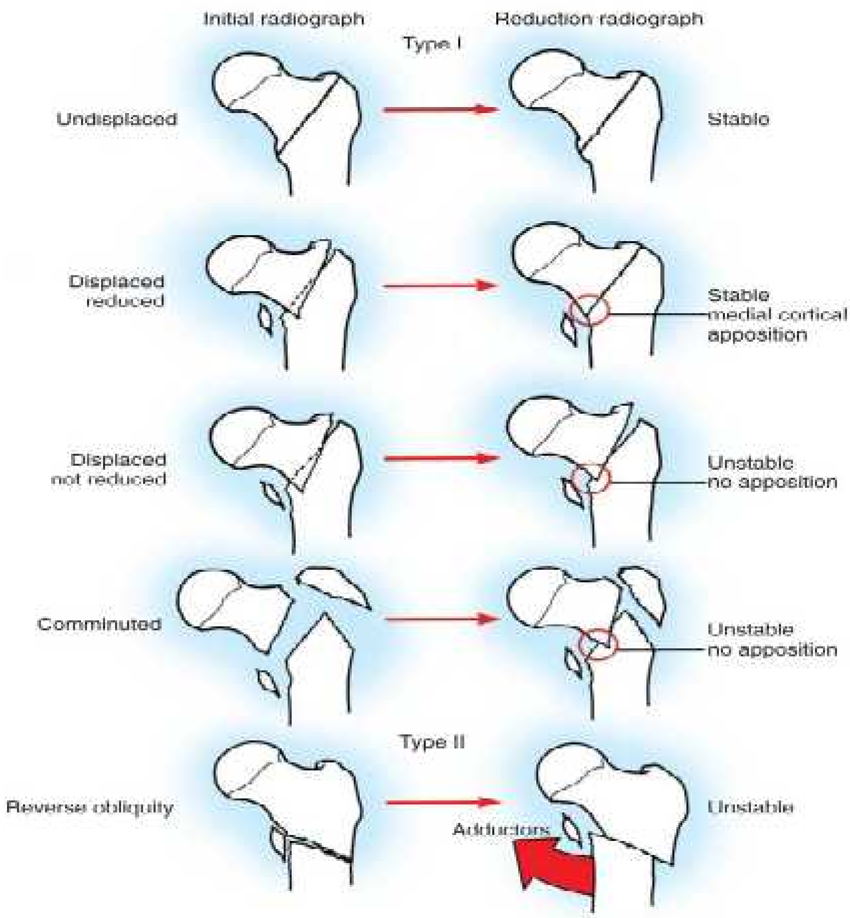


Fig. 13. Evan's Classification

2. BOHLER'S CLASSIFICATION: (1936)

TYPE I:

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

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 atleast 14 weeks. In type IVtraction is applied along the long axis of the body because abduction produces coxavalga.

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

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

TYPE I:

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

TYPE II:

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

TYPE III:

Fractures that are basically subtrochanteric, with atleast one fracture line passing acrossthe 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 twoplanes.

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 maintainreduction& are associated with more complications.

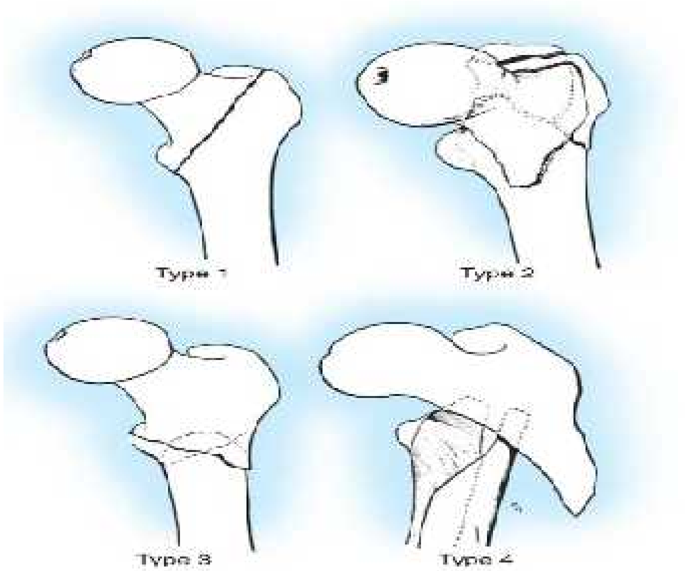


Fig. 14. Boyd and Griffin Classification

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.

TYPE III:

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

TYPE IV:

Comminuted unstable fracture with disengagement of the two main fragments, these areunstable withthe posterior wall exploded, but the spike of the neck fragment is displacedoutside 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

Uncomminutedbitrochanteric fractures with or without displacement with an intactposterior wall and a relatively small lesser trochanteric fragment.

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

Comminutedtrochanteric fractures with disengagement 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 nodisplacement.

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 onthe presence of the medial comminution.

TYPE I:

Stable, that is no medial comminution.

TYPE II:

Unstable, that is displaced lesser trochanter or larger femoral-arch fragment.This classification emphasizes the importance of the calcarfemorale 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.

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 extremelycomprehensive & complete. Each region of the skeleton is assigned an alpha- numerical.

Value& is further classified into a type & a sub group. Schatzker[51] has noted an inter- & intra- observer concordance of close to100% 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- Pertrochantericmultifragmentary
- 31-A3- Intertrochanteric

Each group is then further classified into three subgroups:

- 31-A-1

31-A1.1-Along intertrochanteric line

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

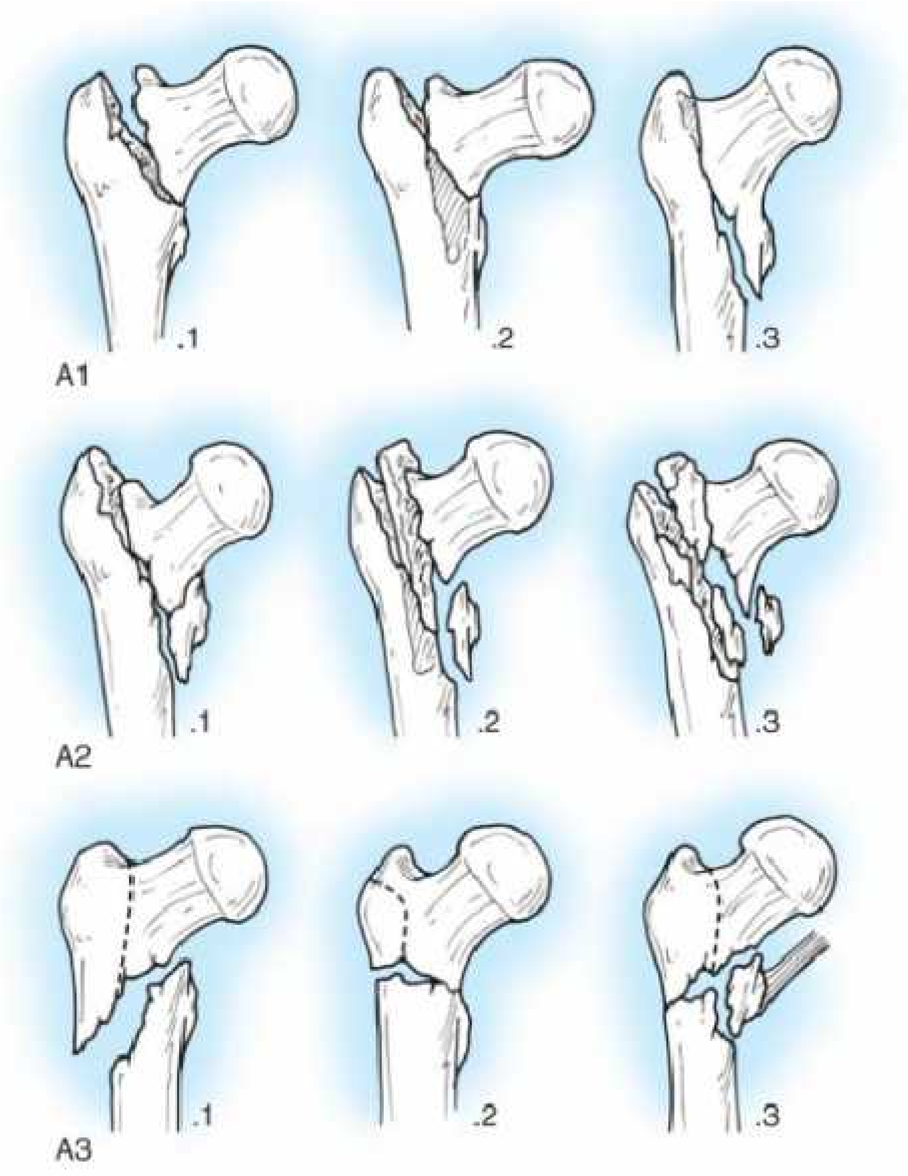


Fig 15 .AO Classification of Intertrochanteric fractures

MANAGEMENT

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.

CLINICALFEATURES:

1. Thelimbisusuallymarkedly shortenedwithexternalrotationdeformity.The externalrotationisusuallygreaterthanthatseeninpatientswithintracapsularfracturesof theneckoffemur,lateralborderofthefoottouchingthebed.
2. There may be swelling in the hip region, and ecchymosis over the greater trochantermaybeseenlater.
3. Tendernessovergreatertrochanter
4. Broadeningandirregularityofgreatertrochanter
5. Supratrochantericshortening

INVESTIGATION

1. Standardradiographicexamination
   a. Antero posterior viewofthepelvis with both hip joints
   b. Crosstablelateralviewoftheinvolvedproximalfemur

Anteroposteriorviewisusefultoknowthefracturepatternandextent,qualityofthebone,an dallowscomparisonwiththecontralateralsidetoidentifyundisplacedandimpactedfracture. APviewin10-15degofinternalrotationwillgivethetrueviewof theproximalfemur.Inseverecomminutedfractures,x raystakenwithtractionhelpinunderstandingthefracturegeometrybetter.

APviewofthecontralateralsidehelpsinmeasurementofneckshaftangleandfor preoperativeplanning.

Thelateralviewhelpstoassesssize,locationandcomminutionofposteriorfragment andhelpstodeterminethefracturestability.

2)M.R.I.andbonescansareusefull inthediagnosisofoccultfractures.

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[57]:

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 uptothe base of the toes with a wooden bar attached to the heel to prevent lateralrotation. After clinical and radiological union of fracture (10-12 wks), it isremoved 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 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. Coxavara 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[58, 59]:

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. Mostintertrochanteric fractures are four part injuries, with secondary comminution of greater and lesser trochanters. The presence of the large 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. Successfulreduction 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 protrusionthrough 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.

Reconstitutionof the medial buttress of unstable fractures by inter fragmentary compression screws 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 youngpatients 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
- 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
- Bipolar prosthesis
- Total hip replacement

NAIL PLATE DEVICES:

The fixed angle nail plate device was first developed byThorton 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 occurredwith 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 reangulation 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 thanscrews. 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 later prevents the head penetration. Dynamic hip screw has been shown to be superior to nail plate. Screw threads ofthe nail enhance the purchase in the osteoporotic bone and the groove in the barrel plate prevents rotation. Jamming, bending orfailure 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 postoperative mobility.
- Less residual pain.
- Decreases the reoperative 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 fractures.
- Delay weight bearing.

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.

- "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 inintertrochanteric 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[60,61,62].

IMPLANT DESIGN

Main implants used in the treatment of intertrochanteric fractures are:

1. Dynamic hip screw (extramedullary devices)

2. Proximal Femoral Nail (intramedullary devices)

The dimensions of the Dynamic hip screw are :

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

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 – 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 : 125,130 & 135 degrees.

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

• Diameter : Proximal – 14mm

Distal – 10, 11 & 12 mm

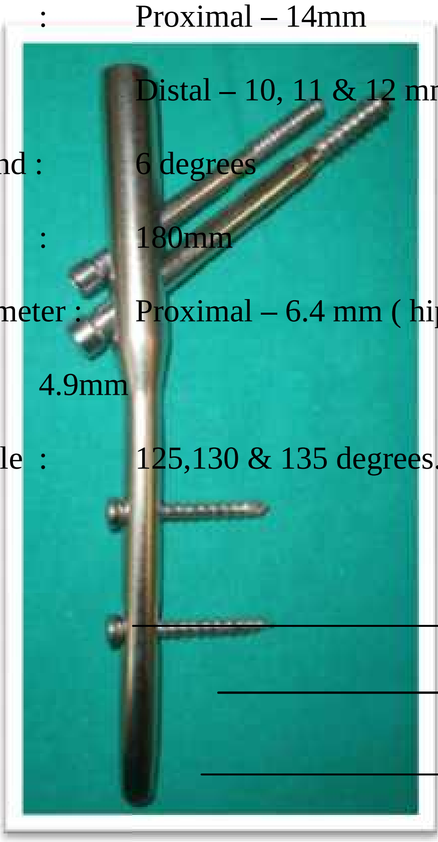
• Valgus bend : 6 degrees

• Length : 180mm

• Screw diameter : Proximal – 6.4 mm (hip pin) & 8mm(neck screw)

Distal – 4.9mm

• Screw angle : 125,130 & 135 degrees.



BIOMECHANICAL ADVANTAGE OF THE INTRA MEDULLARYDEVICE

Lindsey[63], 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 thefracture 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 theproximal fragment
5. To provide bone graft from the reamed products

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[64]in his extensive study of the biomechanical principles of the sliding hipScrew has identified key factors that promote sliding, A reduction in the bending forces isVital 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[64] 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 isbecause 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. Moreinline with the screw less bending forces act across the screw so relatively less.

Force is required to initiate sliding resulting in more impaction [60,62]. Valgus hips are However more prone to develop early O. A.

SLIDING LENGTH

Gundle[65]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[66] 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.

SCREW POSITION

The ideal position of the screw in the head is a debatable issue[61]. 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[67] 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 notedthat not a single case screw cut out occurred if the T.A.D was maintained less than 25mmas compared to a historical control rate of 8 %.

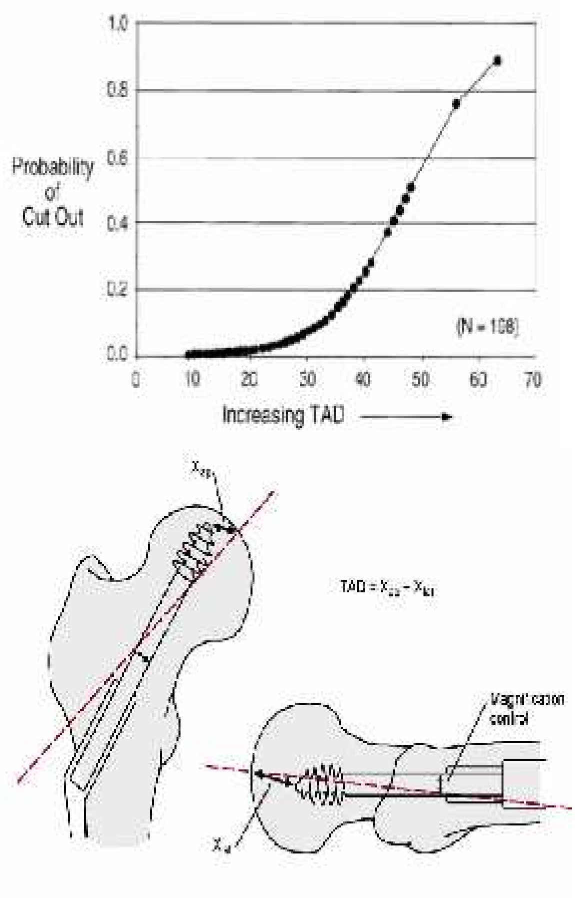


Fig: 17 Tip Apex Distance

JAMMING OF THE SCREW

Kyle in his study[64]noted that jamming of the screw within the barrel will occur if the bending forces exceed the compressive forces & the screw will impact against thebarrel. 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 fixedangle device.

STRAIN PATTERN

Rosenblum[60]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 hipscrew.
- 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 moreresilient to bending forces preventing compression at the fracture site.
- The increased stiffness of the implant would transmit more force to the tip of thenail 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.

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

1. Proximal diameter of 14mm.
2. Entry pointis through GT and not pyriformisfossa (more valgus).
3. Smaller diameter tip causing less stress concentration and less chance offracture.
4. Hip screw and Antirotation screw provide good compression at fracture site withadequate bone stock for revision.

Inadditionithasseveralother favourable characteristics

1. Thepresenceoftwoproximalscrewsprovidesbetterrotationalcontrolof proximalfracturefragment.
2. Itallowslengthandrotationalcontrolevenwhenthelessertrochanterisnotintact
3. Itcanbedynamicallylocked.

ThemainadvantagesofTFNoveritsprecursorgammanailareSince the 2 proximal screws are smaller in diameter ,itisnotnecessaryforthenailto be stoutunlikegammanailandhencetheoretically induceslesscomminutionof proximalsegmentandlessdisruptionofabductorinsertion.

MATERIAL AND METHODS

The material for the present study was obtained from the patients admitted in ____ Department of Orthopaedics with diagnosis of Intertrochanteric fracture from Oct 2015 to march 2017.

A minimum of 30 cases were taken and the patients were informed about the study in allrespects 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 who has been diagnosed as having intertrochanteric fractures.
2. Patients more than 18 years of age.
3. Patient who are fit for surgical intervention.

Exclusion criteria:

1. Patient below 18 years of age.
2. Patients with subtrochanteric extension.
3. Patients with compound fractures.
4. Patients with pathological fractures.
5. Patients unfit for surgery.

Patients admitted with Intertrochanteric fracture were examined and investigatedwith X-ray pelvis with both hips AP and Lateral view (whenever possible). Skin tractionwas 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 advicedby 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 Kyle’s criteria at the follow-ups.Proformaspecially 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.

PREOPERATIVEPREPARATION

- Thepatientsweretakenupforsurgeryafterobtainingwrittenandinformedrisk consentofthenatureandcomplicationsofthesurgery.Theoperativesite(lateral aspectofthethigh)was shavedandpreparedwithbetadinescrub,adaypriortothe surgery.
- Xylocainetestdose&tetanustoxoidinjectionsweregivenpreoperatively.
- All patientswere started on antibiotics prophylactically. A third generation CephalosporinwasadministeredviaIVroutepriorto inductionofanaesthesia,and continuedat12hourlyintervalsfor3-5days,andswitchedovertooralformtillthe 12^{th}daypost-operatively,i.e.untilsutureremoval**.**

PREOPERATIVEPLANNING

1. **Assessmentofneckshaftangle:**Neckshaftanglewasmeasuredonthe unaffectedsideonanAPx-rayusingagoniometer**.**
2. **Assessmentofnaildiameter:**Naildiameterwasdeterminedbymeasuring diameteroftheproximalfemuronanAPx-ray.
3. **Determinationofproximalscrewsizes:** Approximatesizesofthecompressionandantirotationscrewsweremeasuredintheh eadneckregion.A 15mmsmaller screwthancompressionscrewwaschosenfortheAntirotationscrewtopreventZ-Effect.
4. **Lengthofthenail:**AShortTFNnail180mmwasusedinallourcases.

IMPLANTDETAILS

A short trochanteric femoral nail (Fig.30) has alength of 180 mm andproximal diameterof14mm.Thenarrowproximaldiameterenableseasyinsertionandreduces theriskoffemoralfracture.Distally,itisavailablein10,11and12mmdiameters.

Thenailhasa6ºmedio-lateral

angleforeasyinsertionandaflexibledistaltiptoavoidstressgenerationandrefracture.Thisnailisavailableinfemoralneckanglesof130and135degrees.Ithasa 8mmcompressionscrewanda 6.4mm antirotation/stabilizing screwproximal toit.Distally,

Ithas4.9mmbothstaticanddynamiclockingbolts.Thenailhasalongitudinalslotthroughout, soastoaccelerateregeneration of theendostealbone. The nailis made up of 316L stainless steel.

Fig18: INSTRUMENTS AND IMPLANT SET

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:

Fig no 19 Patient positioning

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.

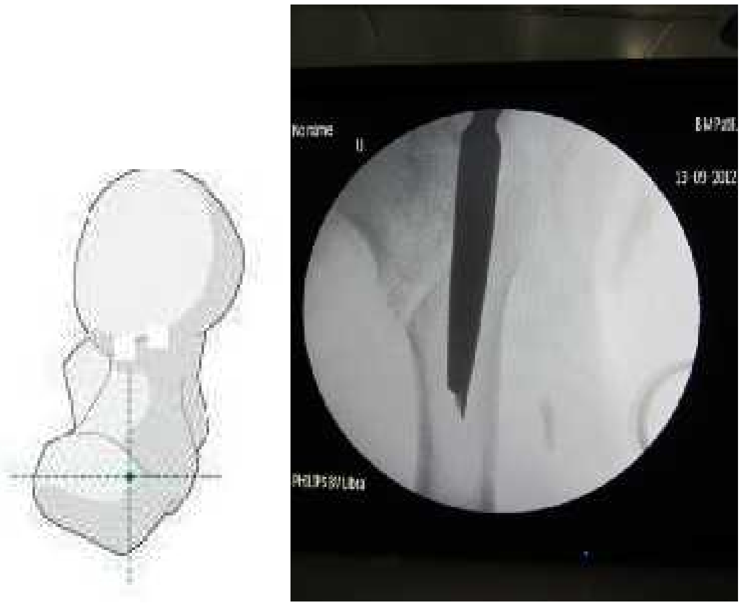


Fig no 20 entry point and confirmation by C-Arm

2. Guide wire insertion

Guide wire: 2.8mm guide wire is inserted in to the femoral shaft and across the fracture site in 6º of valgus. Its position is checked in the C-arm and the entry is widened with the awl.

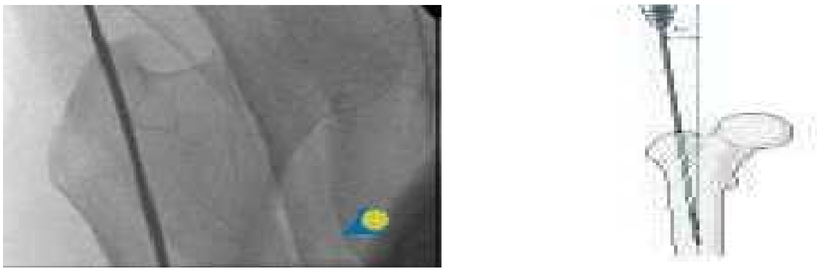


Fig no 21 Guide wire insertion

3. Reaming of the proximal femur

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

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 22 Nail insertion with Zig attached

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.

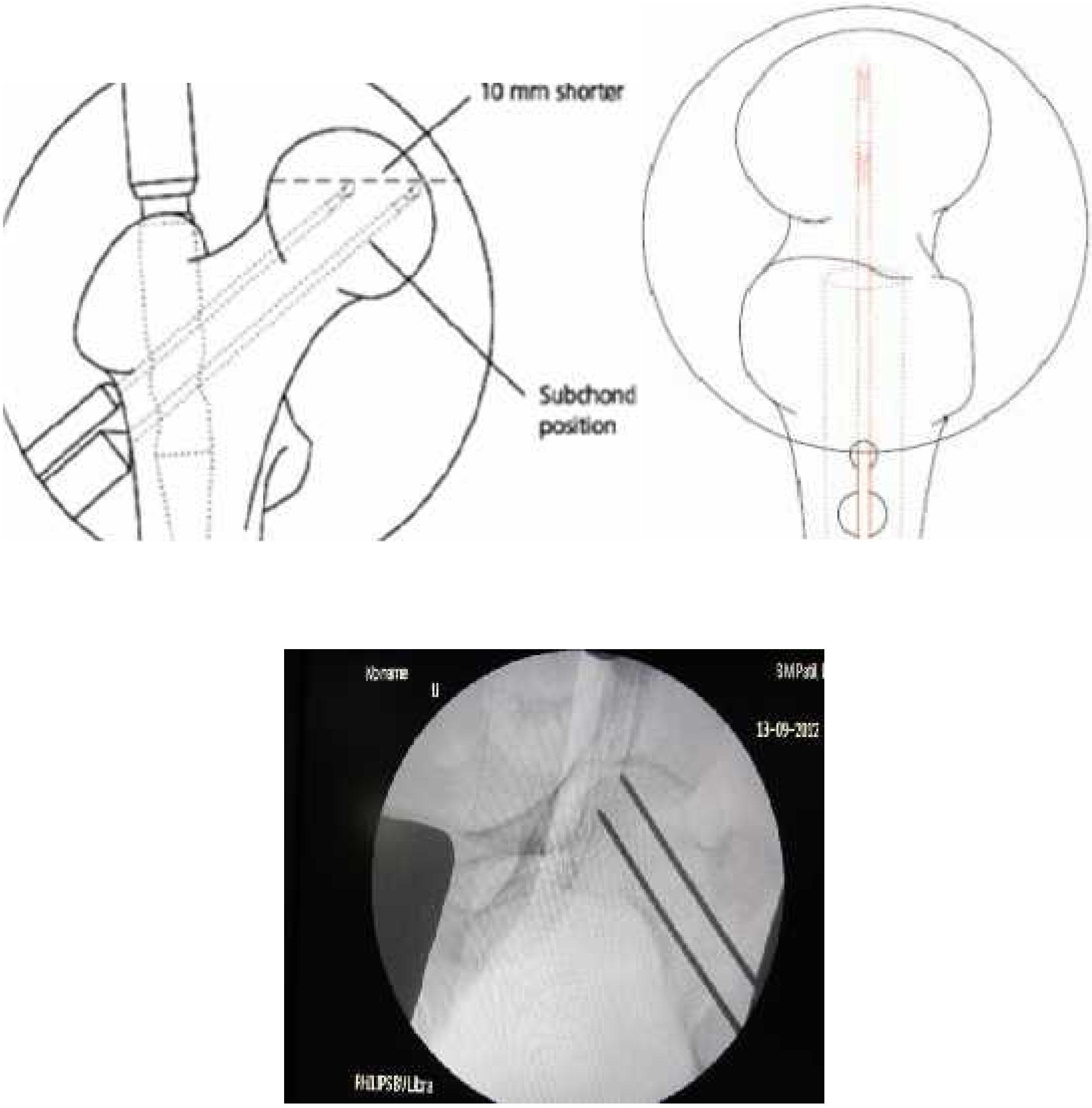


Fig no 23 Placing guide wire pins and confirmation under C-Arm

6. Inserting the screws after the final setting

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

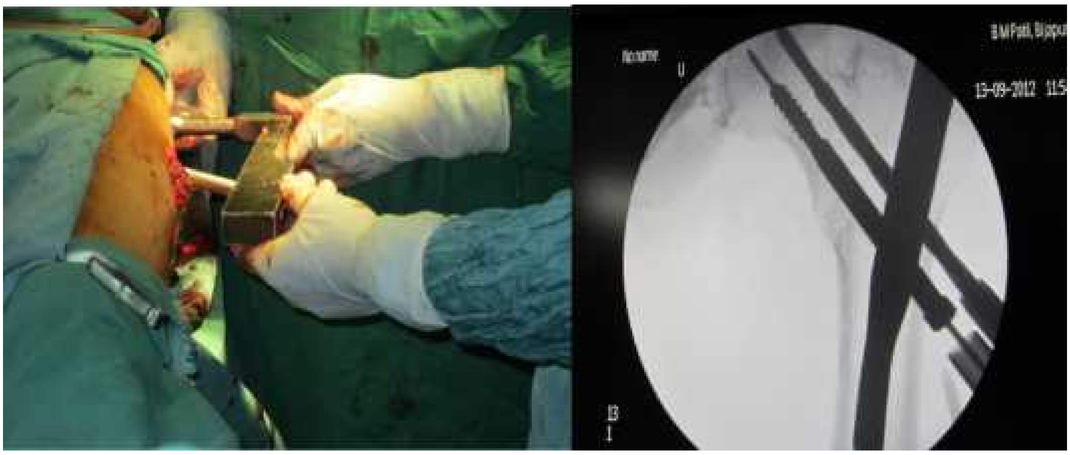


Fig no 24 Insertion of Proximal screws and confirmation under C-Arm

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

Fig no 25 Distal screw insertion

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.

Fig no 26 Skin Closure

Followingparameterswererecordedintra-operatively:

1.Totaltimeofthesurgery

2.Typeofreduction:Closed/Joystick/LimitedOpen

3.Lengthofincision

4.Implantdetails

5.Radiationduration

6.Intraoperativecomplications

7.Qualityofreduction

Aftertreatment:

1) Postoperatively, patient'spulse, bloodpressure, respiration, temperature were monitored.
2) Footendelevationwasgivendependingonbloodpressure.
3) IVthirdgenerationCephalosporin wereadministered 12hourlyfor3-5days,and switched over to oral form till the 12th day post-operatively, i.e. untilsuture removal.
4) Analgesicsweregivenasperpatientcompliance.
5) Bloodtransfusionwasgivendependingontherequirement.
6) Suctiondrainagewasremovedafter48hours, if it is inserted.
7) Dressingwasdoneon2^{nd},5^{th}and8^{th}postoperativeday.
8) Suturesremovedon12^{th}postoperativeday.

PHYSIOTHEAPRY

1. Patientswereencouragedtositinthebedafter24hoursaftersurgery.
2. Activeisometricandisotonicquadricepsexerciseswerestartedfromday2.
3. Nonweightbearingambulationwasstartedfrom2^{nd}week.
4. Partialweightbearingambulationwasstartedfrom6^{th}week.
5. Fullweightbearingambulationwasstartedafterradiologicalsignsofunion.

EVALUATIONOFREDUCTION

Evaluation of the reduction was done using the following criteria on the post operativeAP&LatX-ray.

POSTOPERATIVEEVALUATIONOFREDUCTION

AccordingtoBaumgaertnercriteriamodifiedbyFogagnoloetal.[67]

I .Alignment

i. Anteroposterior plane;normal collodiaphysial angle or slight valgus

ii. Lateralplane:Angulationlessthan20º degrees

IIDisplacementofmainfragments

i. Morethan80%overlappinginboth planes

ii. Shorteninglessthan5mm

Result

Good	:	Meetsbothcriteria
ACCEPTABLE	:	Meets only one criteria
POOR	:	Does not meet both criteria

Followup:

Followupat outpatientlevelat regularintervalsat 6wks,3months,and6monthsforserial clinicalandradiologicalevaluationwasdone.Ifpossible,furtherfollowupwasdone. At everyvisit,patientwasassessedclinicallyregardingpain,limp,hipmovements, walkingability,deformityandshortening.

Clinical assessment :

All patientswereclinically assessed byusingthe**Kyle'scriteria[68].**

Radiological assessment:

Allpatientswereradiologicallyassessedforprogressionandtimeofunion,fracturealignmentand implantrelatedcomplications.

KYLE'SCRITERIA[68]

Allpatientsafter6monthsof followup(afterfractureunion)wereassessedclinically and functionallyas per thefollowingcriteria. Patients werefollowedupforaminimumof6monthsandmaximumof1year.

1. Excellent

a. Fracture united.

b. No pain.

c. No infection.

d. Full range of motion at hip.

e. No shortening.

f. Patient able to sit crossed leg and squat.

g. Independent gait.

2. Good

a. Fracture united.

b. Occasional pain.

c. No infection.

d. Terminal restriction of hip movements.

e. Shortening by half an inch.

f. Patient able to sit crossed leg and squat.

g. Use of cane back to full normal activity.

3. Fair

a. Fracture united.

b. Moderate hip pain.

c. No infection.

d. Flexion restricted beyond eighty degrees.

e. Noticeable limb shortening up to one inch.

f. Patient not able to sit crossed leg.

g. Patient walks with support of walker.

h. Back to normal activities with minimal adjustments.

4. Poor

a. Fractures not united.

b. Pain even with slightest movement at hip or rest.

c. Infection

d. Range of movements at hip restricted, Flexion restricted beyond sixty degrees.

e. Shortening more than one inch.

f. Patient not able to sit crossed leg or squat.

g. Patient cannot walk without walking aid.

h. Normal activities not resumed.

CLINICAL AND RADIOLOGICAL PHOTO GRAPHS

CASE 1

Pre operative X ray

Immediatepost operative

Follow up at Six Months

Able to Sit and Squat

Active flexion

CASE2

Preopx-ray **Postopx-ray**

Post op 3 months x-ray **Post op 6 months x-**ray

Activeflexion **Abletosquat**

CASE3

Preopx-ray **Postopx-ray** **Postop6monthsx-ray**

Sitting cross leg **Weight bearing on operative leg**

Abletosquat

CASE4

Pre OperativePost Operative X Ray Follow up at 6 months

Flexion at Hip cross leg

SLRT **Sitting cross leg**

INTRAOPERATIVECOMPLICATIONS

Greater Trochanter Splintering

Post operative complication

Z effect at 1.5 months

Union of fracture after revision surgery .

RESULTS AND OBSERVATION

The study involved 30 confirmed cases of Intertrochanteric fractures of either sex from Oct 2015-march 2017. 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 20 years of age. The age distribution was from 20 to 90 years. The average age was 58 years and the largest group of patients being from 60 to 70 years.

Table no 1 Age distribution

Age	No of patients	Perecentage
20-30	2	6.6
30-40	2	6.6
40-50	5	16.6
50-60	4	13.3
60-70	9	30
70+	8	26.6
Total	30	100

Mean±SD= 58.13±15.3

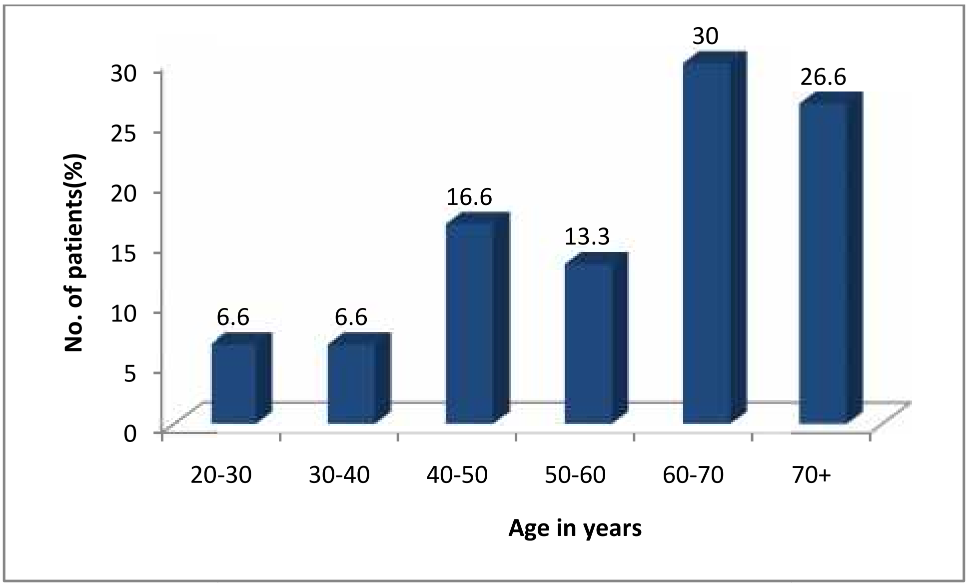


Fig 27 Age Distribution

SEX

There were 22 males and 8 females in the study.

Table 2: Gender distribution

Gender	No of patients	Percentage
Male	22	73
Female	8	27
Total	30	100

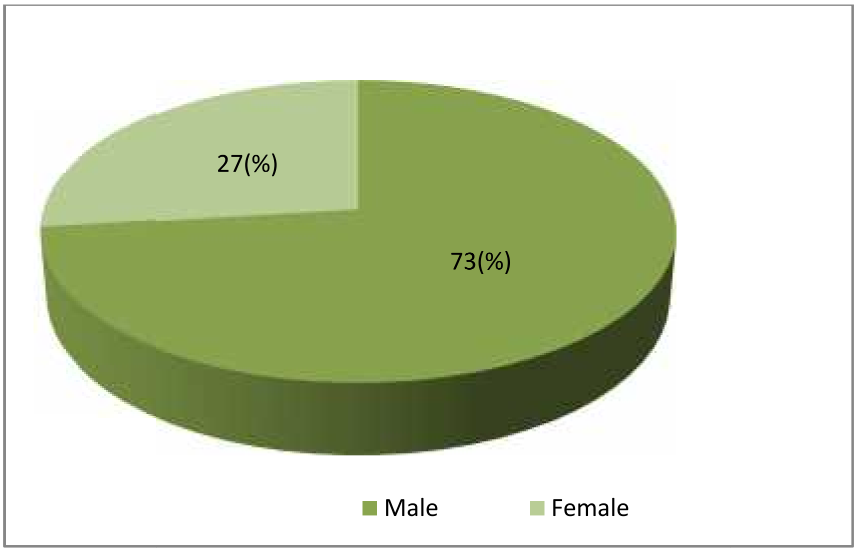


Fig No 28 Gender Distribution

MODE OF INJURY

Domestic fall and road traffic accident were the mode of injury in all the patients. Most of the patients with domestic fall were older in age or had osteoporosis.

Table – 3 Mode of injury

Mode of Injury	No of patients	Percentage
Domestic fall	19	63.3
Road traffic accidents	11	36.7
Total	30	100

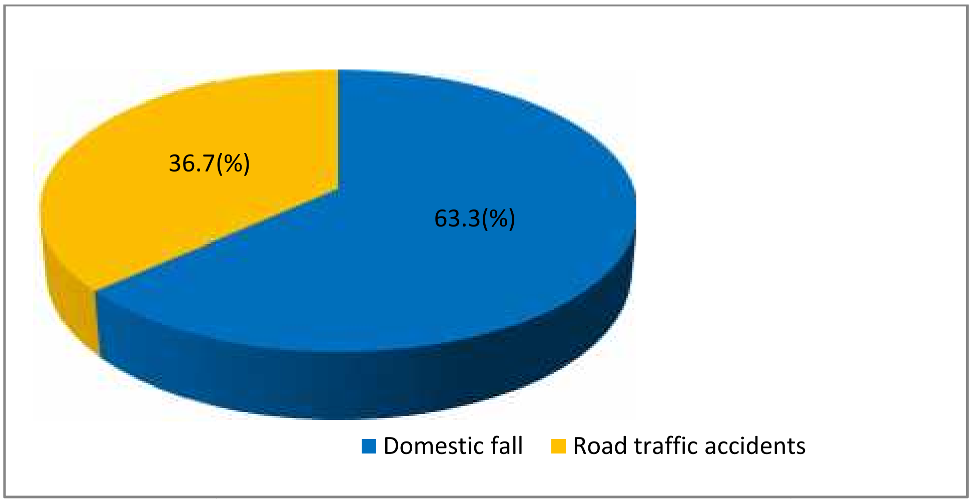


Fig 29 Mode of injury

SINGH'S INDEX

Table 4: Singh's Index Grades

Singh's Index Grades	No of patients	Perecentage
I	0	0
II	1	3.3
III	13	43.3
IV	12	40.0
V	4	13.3
Total	30	100

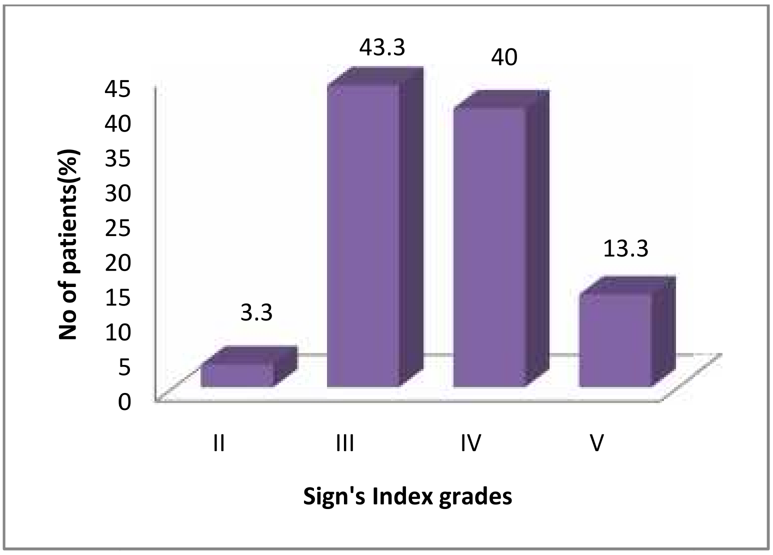


Fig No. 30 Singh index of osteoporosis

FRACTURE PATTERNS

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 5 Fracture pattern

Type of fracture	No of patients	Percentage
31A1	10	33.3
31A2	12	40
31A3	8	26.7
Total	30	100.0

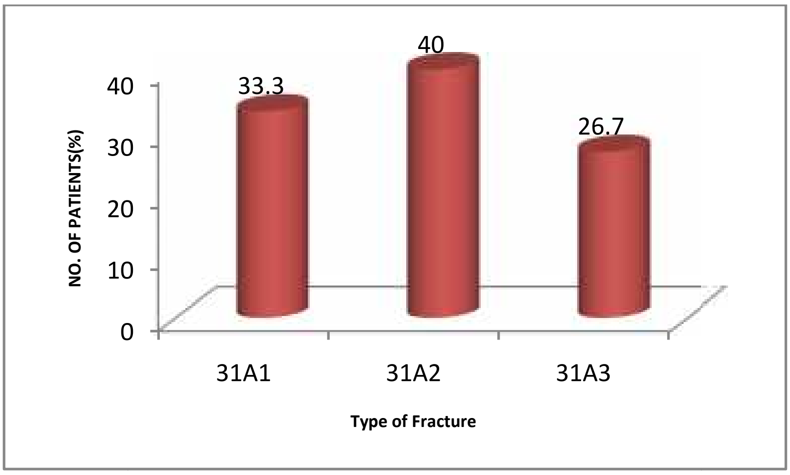


Fig No.31 Fracture patterns

BLOOD LOSS AND BLOOD TRANSFUSION

Blood loss was counted intra operatively by number of mops used during the surgery.One mop equal to 50ml blood loss approximately. The average blood loss was 1.62 mopsso 81ml (50-150ml). 4 patients required intra operative blood transfusion as there preoperative haemoglobin was less. None required blood transfusion post-operatively.

RADIATION EXPOSURE

The average radiation exposure via C-arm was 599.11 sec at 63 Gyrads.

OPERATING TIME

Average operating time was 55mins (32min-95min) after anesthesia.

ASSOCIATED MEDICAL PROBLEMS:

Four patients (13.3%) were suffering from Hypertension , two patients (6.7) suffering from Diabetes mellitus and three patients(10%) were having both Diabetes mellitus and Hypertension.

Table 6: Associated medical problems

Associated medical problems	No of patients	Percentage
Diabetes Mellitus (DM)	2	6.7
Hypertension (HTN)	4	13.3
HTN & DM	3	10
NIL	21	70.0
Total	30	100.0

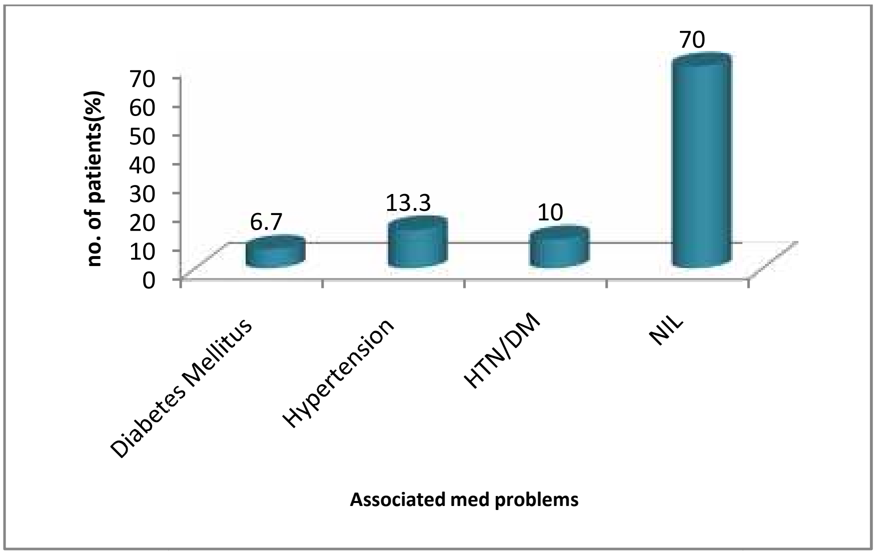


Fig No. 32 Associated Medical Problems

ASSOCIATED INJURIES :

One patients(3.3%) were having ipsilateral Distal end radius fracture and one patient (3.3%) from ipsilateralhumerus shaft fracture.

REDUCTION

Fracture was reduced anatomically by closed means. If that was not achieved then it wasachieved by limited open reduction during surgery. Closed reduction was achieved in 27 patients (88.24%).

Table- 7 Reduction

Reduction	No. of patients	(%)
Closed	27	90
Limited open	3	10

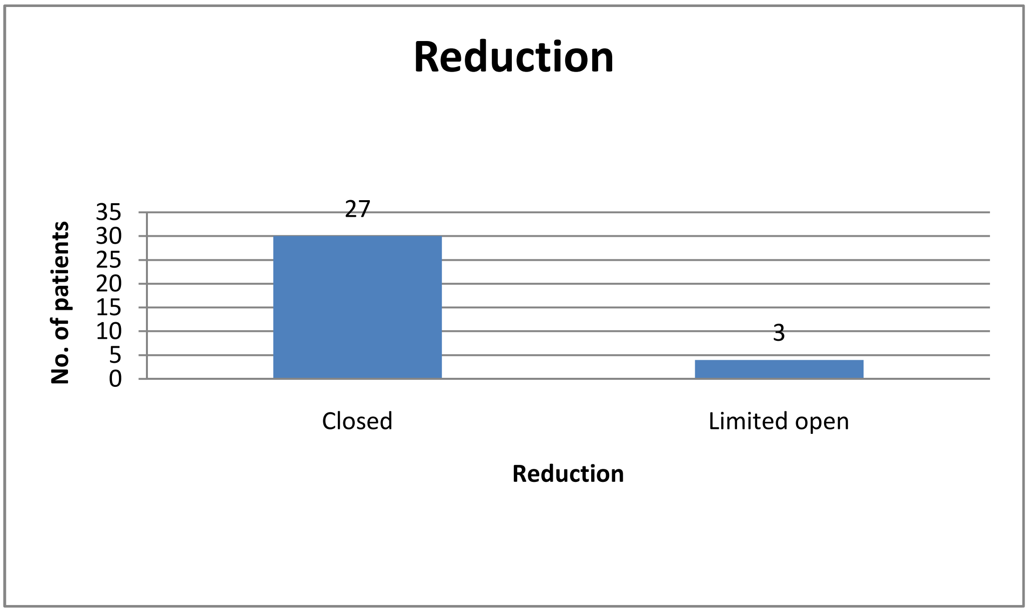


Fig 33 Reduction of Fracture

COMPLICATIONS

Intra – Operative complication

In our study, we encountered certain complications intraoperatively. Most of these complications occurred :

- In three of our patient we had to do open reduction.
- In one cases we failed to achieve anatomical reduction .
- Greater trochanter splintering was seen in one patient which was healed well Later.
- We had one case of fixation of fracture in varus angulation.
- We didn’t face any Fracture of lateral cortex
- No Fracture displacement by nail insertion
- We did not found any jamming of instruments in our study .
- No Breakage of drill bit was seen in our study.

Table – 8 Intraoperative complications

Sl . no	Complications	No of patients
1)	Difficulty in achieving closed reduction	3(10%)
2)	failed to achieve anatomical reduction	1(3.3%)
3)	Failed to put derotation screw	0
4)	difficulty in distal locking in 0 patients	0
5)	fixation of fracture in varus angulation	1(3.3%)
6)	Fracture of lateral cortex	0 (0%)
7)	Jamming of Instruments	1(3.3%)
8)	Greater trochanter splintering	1(3.3%)

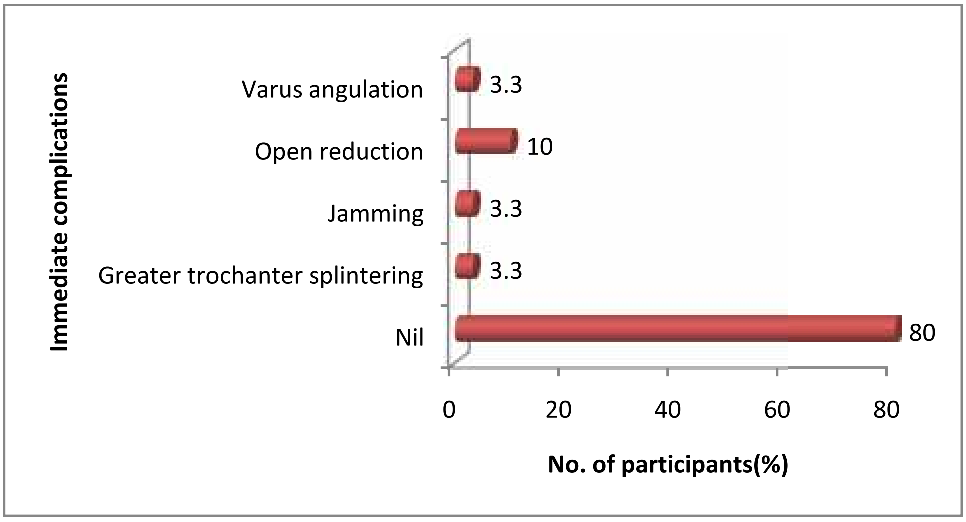


Fig 34 Intraoperative Complication

Post operative complication:

Early :

- Shortening of 2mm is seen in 2patient.
- No Rotation deformity seen.

..

- In two patient Superficialinfection was seen.
- No cases of Deep infection.
- None suffered from Bed sores.
- No Mortality.

Table 9 Early post op complication

Sl .no	complication	No of patients
1	Shortening	**2 (3%)**
2	Rotation deformity	**0 (0%)**
3	Superficial infection	**2 (6.7%)**
4	Deep infection	**0 (0%)**
5	Bed sores	**0**
6	Mortality	**0 (0%)**

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 .VarusMal-Union.

Two patients hadVarus Mal union in my study

Table 10: Delayed complications

Delayed complications	No of patients	Percentage
NIL	25	83.3
Shortening	2	6.7
VM,	2	6.7
Z-EFFECT	1	3.3
Total	30	100.0

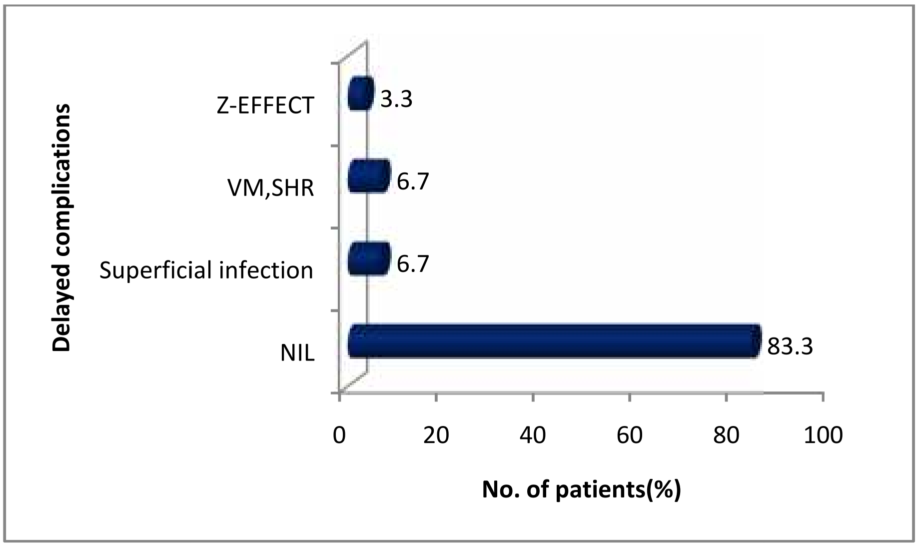


Fig 35 Post operative Complications

HOSPITAL STAY

The average hospital stay was 14.11 (10- 26) days from date of admission to date of discharge. It varied in patients due to factors like availability of operation theatre and comorbid conditions of the patients.

CRITERIA FOR EVALUATION AND RESULTS [KYLE'S criteria][68]

All the patients after union of fracture or after 6 months were grouped and the anatomical and functional results evaluated as follows.

1. Excellent

a. Fracture united.

b. No pain.

c. No infection.

d. Full range of motion at hip.

e. No shortening.

f. Patient able to sit crossed leg and squat.

g. Independent gait.

2. Good

a. Fracture united.

b. Occasional pain.

c. No infection.

d. Terminal restriction of hip movements.

e. Shortening by half an inch.

f. Patient able to sit crossed leg and squat.

g. Use of cane back to full normal activity.

3. Fair

a. Fracture united.

b. Moderate hip pain.

c. No infection.

d. Flexion restricted beyond eighty degrees.

e. Noticeable limb shortening up to one inch.

f. Patient not able to sit crossed leg.

g. Patient walks with support of walker.

h. Back to normal activities with minimal adjustments.

4. Poor

a. Fractures not united.

b. Pain even with slightest movement at hip or rest.

c. Infection

d. Range of movements at hip restricted, Flexion restricted beyond sixty degrees.

e. Shortening more than one inch.

f. Patient not able to sit crossed leg or squat.

g. Patient cannot walk without walking aid.

h. Normal activities not resumed.

RESULTS ACCORDING TO KYLE'S CRITERIA

There were 30 confirmed cases of intertrochanteric fractures .

Table 11: **Results according to Kyle's Criteria**

Results	No of patients	Percentage
Excellent	11	36.7
Good	13	43.3
Fair	5	16.7
Poor	1	3.3
Total	30	100.0

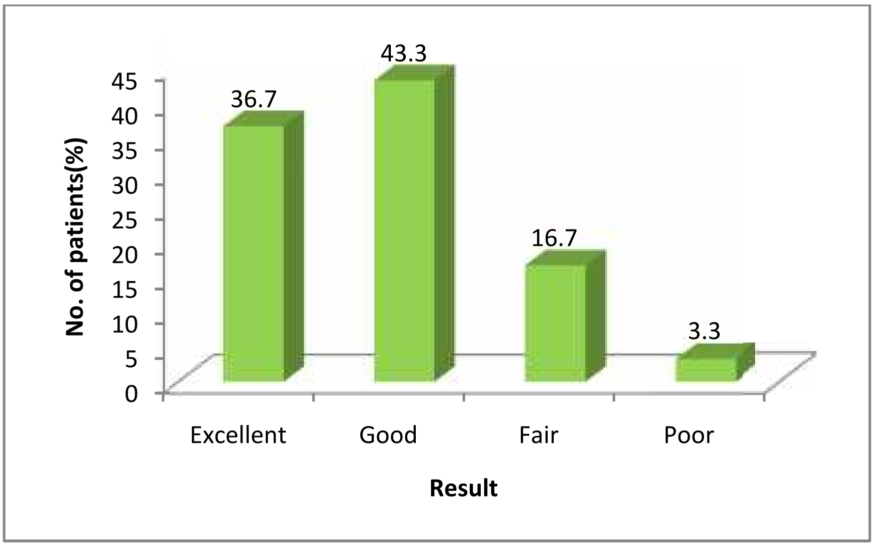


Fig 36 Results according to Kyle's criteria

6. DISCUSSION

The successful treatment of Intertrochanteric fractures depends on many factors like[69]:

- 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 30 patients of Intertrochanteric fractures were studied.

In our study the average age was 58 years which was comparable to Indian as well as western authors with similar study.

We had an 22 male patients and 8 female patients, this resembles many Indian studies. The most common mode of injury in our study was domestic fall 63.7%, which is comparable to most of the Indian studies. This was also affected by the age as the older the patient are more likely getting the fracture by domestic falls.

In our study 33% were stable fracture pattern and 67% 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 43% had a grade – III osteoporosis. The average intra operative blood loss was very minimal. The average was 81ml and it was more in patients who required a limited open reduction. Only four (11.%) of our patients required intra or post operative transfusion. But many of them had very low preoperative haemoglobin. Radiation exposure was calculated in seconds, it was 599.11 seconds by the C-arm. Stable fractures 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. We had a longer operating time in the beginning which reduced greatly in the later part of the study. This signifies the learning curve of the Trochanteric femoral nailing.

The average hospital stay was 14 days. It was more in patients with co-morbid conditions and complications with highest being 22 days.

Total Post operative complications in our study were 17%. We had “Z - effect” in 3.3% of patients which was mostly due to improper placement of the hip screw or cervical screw and early mobilization of the patients. All these patients required revision with a differentsizescrews and fracture healed well after revision. This was comparable to W.M.Gadegoneetal[33] it was slightly lower than their study.

There was no case of non-union. 3% of our patients had greater trochanter splintering while inserting the nail but no other intervention was required and all the fractures healed well.

Infection was present in 6.7% of the patient it was superficial which was treated with antibiotics and dressing in the ward, none required debridement or revision and healed well.

At the follow up there was no complaint of anterior thigh pain or the fracture of the femoral shaft at the tip of the nail.

Results were evaluated by Kyle’s criteria[64]in our series we had 36.7% excellent, 43.3% good, 16.7 % fair and 3.3% poor results. It was similar to

W.M.Gadegone et al[33]&pavelka et al[26] 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[69] 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 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. In our study 10 % patients required limited open reduction which was higher than Christian Boldin et al as they required in 9%[7] .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. Failure to do this leads to the "Z - effect". In which the cervical pin backs out and the hip pin pierces the joint or the vice-versa. Distal locking was done with the interlocking bolt and both static and dynamic holes were locked in all the nails in our study.

In our study one of the important factor was the cost of the implant as Trochanteric femoral nail is costly than the dynamic hip screw, but at the end it didn't cause much of the difference as:

- Less operative time thus reducing the cost
- No or less need of transfusion of blood
- Post operative antibiotics were used less thus reducing the cost of the drugs
- Less hospital stay
- Early return to daily activities.

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[23].

But Dynamic hip screw requires a relatively larger exposure, more tissue traumaand anatomical reduction. All these increase the morbidity, probability of infection andsignificant blood loss. It also causes varus collapse leading to shortening and inability ofthe 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 anatomicalreduction, failure of fixation device and incorrect placement of the screw.[70]

We found Trochanteric femoral nail to be more useful in unstable and reverse obliquepatterns due to the fact that it has better axial telescoping and rotational stability. It hasshown to be more biomechanically stronger because they can withstand higher static andseveral fold higher cyclical loading than dynamic hip screw. So the fracture heals withoutthe primary restoration of the medial support. The implant compensates for the functionof the medial column.[26]

The gamma nail is associated with specific complicationslike anterior thigh pain, fracture at the tip of the nail.But trochantric femoral nail is has smaller diameter at the tip which reduces the stress concentration at the tip.

Its position is near to the weight bearing axis so the stress generated on the implant is negligible.Ttrochanteric femoral nail also acts as a buttress in preventing the medialization of the shaft. The entry point of the Trochanteric femoral nail is at the tip of the greater trochanter so it reduces the damage to the hip abductors[71]unlike the nails which has entry through pyriformis fossa[71]. The hip screw and the anti rotation cervical screw of the Trochanteric femoral nail adequately compress the fracture, leaving between them adequate bone block for further revision should the need arise.

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 and reverse oblique type.

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

- Peritrochanteric 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 equally good results in all grades of osteoporosis.
- It is a quick procedure with a small incision and with significantly less amount of blood loss.
- It gives good results even with non-anatomical reduction.
- Hip screw and cervical screw placement is important. They have to be parallel in AP and overlapping in lateral. Cervical screw should 10mm shorter than hip screw to avoid the “Z - effect”.
- Nail entry is on the tip of the greater trochanter or lateral to it as medial entry will cause the distraction.
- Complications were minimal and comparable with other fracture systems. But Trochanteric femoral nailing requires a higher surgical skill, good

fracture table, good instrumentation and good C-arm control. It has a steep learning curve.

- 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.

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

SUMMARY

Intertrochanteric femoral fractures are of intense interest globally. Intertrochanteric fracture is a leading cause of hospital admissions in elderly people. The number of such admissions is on a raise because of increasing life span, sedentary habits and increased road traffic accidents.

Conservative methods of treatment results in malunion with shortening and limitation of hip movement as well as complications of prolonged immobilization like bed sores, deep vein thrombosis and respiratory infections.

This study is done to analyze the surgical management of Intertrochanteric fractures using Trochanteric Femoral Nail.

In our series of 30 cases there were 22 male and 8 female, maximum age of 90 yrs and minimum age of 20 yrs, most of the patients were between 60 to 70 yrs. Mean age of 58 yrs. 63.3% of cases were admitted due to Domestic fall and 36.7% due to road traffic accidents with common predominance of both sides.AO Type 31A2 fracture accounted for 40 % of cases. Mean duration of hospital stay is 14 days and mean time of full weight bearing is 6 wks. Out of 30 cases 1 case expired after 7 months due to non orthopaedic cause and1 cases were lost to follow up. Good to excellent results are seen in 81% cases, Fair in 16%, 3% case with poor results.

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ANNEXURES

ETHICAL CERTIFICATE

PROFORMA

CASE NO

NAME

AGE/SEX

I.P. NO

DATE OF ADMISSION

DATE OF SURGERY

DATE OF DISCHARGE

OCCUPATION

ADDRESS

1) COMPLAINTS

2) HISTORY OF PRESENT ILLNESS:

a) Duration between the injury and first visit

b) Symptoms — Swelling

Pain

Loss of function

3) MODE OF INJURY

a) Fall

b) Blunt trauma

c) Vehicular accidents

4) GENERAL PHYSICAL EXAMINATION:

Pulse: B.P:

5) SYSTEMIC EXAMINATION:

Respiratory system –

Cardiovascular system –

Per abdomen –

Central nervous system

6) LOCAL EXAMINATION:

INSPECTION

a) Deformity and Attitude

b) Shortening

c) Swelling

d) Skin

e) Wounds if any

f) Other injuries or fractures if any

Right Left

7) MEASUREMENTS

PALPATION

a) Tenderness

b) Pain elicited on manipulation

c) Local bony irregularity

d) Swelling

e) Abnormal mobility

f) Crepitus/grating of fragments

a) Absence of transmitted movements

h) Wounds Right or Left

Measurements

Apparent	-	xiphisternum to medial malleolus
Real	-	Anterior superior iliac spine to Medial malleolus
	-	Anterior superior iliac spine to Medial joint line
	-	Medial joint line to medial malleolus

Bryants Triangle:

Nelaton's line:

MANAGEMENT: INVESTIGATIONS:

X-ray of antero-posterior view of pelvis with both hips and lateral view of affected hip
will be taken.

BLOOD:	Hb%
	TC
	DC
	ESR
	Blood grouping Rh typing
URINE	Albumin
	Sugar

BLOOD SUGAR RANDOM

BLOOD UREA

SERUM CREATININE

ECG in elderly

CHEST X RAY - PA view

MANAGEMENT:

- Type of fixation used
- Stability of the operating- table
- Intra operative complications if any

POST OPERATIVE MANAGEMENT:

- **Mobilization**
    - Date of mobilization of hip
    - Date of patient sitting
    - Date of weight bearing
- **Wound healing, and suture removal**
- **Complications**
    - Infection
    - Change in position of implant
    - Loss of reduction
    - Nerve palsy
- **Date of discharge**

CONDITION AT DISCHARGE

- **Clinical**
    - Shortening if any
    - Complications if any

- Deformity

- o Flexion
- o Adduction
- o Rotational

- Range of movements
  - o Active
  - o Passive
  - o Flexion
  - o Adduction
  - o Abduction
  - o Internal rotation
  - o External rotation

Follow up:

(4-6 weeks)

➢ Clinical

- Patient complaints
- o Pain
- o Limp
- o Any other

- Deformity
  - o Flexion
  - o Adduction/ Abduction
  - o Rotational

- Movements
  - o Flexion
  - o Adduction
  - o Abduction
  - o Rotation

- Quadriceps
    - Wasting
    - Power

- Shortening
- Radiological
    - Position of the in-implant
    - Position of fragments
- Follow up

  (8to 10 weeks)

- Clinical
    - Patient complaints
        - Pain
        - Limp
        - Any other
    - Deformity
        - Flexion
        - Adduction / Abduction
        - Rotational
    - Movements Active Passive

Movements

- Flexion
- Adduction
- Abduction
- Rotation
- Squatting
    - Easy

- Difficult
- Not possible

Quadriceps

- Wasting
- Power

- Shortening compensation if any
- Walking distance
    - Free
    - Painless
    - Pain mild
    - Pain severe
- **With aid**
    - Pain less
    - Pain mild
    - Pain severe
-
- **Radiological**
    - Fracture union and date
    - Position of implant
    - Position of fragments

Follow up

(20 to 24 weeks)

➢ **Clinical**

- Patient complaints
    - Pain

- Limp
- Any other

- Deformity
  - Flexion
  - Adduction / Abduction
  - Rotational

Movements	Active	Passive

- Flexion
- Adduction
- Abduction
- Rotation
- Squatting
  - Easy
  - Difficult
  - Not possible

INFORMED CONSENT FORM

TITLE OF RESEARCH	:	**A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF INTERTROCHANTERIC FRACTURES TREATED WITH TROCHANTERIC FEMORAL NAIL.**
Principle Investigator	:	
P.G. Guide Name	:	

M.S ORTHOPAEDICS

PROFESSOR AND HOD

All aspects of this consent form are explained to the patient in the language understood by him/her.

I, the undersigned,________________ , S/O D/O W/O ________________, aged ____years, ordinarily resident of _____________ do hereby state/declare that Dr ______________________________________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 ____________________informed me that he/she is conducting dissertation/research titled “A Prospective Study Of Functional Outcome Of Intertrochanteric FracturesTreated With Trochanteric Femoral Nail”under the guidance of ____________________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.

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

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 gyrads in seconds
13. ImmCompl: Immediate complication

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

MASTER CHART

Sl no	Name	IP NO	Age	Sex	D/O/S	MOI	SI	SIDE	Type of #	Med Problems	Ass Injuries	ImmComp.	D compl	HS	Result
1	AMOGH	37247	50	M	10\10\2015	D	IV	RT	31A1	NIL	NIL	NIL	NIL	13	E
2	NINGAMMA	32630	68	F	17\10\2015	R	V	Rt	31A2	HTN	NIL	NIL	NIL	20	E
3	SIDDAMMA	34636	67	F	30\10\2015	R	III	RT	31A3	NIL	NIL	OR	NIL	14	F
4	HANAMANTH	31099	65	M	12\10\2015	R	III	Rt	31A1	DM	NIL	NIL	SI	12	E
5	RAMACHANDRA	38780	80	M	05\12\2015	D	III	Lt	31A3	HTN	NIL	VA	VM,SHR	15	G
6	MAHADEV	35586	50	M	05\11\2015	R	IV	Rt	31A2	NIL	NIL	NIL	NIL	13	E
7	CHANDRABAGA	36219	45	F	09\11\2015	D	V	Lt	31A1	NIL	NIL	NIL	NIL	13	E
8	MALAPPA	36827	45	M	19\11\2015	D	IV	Rt	31A2	NIL	NIL	GTS	NIL	14	E
9	BASAPPA	38411	60	M	07\12\2015	R	IV	Lt	31A1	HTN/DM	NIL	NIL	NIL	20	G
10	PARUBAI	38987	60	F	15\12\2015	R	III	Rt	31A2	NIL	NIL	NIL	Z-EFFECT	15	F
11	SRIKANTH	3288	64	M	04\02\2016	D	III	Lt	31A2	NIL	Humerus shaft #	OR	NIL	13	G
12	CHANDSAB MULLA	9123	51	M	29\03\2016	D	II	Rt	31A1	NIL	NIL	NIL	NIL	22	G
13	IRAPPA TALEWAD	10233	80	M	04\04\2016	D	IV	Rt	31A3	NIL	NIL	NIL	NIL	12	F
14	GANGAMMA	13835	62	F	3\04\2016	D	IV	Rt	31A1	HTN	NIL	jam	NIL	12	E
15	SATISH	16897	50	M	24/5/2016	D	IV	Lt	31A2	NIL	NIL	NIL	NIL	12	G
16	GOPAL RATHOD	22076	45	M	7/7/2016	R	IV	Rt	31A2	NIL	NIL	NIL	NIL	10	G
17	REVUTAPPA	22242	49	M	8/7/2016	D	IV	Rt	31A1	NIL	NIL	NIL	nil	11	E
18	SEETABAI	23033	70	F	19/7/2016	R	III	Lt	31A3	NIL	NIL	NIL	NIL	12	F
19	SIDDAPPA	21611	78	M	9/7/2016	D	III	Rt	31A2	HTN,DM	NIL	NIL	SI	17	F

20	HANUMANTHARAYA	21987	65	M	9/7/2016	D	III	Lt.	31A3	HTN	D R #	OR	NIL	12	G
21	KAMALABAI	26555	65	F	30/7/2016	D	IV	Rt	31A3	NIL	NIL	NIL	NIL	10	G
22	SUDHAKAR	27375	28	M	27/8/2016	D	V	Rt	31A2	NIL	NIL	NIL	NIL	12	G
23	SAVALAGAPPA	28380	83	M	6/9/2016	R	III	Lt	31A3	NIL	NIL	NIL	NIL	11	G
24	RAMACHANDRA	34255	70	M	20/10/2016	D	III	Lt	31A2	DM	NIL	NIL	VM,SHR	18	P
25	CHAYA	33907	28	F	14/10/2016	R	V	Lt	31A1	NIL	NIL	NIL	NIL	16	E
26	GANESH	33807	36	M	27/10/2016	D	IV	Lt	31A2	NIL	NIL	NIL	NIL	13	G
27	JPTEPPA	34916	70	M	5/11/2016	D	III	Lt	31A1	DM,HTN	NIL	NIL	NIL	17	G
28	NINGAPPA	39386	75	M	3/12/2016	D	III	Lt	31A3	NIL	NIL	NIL	NIL	16	G
29	BASAYYA	242	48	M	5/1/2017	R	III	Rt	31A1	NIL	NIL	NIL	NIL	10	E
30	RAJESH JAIN	1243	37	M	28/1/2017	D	IV	Rt	31A2	NIL	NIL	NIL	NIL	13	E