MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF HIP IN ADULTS TREATED WITH PROXIMAL FEMORAL NAIL – A PROSPECTIVE STUDY

By

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Under the guidance of

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF HIP IN ADULTS TREATED BY PROXIMAL FEMORAL NAIL- A PROSPECTIVE STUDY"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. O. B. Pattanashetty,** Professor and Head of Department, Department of orthopaedics at B. L. D. E. A's Shri. B. M. Patil Medical College Hospital and Research Centre, Bijapur.

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PLACE: Bangalore ***Dr. Preetish Endigeri***

DATE:

LIST OF ABBREVIATIONS USED

(In alphabetical order)

#	:	Fracture
&	:	And
Ant	:	Anterior
AO	:	Arbeitsgemeinschatt für Osteosymthesefragen
ASIF	:	Association for the Study of Internal Fixation
Deg	:	Degree
DHS	:	Dynamic Hip Screw
Dia	:	Diameter
GTS	:	Greater Trochanter Splintering
IT	:	Intertrochanteric
Lat	:	Lateral
Med	:	Medial
O.A.	:	Osteoarthrits
OTA	:	Orthopaedic Trauma Association
PFN	:	Proximal Femoral Nail
Post	:	Posterior
TAD	:	Tip Apex Distance
TBPP	:	Trochanteric Buttress Plate

ABSTRACT

BACKGROUND AND OBJECTIVES:

Intertrochanteric fractures of the femur remain some of the most challenging fractures facing orthopaedic surgeons. Most of the fractures in the elderly results from trivial injury from standing or walking, while in the younger age group it’s mainly due to road traffic accidents. Closed management of these intertrochanteric fractures thus poses difficulties in obtaining and maintaining a reduction, making operative management the preferred treatment. Hence this study is intended to determine the effectiveness of intramedullary fixation of intertrochanteric fractures with proximal femoral nail and the complications involved in the management of intertrochanteric fractures.

METHODOLOGY:

This is a prospective study of 34 cases of intertrochanteric fracture admitted to BLDEA’S Hospitals between October 2011 and August 2013 treated with Proximal femoral nail. Cases were taken according to inclusion and exclusion criteria.

RESULTS:

In our study of 34 cases, there were 20 male and 14 female patients with age ranging from 28 years to 94 years with most patients in between 51-60 years. 65% of the cases admitted were due to domestic fall and 35% due to road traffic accidents with common preponderance of fracture in both limbs. AO Type 31A2 fracture accounted for 47% of cases. Mean duration of hospital stay was 15.11 days and mean time of full weight bearing was 6 weeks in our patients. Out of 34 cases, 3cases were lost to follow up and 1 case died due to cause other than orthopaedic cause. Good to excellent results were seen in 82% of cases in our study.

CONCLUSION:

Proximal femoral nail is a reliable implant for intertrochanteric fractures leading to high rate of bone union, less soft tissue damage decreased duration of surgery and less blood loss

KEY WORDS:

PFN, Intertrochanteric fractures, kyle's criteria, AO Classification

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1. INTRODUCTION

Intertrochanteric fractures are common in old age group[1]. These fractures are three to four times more common in elderly women and the mechanism of injury is usually due to low energy trauma like simple fall[2] and in adults due to road traffic accidents. By 2040 the incidence is estimated to be doubled[3]. In India the figures may be much more[3]. These fractures unite readily with conservative line of treatment and there is no fear of complications like, avascular necrosis of head, and its sequel of osteoarthritis. In trochanteric fractures treated without surgical interventions, malunion with coxa vara deformity resulting in shortening of limb and limp are commonly seen[4].

Various operative procedures with different implants have been described for the treatment of intertrochanteric fractures. Earlier active treatment was usually delayed for as long as 3 to 4 weeks which lead to secondary complications. The primary goal of the treatment has to be early mobilization to avoid secondary complications, which can be achieved by open reduction and internal fixation. Intertrochanteric femur fractures may be treated with either a sliding hip screw or a trochanteric nail. The hip screw has been considered the device of choice because fracture union predictably occurs. A problem with sliding hip screws is collapse of the femoral neck, leading to loss of hip offset and shortening of the leg. Although some such sliding is expected, too much shortening is detrimental to hip function. Therefore a new intramedullary device – Proximal Femoral Nail was designed in 1996 which gives an advantage of minimally invasive surgery[5].

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

2. OBJECTIVES

To study and evaluate the functional results of Proximal Femoral Nail in the management of intertrochanteric fractures by using Kyle's criteria.

3. 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 of spinal 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 1^{st} 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. Extracapsular fractures
3. Fractures through greater trochanter.

This classification is still valid. He also recognized the difference in prognosis of intracapsular and extracapsular fractures of neck of femur.

In 1852 Antonious Mathijsen (1803-1875) introduced the plaster of paris bandage. This was the most important development in the management of fractures.

Hugh Owen Thomas (1834-1891) who belongs to an English family of bone setters, 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 published a classification of fractures at the upper end of the femur an improvement over Cooper's classification.

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

In 1909 Steinmann introduced skeleton traction with the Steinmann pin and Kwire which form the part of conservative treatment of fractures of the proximal femur.

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

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

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 treatment of Trochanteric fractures, which was a breakthrough to conservative treatment.

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

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

In 1955 Schumpelick W.Jantzen published the use of sliding screw plate and in the same year Pugh and Badgely in 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 management of Trochanteric fractures.

In 1996 AO/ASIF developed a new device "Proximal Femoral Nail" which has been useful in early mobilization and treatment of proximal femoral fractures

REVIEW OF LITERATURE :

Proximal femoral nail offers several potential advantages over the sliding hip screw and plate[6] like:

a) An Proximal femoral nail provides more efficient load transfer than does a Sliding hip screw, because of its location.

b) A shorter lever arm of the Proximal femoral nail can decrease tensile strain on the implant so decreasing the risk of implant failure.

c) Because an Proximal femoral nail incorporates a sliding hip screw, the advantage of controlled fracture impaction is maintained.

d) The Proximal femoral nail location limits the amount of sliding and therefore limb shortening and deformity that can occur.

e) Insertion of Proximal femoral nail requires shorter operative time and less soft tissue dissection than a sliding hip screw, So decreasing the overall morbidity.

G. S. Kulkarni et al[3] reviewed the current concepts of treatment of Intertrochanteric fractures. They concluded that unstable Intertrochanteric fractures can be helped by medullary fixation as there is more failure of Dynamic hip screw. Proximal femoral nail developed by A.O. has two sliding screws. Advantages of their screws are:

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

Simmermacher R. K et al[5] reviewed 191 patients having proximal femoral fractures treated with proximal femoral nail in one year. After a follow up period of 4 months 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[7] 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[8] 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 of the both femoral neck and shaft was seen in patients treated with Dynamic hip screw, this difference was statistically significant.

Klinger H. M. et al[9] have done a comparative study of 173 unstable intertrochanteric femoral fractures treated with Dynamic hip screw and trochanteric buttress plate Vs proximal femoral nail. In case of proximal femoral nail 17.2% revisions were necessary and in the case of dynamic hip screw with TBPP 21.6%. A shorter operation time and a considerable shorter in patient stay were common with proximal femoral nail. They concluded that Dynamic hip screw with TBPP had a higher incidence of complications in unstable trochanteric fractures than proximal femoral nail.

Reska M. et al[10] 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 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[11] 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 12 months bone union was achieved in all patients.. The outcomes were excellent in 64%, good in 28% and satisfactory in 8%. They concluded that the long proximal femoral nail is a high quality implant that increases our options of treatment of all the reconstruction nails.

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

Ramesh Krishna.K[13] 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 intera-operative complications but it is technically difficult and need more expertise.

In 2009, a retrospective review of 26 cases concluded PFN is a suitable implant for unstable intertrochanteric femoral fractures needing open reduction and internal fixation. It has low per operative and post operative morbidity[14].

In 2009, another study on 35 patients concluded that the correct positioning of the osteosynthesis material and use of an intramedullary nail providing a stronger fixation of the proximal part may reduce mechanical complications following the treatment of unstable intertrochanteric hip fractures[15].

SURGICAL ANATOMY[2,6,16,17]

The hip is a ball & socket joint, 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 to140 deg. with the shaft in the anterioposterior plane& angle of 10-20 deg (anteversion) in the lateral plane. The intertrochanteric region consists of the greater & lesser trochanter, representing a zone of transition from the neck to the shaft. This area consists primarily of dense trabecular bone that serves to transmit & distribute stress. The *Calcar femorale*, is a vertical wall of dense bone extending from the posteromedial aspect of the femoral shaft to the posterior portion of the neck, which forms an internal trabecular strut within the inferior portion of the neck.

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

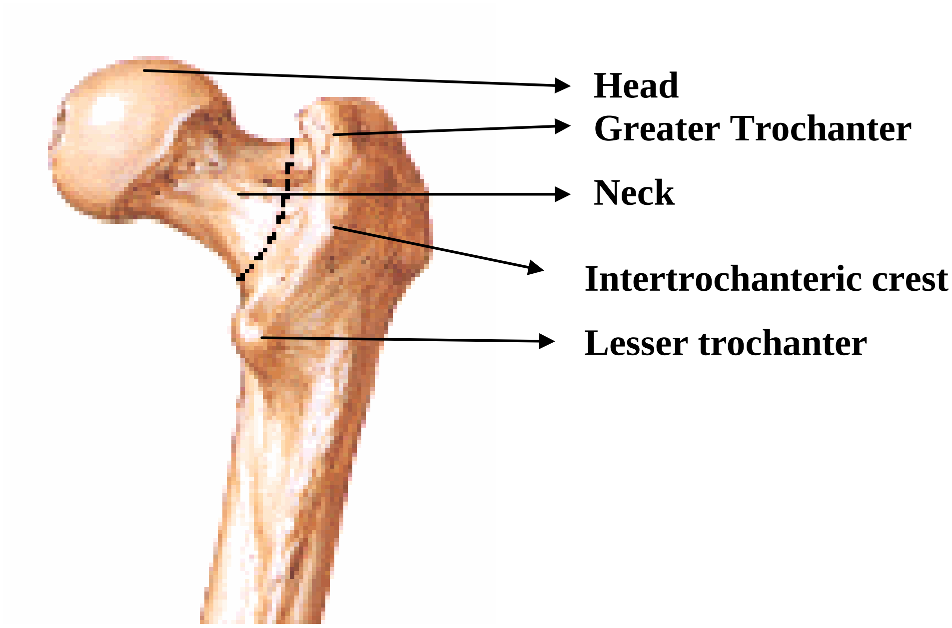

Fig 1 Ant view anatomy of proximal femur

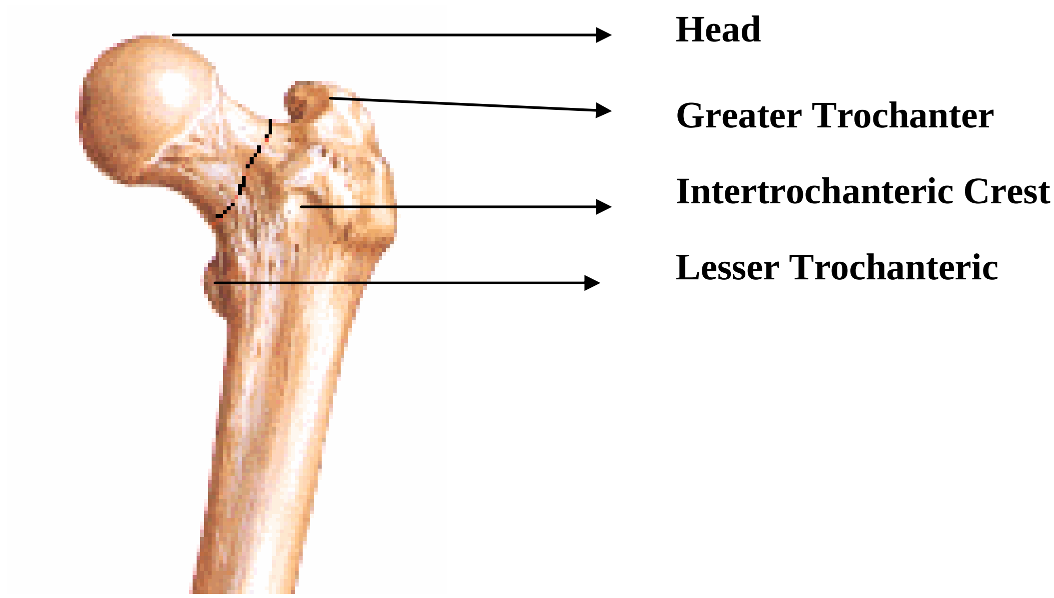

Fig 2 Post view anatomy of proximal femur

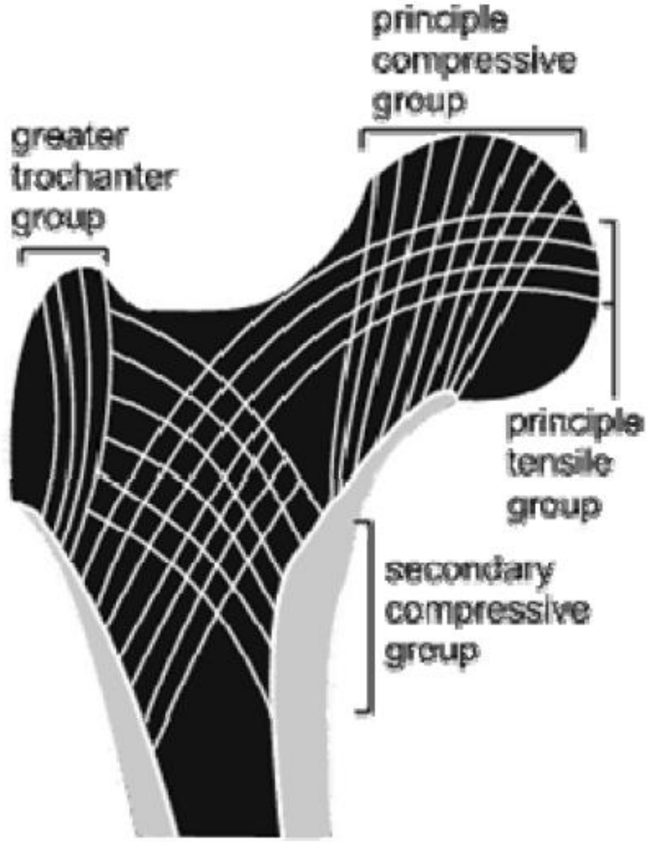

Fig: 3 Trabecular pattern

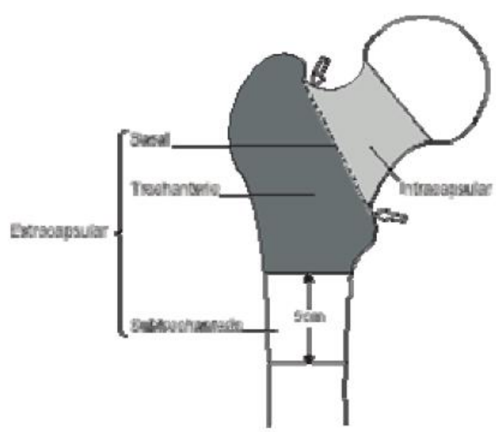

Fig: 4 Regions of the proximal femur

THE TRABECULAR PATTERN

The proximal end of the femur is composed of cancellous bone. The forces acting on the hip create a distinct trabecular pattern namely compression group & the tension group.

In the frontal section the trabeculae are seen in two distinct arches one arising from the medial cortex to the shaft of the femur & the other taking origin from the lateral cortex.

These Trabeculae are divided into: (Fig. 3)

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

In the neck region the primary compressive, the secondary compressive & the tensile trabeculae enclose an area containing weak bone, the Wards triangle. Singh & Maini have developed an index of osteoporosis, based on the deficient trabecular pattern. They graded osteoporosis from I to VI with VI being normal & I being severe osteoporosis.

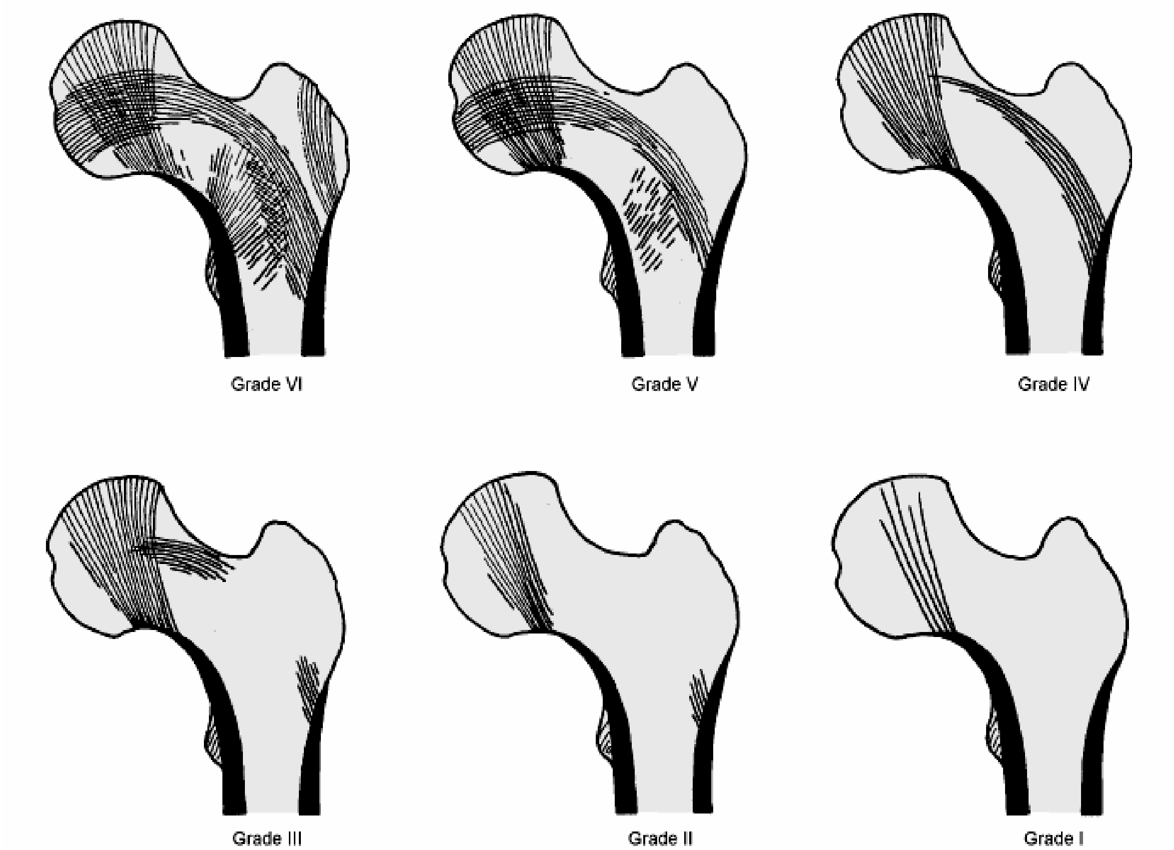

Fig: 5 showing the Singh & Maini index with Gr.1 Representing severe osteoporosis & Gr.6 Normal bone.

MUSCLES

There are numerous powerful muscles surrounding the trochanteric region.

The muscles can be grouped as follows:

THE ABDUCTORS

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

Hip joint and Muscles around hip

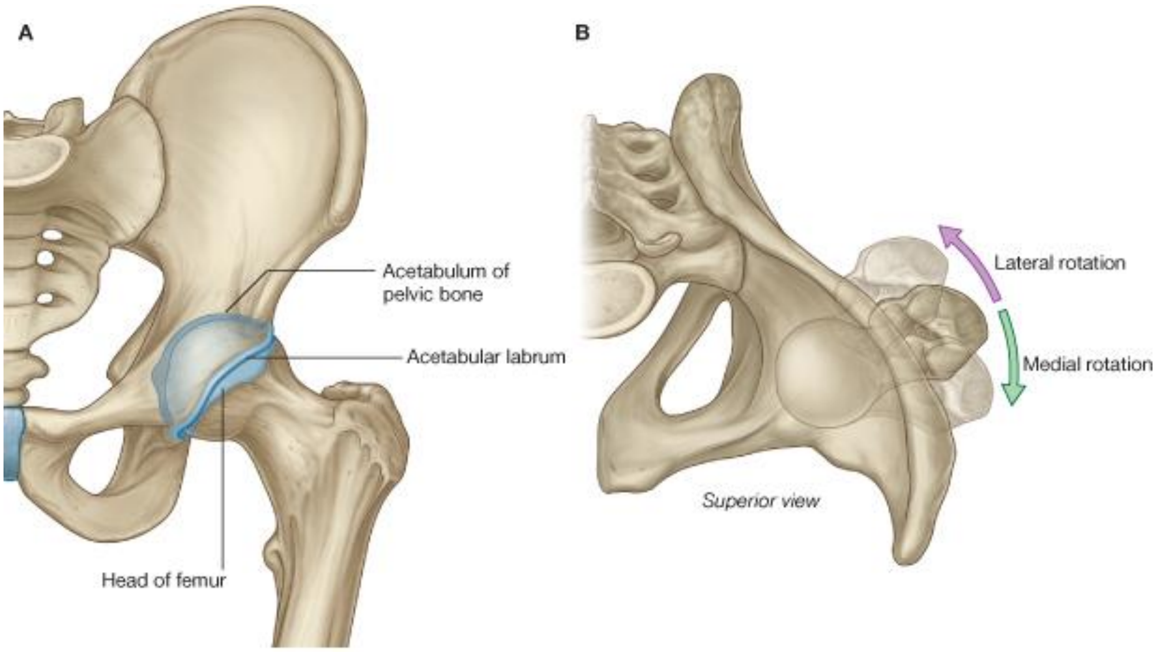

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Fig 6

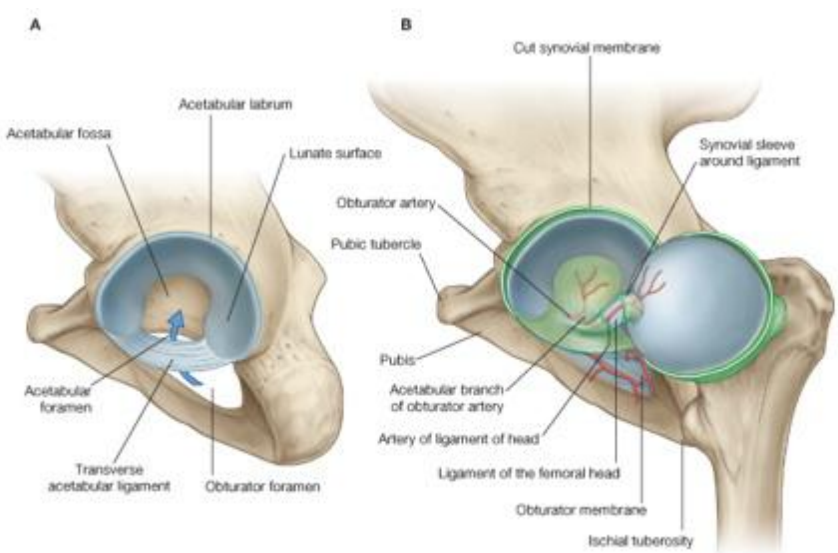


Fig 7

Hip joint and muscles around hip

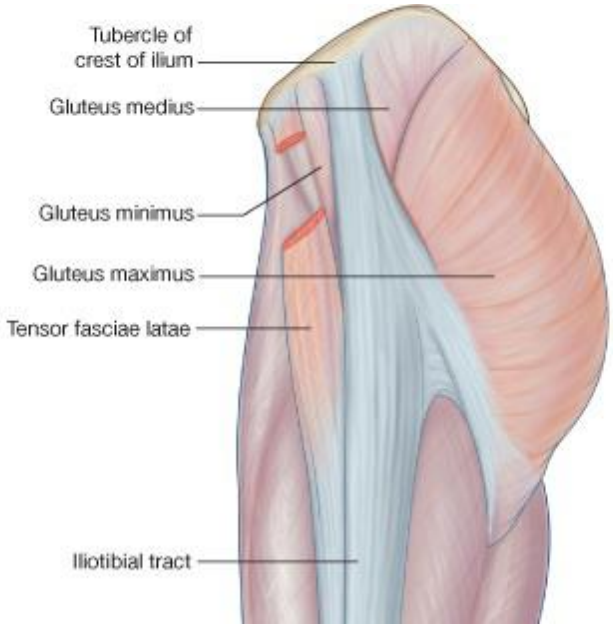


Fig 8 muscles in lateral aspect

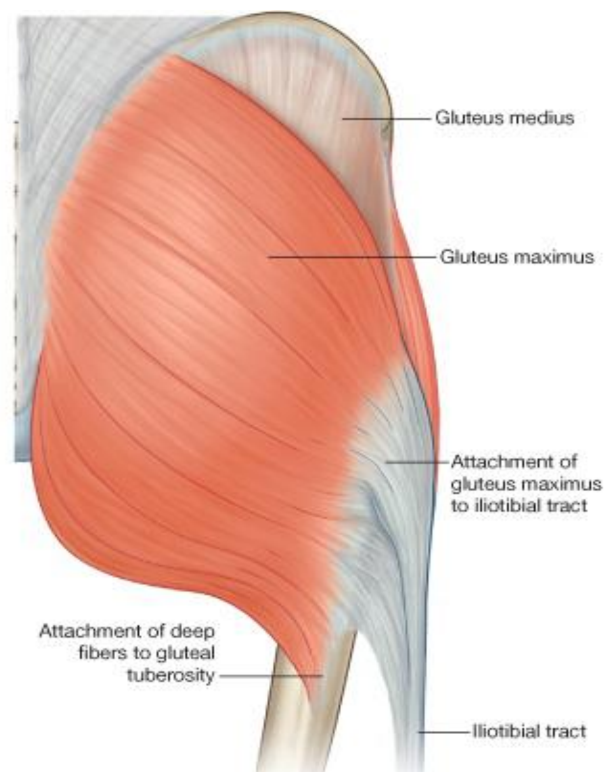


Fig 9 Muscles in Post aspect of hip

Hip joint and muscles around hip

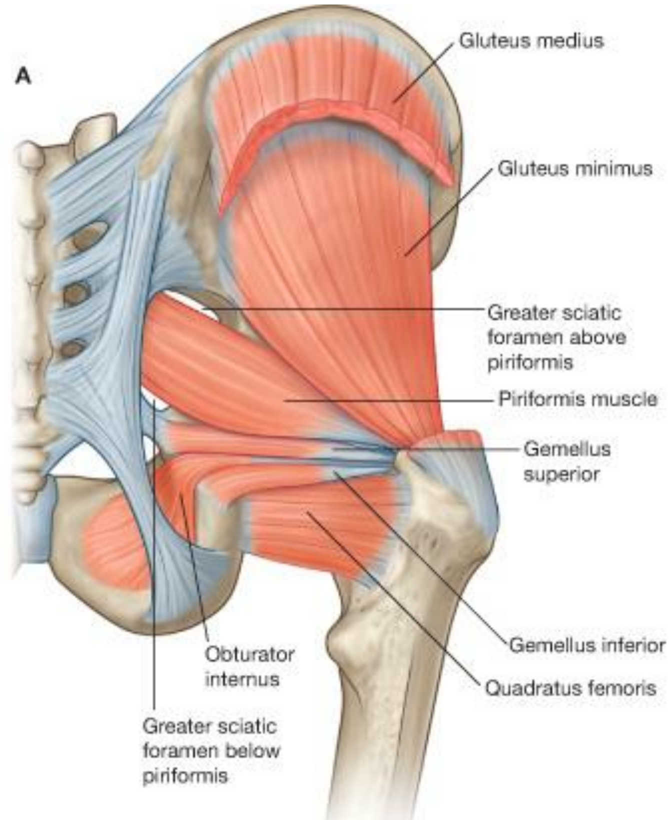


Fig 10

THE FLEXORS

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

THE SHORT EXTERNAL ROTATORS

These muscles include the *piriformis, obturator internus, obturator externus, superior &inferior gemili* and *quadratus femoris.* They insert along the posterior aspect along the inter trochanteric 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 PROXIMAL FEMUR:

ARTERIAL BLOOD SUPPLY (Fig 11 & 12)

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

1. Medial circumflex femoral artery. (which branch into)

a. Lateral epiphyseal artery

b. Superior metaphyseal artery

c. Inferior metaphyseal artery (supply head derived from metaphysic)

2. Lateral circumflex femoral artery

3. Superior gluteal artery

4. Obturator artery, Medial epiphyseal artery (artery of ligamentum teres branch from acetabular artery).

5. First perforating branch of profunda femoris artery.

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

decreases to head from children to adult. Femoral circumflex arteries 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 divided

into :

- 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

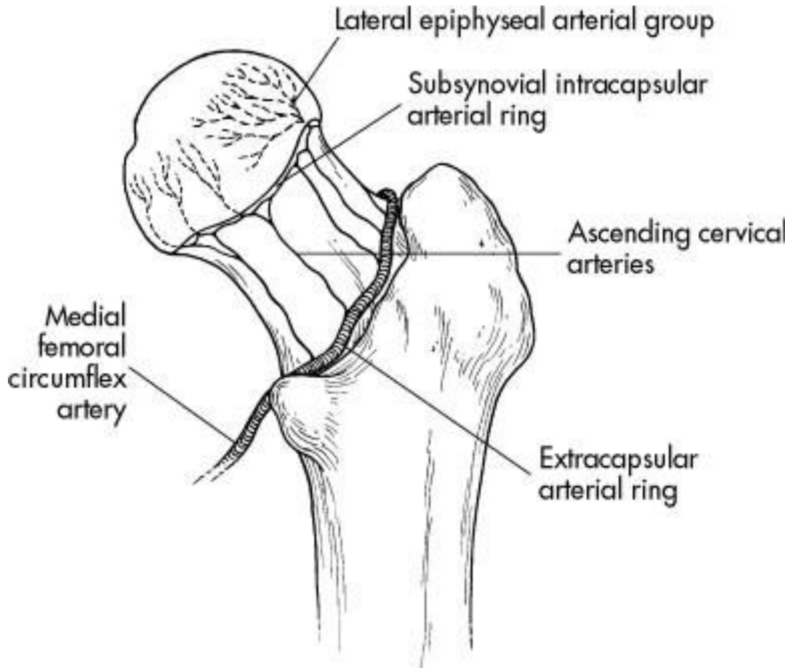


Fig: 11. Vascular supply of the proximal femur

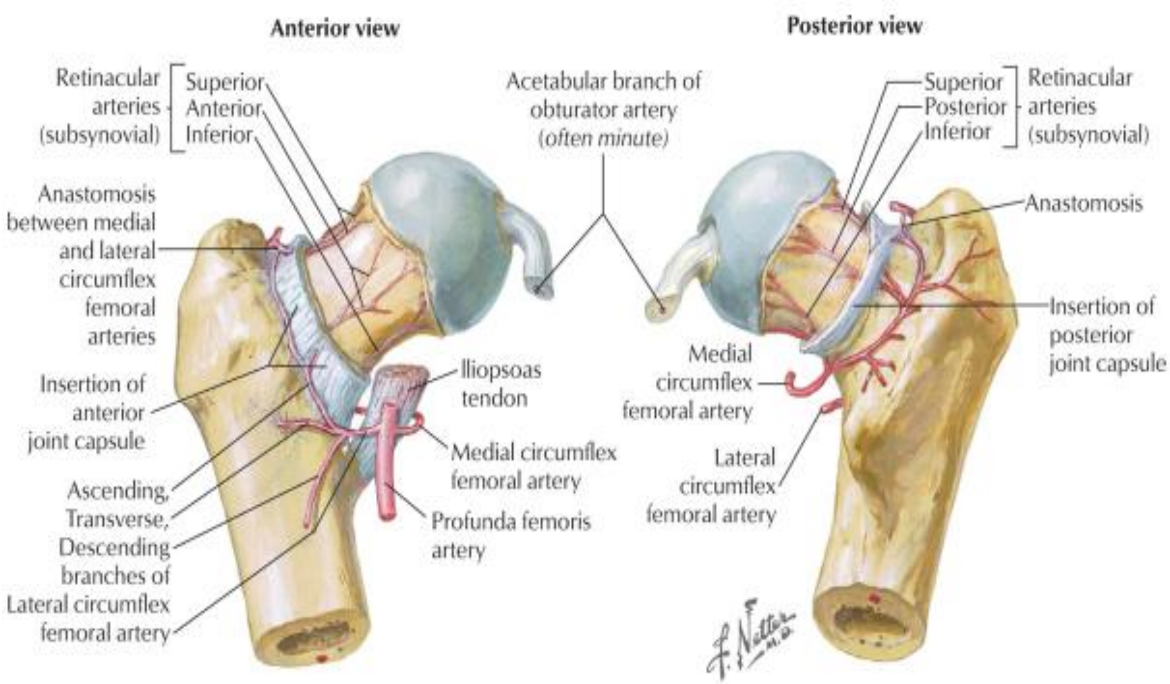


Fig 12. Vascular supply of Proximal femur

VENOUS OUTFLOW:

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

BLOOD SUPPLY TO HIP JOINT

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

NERVE SUPPLY TO HIP JOINT

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

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

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

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

BIOMECHANICS OF THE HIP JOINT[18,19]

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

Hip joint moves in all directions. In Saggital plane motion of flexion ranges from 0-140 degrees and 0-15 degree of extension. In frontal plane motion of adduction is 0-30 degrees and abduction 0-45 degrees. In transverse plane motion of internal rotation ranges from 0-30 degree and external rotation 0-40 degrees. The proximal fragment is abducted by abductors (Gluteus medius and minimus), is flexed by 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 body weight occurs immediately after heel strike with another peak of 7 times body weight at toe off. In females, the magnitudes of joint reaction forces are decreased, with first peak approximately 2.5 times body weight and second peak approximately 4 times body weight.

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

PATHOMECHANICS OF INJURY

CAUSATIVE MECHANISM OF INTERTROCHANTERIC FRACTURES

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

The suggested two mechanisms of injury are[6]:

1. The first is a fall producing a direct blow over the trochanter
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 third recently suggested mechanism is the cyclical loading which produces micro and macro fractures which is commonly seen in osteoporotic and diseased bones.

According to **HORN AND WANG**[20] it is the failure of the weakened bone stock to withstand a sudden bending or twisting strain thrown on it while the patient is weight bearing. This is also supported by the characteristic radiological findings of communition on the medial side, varus deformity and gaping of the fracture on the lateral side. During ambulation both static and dynamic forces are applied to the proximal femur.

Due to these a distending force is generated on the lateral aspect of the neck shaft angle and by inference a compression force is generated on the medial aspect. In daily ambulation dangerously large stresses must be thrown on the peculiarly susceptible neck shaft angle and there exists an inbuilt mechanism to mitigate these stresses. Those muscles which by their active contraction while the limb is weight bearing tend to straighten out the neck shaft angle could be regarded as constituting a stress resistant system. These muscles include the short external rotators, the pyriformis, the uppermost fibers of the adductor magnus, the adductor brevis and the pectineus all those muscles pursuing a more or less horizontal course between the trunk and the femur. The stress resisting effect of these muscles has been compared to that of a tensioned steel cable in a beam of pre stressed concrete, except that the tension in the muscles can vary reflexely in response to the varying stresses thrown on the bone.

Horn & Wang suggested that failure of this stress resistant mechanism to operate either because of muscle weakness or delayed reaction time, especially in osteoporotic bones, may be an etiological factor in the causation of intertrochanteric fractures.

FRACTURE ANATOMY

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

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

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

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

FRACTURE GEOMETRY AND INSTABILITY

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

• Lesser trochanter communition

• Reverse oblique fracture

• Intertrochanteric fracture with sub- trochanteric extension.

A truly stable Intertrochanteric fracture is one that when reduced has cortical contact without a gap posteriorly& medially. This contact will prevent further displacement into varus & retroversion. In the stable fracture the posterior & medial cortices are not comminuted & there is no displaced fracture of the lesser trochanter.

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

THE LATERAL WALL

The lateral wall of the trochanteric region has been given little importance in the past. Now it is believed that extensive communition of the lateral wall requires to be repaired thus the development of the trochanteric plate to buttress the lateral wall[21].

REVERSE OBLIQUE FRACTURE

In this type of fracture the fracture line extends from lesser trochanter inferiorly to the lateral cortex. The geometry of the fracture is such that it is inherently unstable .If this fracture is missed & treated with a sliding hip screw with plate it results in medialization of the distal fragment & a day one failure. Such fractures are best treated with a 95 blade plate or an intra medullary nail[22,23].

INTERTROCHANTERIC FRACTURE WITH SUB-TROCHANTERIC EXTENSION

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

BIOMECHANICS OF THE INTERNAL FIXATION

The understanding of the biomechanical properties of implants used in intertrochanteric fractures is vital in knowing how implant failure & non union 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[24-26].

IMPLANT DESIGN

Main implants used in the treatment of intertrochanteric fractures are:

1. Dynamic hip screw[3] (extramedullary devices)

2. Proximal Femoral Nail (intramedullary devices)

The dimensions of the Dynamic hip screw are :

Plate: Thickness – 5.8 mm

Width – 10 mm

Hole spacing – 16 mm

Barrel diam. – 12.5 mm

Barrel angle – 130,135,140, 145 & 150.

Barrel length – long 32 mm

Short 25 mm.

• Screw : Shaft diam. – 8mm

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

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

Distal – 4.9 mm

• Screw angle: 125,130 & 135 degrees.

BIOMECHANICAL ADVANTAGE OF THE INTRA MEDULLARY DEVICE

Lindsey[27], in his study has pointed out the numerous advantages of the intramedullary device with sliding screw:

1. To provide fixation of the head & neck.

2. To allow femoral head & neck collapse & subsequent impaction of the fracture site.

3. To lie within the intra medullary canal thus reducing the lever arm.

4. The implant itself serves as a buttress against lateral translation of the proximal fragment

5. To provide bone graft from the reamed products

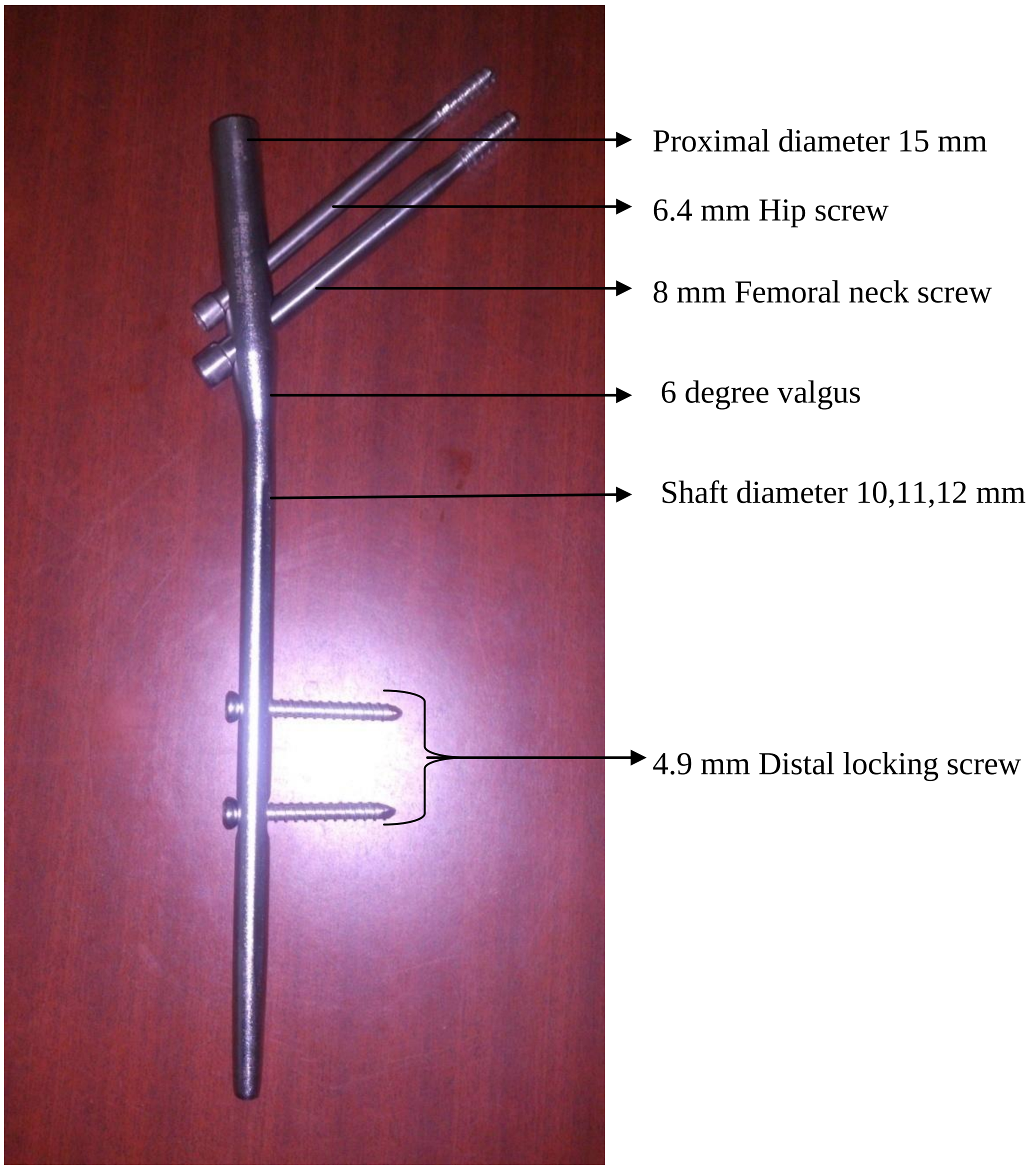


Fig 13 . Proximal femoral nail

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

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

In his subsequent studies on the sliding in second generation locked nails, Kyle[28] has noted that increased forces are required to initiate sliding in intra medullary devices as compared to sliding hip screw with plate. Amongst all intra medullary devices the Gamma nail requires the largest force. The explanation lies in the barrel of the side plate, the barrel provides a free passage for the screw to slide, thus the longer the barrel length the less the forces required to initiate sliding.

BARREL PLATE ANGLE

The most routinely used barrel plate angle in most studies is 135 degrees; this is because of the ease of insertion & the more anatomical restoration of femoral neck angle. However the 150 degree side plate has several advantages, since the forces are acting more in line with the screw less bending forces act across the screw so relatively less force is required to initiate sliding resulting in more impaction [24, 25]. Valgus hips are however more prone to develop early O. A.

SLIDING LENGTH

Gundle [26] 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 [27] 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.

SCREW CUT OUT

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[26]. 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[32] described the T.A.D as the distance from the tip of the screw to the subchondral bone in both the A.P. & lateral views .In his series of 120 cases he noted that not a single case screw cut out occurred if the T.A.D was maintained less than 25mm as compared to a historical control rate of 8 %.

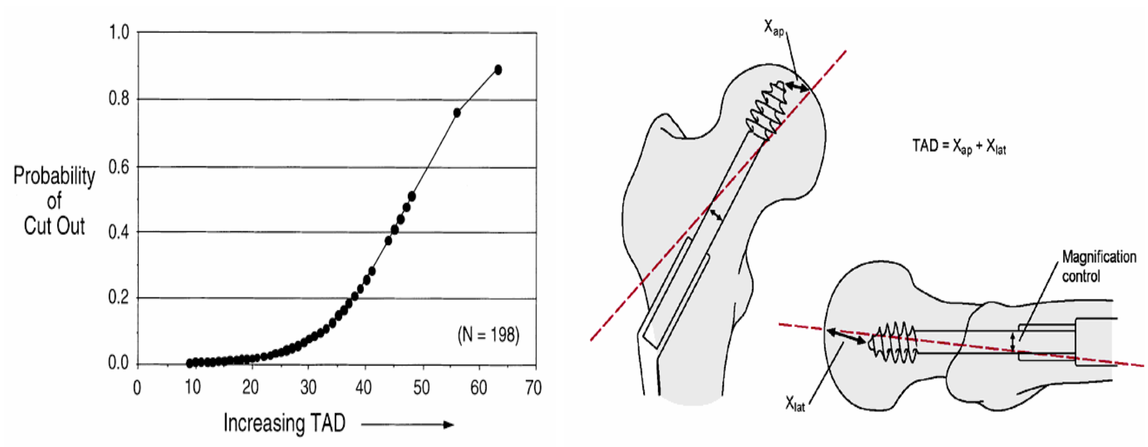


Fig: 14 Tip Apex Distance

JAMMING OF THE SCREW

Kyle in his study[28-33] noted that jamming of the crew within the barrel will occur if the bending forces exceed the compressive forces & the screw will impact against the barrel. This situation is avoided by:

1. Maximum engagement of the screw in the barrel.

2. Use of valgus angle devices.

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

STRAIN PATTERN

Rosenblum[24] in his biomechanical study of 10 cadeveric femora noted that the Gamma nail had an increasing stiffness. This stiffness was a result of:

• The large proximal diameter (17 mm) of the proximal end

• Larger compression screw diameter 12 mm as compared to 8 mm in the sliding hip screw.

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

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

1. Proximal diameter of 15mm.
2. Entry point is through GT and not pyriformis fossa (more valgus).

3. Smaller diameter tip causing less stress concentration and less chance of fracture[48].
4. Hip screw and Antirotation screw provide good compression at fracture site with adequate bone stock for revision.

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[36] **(**1949)

2. BOHLER'S CLASSIFICATION (1936)

3. BOYD & GRIFFIN CLASSIFICATION[37] (1949)

4. KYLE & GUSTILO CLASSIFICATION[33] **(**1979)

5. TRONZO CLASSIFICATION (1973)[38]

6. J.C.SCOTT'S CLASSIFICATION[39]

7. MURRAY AND FREW (1949)[40]

8. **JENSEN & MICHAELSON CLASSIFICATION**[41] **(**1975)

9. HAFNER'S CLASSIFICATION[42]

10. W.K. MASSIE'S CLASSIFICATION[43] (1963)

11. A.O. & O.T.A. (MULLER) CLASSIFICATION[6,44](1990)

1. EVAN'S CLASSIFICATION (Fig. 10)

Evans[32] in 1949, made an important step in understanding the stability of the intertrochanteric fractures. He observed that the key to a stable reduction is the restoration of the posteriomedial cortical continuity. In the stable group the posteriomedial cortex is intact or is minimally comminuted, making it possible to obtain a stable reduction. Unstable fractures on the other hand have extensive posteriomedial communition & displacement they are inherently unstable. Stability can be restored by obtaining opposition of the posteriomedial cortex. The reverse oblique fracture is inherently unstable because of the tendency of the shaft to displace medially.

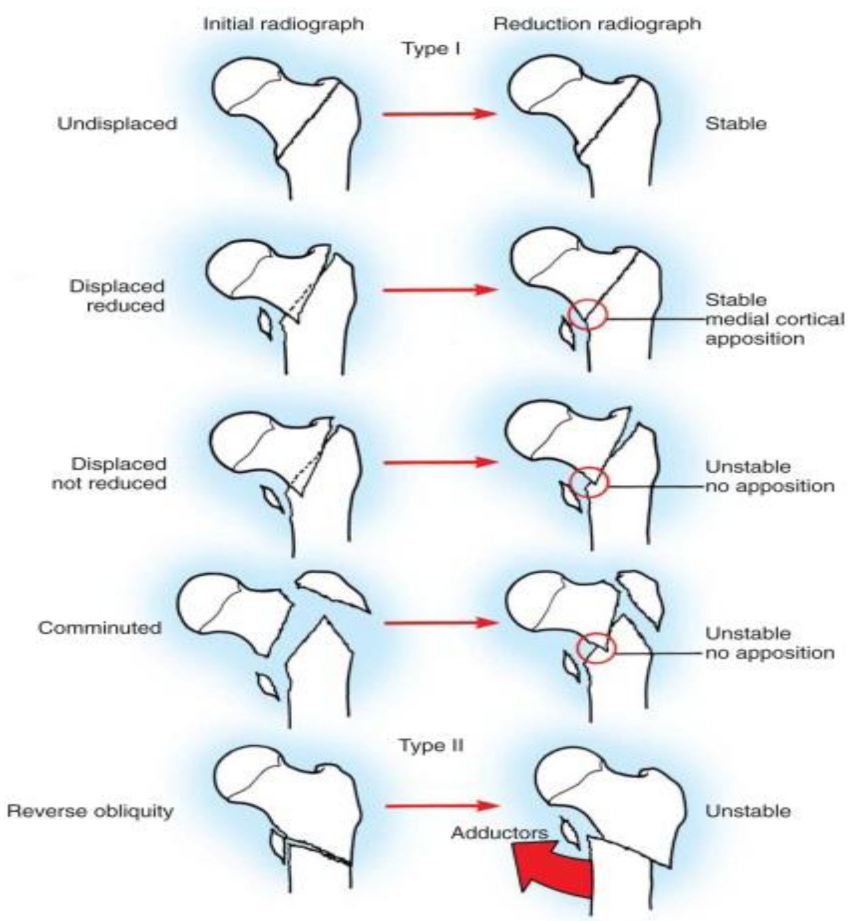


Fig. 15. Evan's Classification

2. BOHLER'S CLASSIFICATION: (1936)

TYPE I:

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

TYPE II:

Fracture through the trochanters 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 IV traction is applied along the long axis of the body because abduction produces coxa valga.

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

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

TYPE I:

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

TYPE II:

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

TYPE III:

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

TYPE IV:

Fractures of the trochanteric region and the proximal shaft with fracture in at least two planes. Reduction of TYPE I fractures are simple and can be maintained with little difficulty.

TYPE II, III & IV fractures are increasingly more difficult to reduce and to maintain reduction and are associated with more complications.

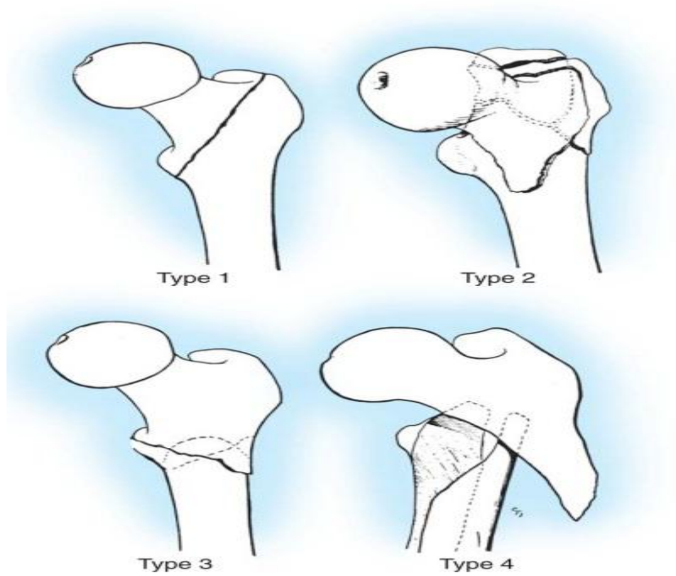


Fig. 16. Boyd and Griffin Classification

4. KYLE, GUSTILO & PRIMER'S CLASSIFICATION:

TYPE I:

Stable, undisplaced intertrochanteric fractures

TYPE II

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

TYPE III:

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

TYPE IV:

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

TYPE V:

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

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

5. TRONZO'S CLASSIFICATION (1973):

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

Type I

Incomplete trochanteric fractures with only greater trochanter fractured.

Type II

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

Type III

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

Type IV

Comminuted trochanteric fractures with disengagement of two main fragments.

Type V

Trochanteric fractures with reverse obliquity to the fracture line.

6. J.C.SCOTT'S CLASSIFICATION:

TYPE I:

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

TYPE II:

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

TYPE III:

Consists of, fractures with reversed obliquity, involving the lesser trochanter and 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 and whatever method of treatment is employed, the results were uniformly discouraging. The third group of fractures was less troublesome than the second.

7. MURRAY AND FREW (1949):

Based on the presence of the medial comminution.

TYPE I:

Stable, that is no medial comminution.

TYPE II:

Unstable, that is displaced lesser trochanter or larger femoral-arch fragment. This classification emphasizes the importance of the calcar femorale and the medial cortical buttress. This classification does not take into account the postero lateral 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 postero-lateral support due to displaced greater trochanters

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 and based on the presence of mechanical instability as related to detachments of the lesser and 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 and undisplaced. This leads to fairly reliable information about the reduction but does not give sufficient grading.

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

TYPE I: Stable, undisplaced

TYPE II: Stable, displaced

TYPE III: Unstable, displaced.

11. A.O. (MÜLLER) CLASSIFICATION:

The classification system devised by Müller & the A.O. group is extremely comprehensive & complete. Each region of the skeleton is assigned an alpha- numerical value & is further classified into a type & a sub group. Schatzker[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- Peritrochanteric multifragmentary

• 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

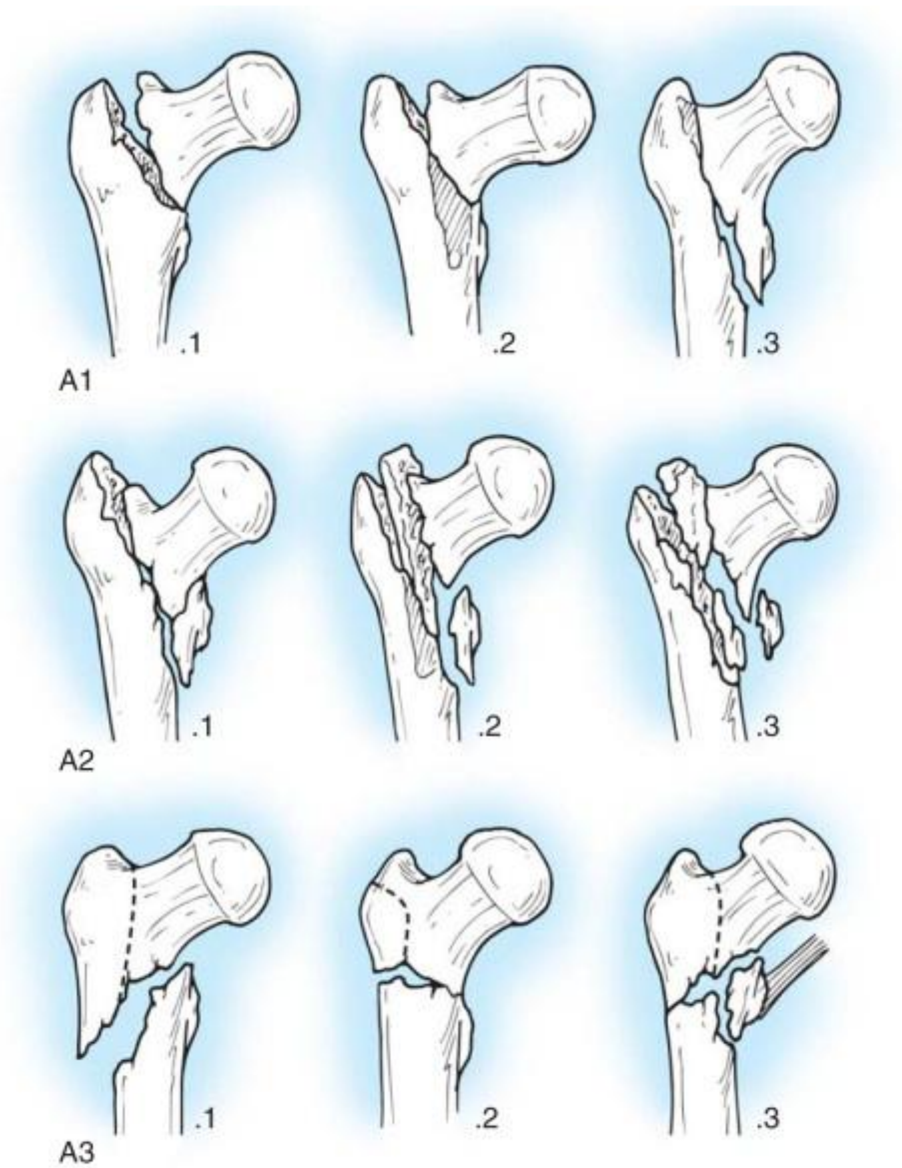


Fig 17 .AO classification of Intertrochanteric fractures

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.

On examination:

The attitude of the affected limb will be in the classical external rotation with shortening and the lateral border of the foot touching the bed completely.

There will be swelling around the hip and proximal thigh depending upon the severity of the trauma. Tenderness is present over the greater trochanter, patient is unable to lift the limb. There is a supratrochanteric shortening giving rise to true shortening of the limb. Abnormal movements and crepitus at the fracture site though not seen routinely due to acute pain are present.

Subcutaneous hemorrhages may become evident with the passage of time.

INVESTIGATIONS:

X-ray pelvis with hips AP and cross table lateral are diagnostic. It will show the site and type of fractures used in the variety of classifications. M.R.I. and bone scans are useful in the diagnosis of occult fractures.

TREATMENT

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

TYPES OF CONSERVATIVE TREATMENTS

The various conservative methods used in a patient who is unfit for surgery or unwilling for surgery are[41]:

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 upto the base of the toes with a wooden bar attached to the heel to prevent lateral rotation. After clinical and radiological union of fracture (10-12 wks), it is removed and physiotherapy is begun. This is an old form of treatment.

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

3) Skeletal traction: this is the commonest method used in conservatively treated cases. Heavy skeletal traction is used through the upper tibial skeletal pin over a BÖHLER BROWN splint. About 10% of the body weight is used for the traction; patient is advised to do the quadriceps exercise for the five minutes every one hourly. After 10-12weeks traction is removed and patient is gradually mobilized and walking aids are used initially till consolidation of the fracture.

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

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

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

TYPES OF OPERATIVE METHODS[3, 42]**:**

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 and thrombo-embolic diseases. It also minimizes the incidence of decubitus ulcers and limb contractures. Most intertrochanteric fractures are four part injuries, with secondary comminution of greater and lesser trochanters. The presence of the large posteromedial fragment defines an unstable pattern. Restoration of the bone opposition and stability by closed reduction on a fracture table is not possible in such cases with medial comminution. Successful reduction restores the osseous stability by achieving medial cortical abutment and impaction of the major fracture fragments in a normal or slight valgus alignment. An ideal fixation device should permit controlled intraoperative compression of the fracture and should allow the fracture to settle in a stable position and prevent nail protrusion through the femoral head. The device should act as an internal splint. Complications arise when the surgical construct is inadequate to with stand the major forces to which the proximal femur is subjected. Some of these complications are:

• Varus settling of the fracture.

• Cutting out or protrusion of the nail or screw.

• Fatigue failure of the implant.

Relative contraindications to the surgery are

• Contaminated wound at the operative site.

• Septicemia

• Delay in the treatment more than 3 wks

• Other associated conditions e.g. cardio pulmonary diseases, thrombo embolic diseases etc.

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

patients 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
- Kuntscher condylocephalic 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 by Thorton later modified by Holt, Jewett, Sarmiento, Mc Laughin etc. These devices were widely used in the past before invention of sliding screw plate devices. This nail does not allow control collapse. But with this, penetration of the nail in to the femoral head and in to the joint occurred with the collapse of the fracture. So a stable reduction before nail insertion is essential to prevent this complication. But this gives a poor grip in the proximal fragment increasing the chances of 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 then screws. It is much stronger than Jewett nail plate device.

SLIDING NAIL PLATE DEVICES:

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

PRINCIPLE:

To allow control impaction (collapse) were the shearing force on the femoral head is transferred to the axis of the sliding screw to produce a compression force (act as a lag screw) when fragments collapse the stem will back out within the barrel of the device. Clawson pointed out that to ensure impaction the barrel of the hip screw should not cross the fracture site. The screw has either sharp end or blunt end , the later prevents the head penetration. Dynamic hip screw has been shown to be superior to nail plate. Screw threads of the nail enhance the purchase in the osteoporotic bone and the groove in the barrel plate prevents rotation. Jamming, bending or failure to slide the screw acts as fixed angle nail plate .

Advantages of the Dynamic hip screw:

- Decreases the penetration of the nail into the acetabulum.
- Improves 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 condylocephalic 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 of the disadvantages associated with Proximal Femoral Nail:

- 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 proximal femoral nails having smaller 15mm diameter of the tip proximally. 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.

4. MATERIAL AND METHODS

The material for the present study was obtained from the patients admitted in B.L.D.E.A.S' Shri B.M.Patil Medical college hospital and research centre, Department of Orthopaedics with diagnosis of Intertrochanteric fracture from Oct 2011 to Aug 2013 . A minimum of 34 cases were taken and the patients were informed about the study in all respects and informed consent was obtained from each patient.

METHOD OF COLLECTION OF DATA

- By interview
- By follow up at intervals of 1, 2, 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 20 years of age.
3. Patient who are fit for surgery.

Exclusion criteria:

1. Age group less than 20.
2. Patients not fit/ not willing for the surgery.
3. Patients with compound fractures.
4. Patients with pathological fractures.
5. Patients with polytrauma.
6. Fractures with subtrochanteric extension.

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

INVESTIGATIONS

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

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

- HIV, HbsAg.
- Blood urea.
- Serum Creatinine.
- Blood sugar Level.
- ECG.
- Chest X –ray.

Physician opinions were taken as to the fitness of patient before surgery as and when necessary. X-ray were reviewed again and classified with using Orthopaedic Trauma Association (OTA) classification. All fractures were treated using a Proximal femoral nail. All patients were assessed by using the Kyle’s criteria at the follow-ups.

Proforma specially made for the study was used. Data collected at the end of the study was statistically compared and analyzed with the similar studies done before.

Proximal Femoral Nail Implant details:

The implant consists of a proximal femoral nail, self tapping 6.4mm hip pin, self tapping 8 mm femoral neck screw, 4.9 distal locking screws, and an end cap. Proximal femoral nail is made up of either 316L stainless steel or titanium alloy which comes in following sizes.

1] Length: standard PFN –250 mm Long PFN- 340, 380, 420mm.

2] Diameter: 9,10,11,12 mm.

3] Neck shaft angle range: 125^0, 130^0,135^0.

The nail is having 14mm proximal diameter. This increases the stability of the implant. There is 60 mediolateral valgus angle, which prevent varus collapse of the fracture even when there is medial comminution.

The distal diameter is tapered to 9 to 12 mm which also has grooves to prevent stress concentration at the end of the nail and avoids fracture of the shaft distal to the nail. Proximally it has 2 holes the distal one is for the insertion of 8 mm neck screw which acts as a sliding screw, the proximal one is for 6.4 mm hip pin which helps to prevent the rotation. Distally nail has two holes for insertion of 4.9 mm locking screws, of which one is static and the other one is dynamic which allows dynamization of 5 mm.

In our study we used a standard length PFN of 250 mm with distal diameter of 10,11,12 mm the proximal diameter of nail is 14mm.The proximal derotation screw of 6.4mm and distal lag screw of 8mm.Distal locking is done with self tapping 4.9mm cortical screws one in static mode and the other in dynamic mode allowing 5mm dynamization. The nail is universal with 6 degrees mediolateral angulation and with a neck shaft angle of 135 degrees. we did not use end cap.

Fig 18. Instruments used for proximal femoral nail

A.Sliding hammer rod **B**.Wrench **C**. Distal cortical screw drill bit **D**. Proximal screw drill bit **E.** Distal cortical screws **F**. Zig attached to nail with drill sleeves **G.** Screw driver **H.** Proximal screws **I**. Guide wire **J.** Reamer **K**. BoneAwl

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 PFN was fixed in a following manner:

Fig no 19 Patient positioning

1. Entry point

Insertion of the guide pin: It should be on the 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.

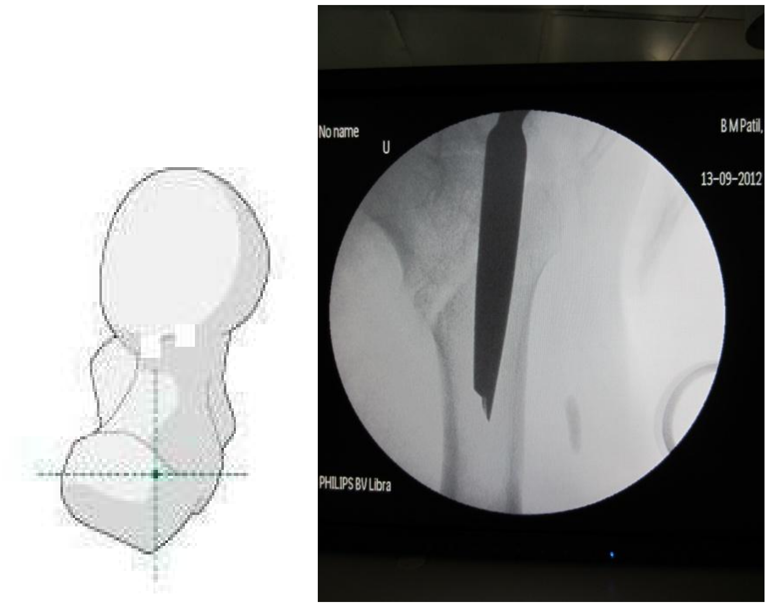


Fig no 20 entry point and confirmation by C-Arm

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.

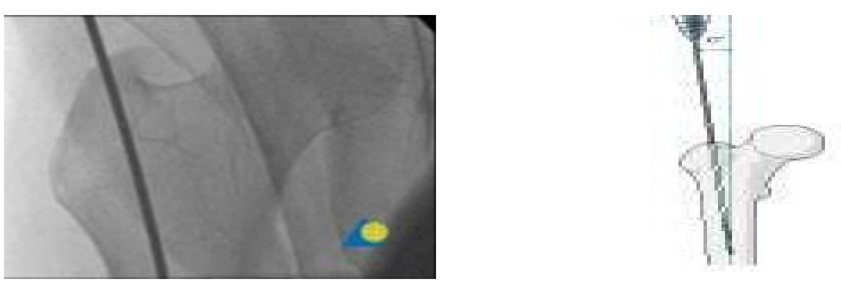


Fig no 21 Guide wire insertion

3. Reaming of the proximal femur

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

Reaming

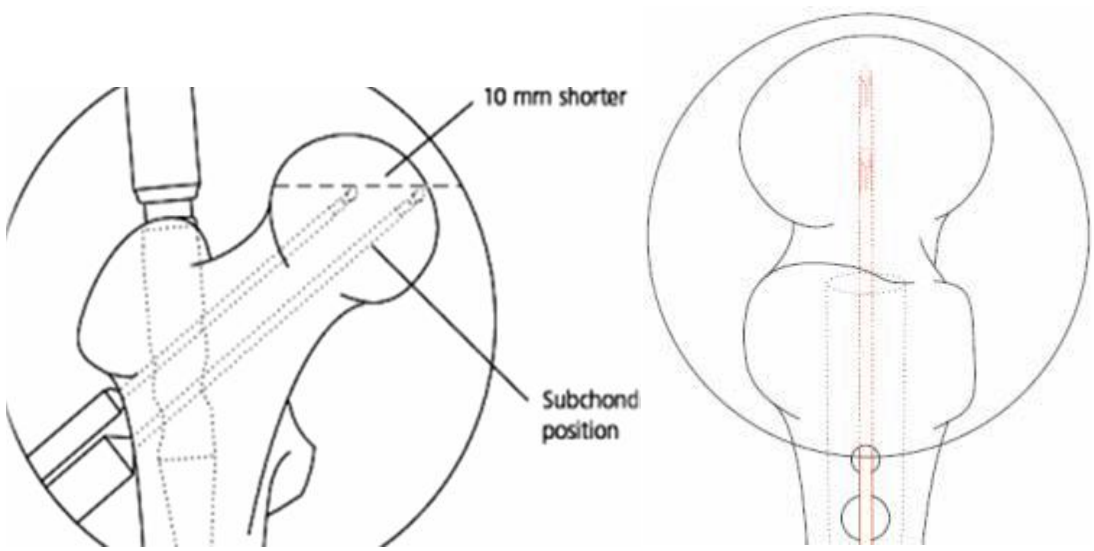
4. Nail insertion

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.



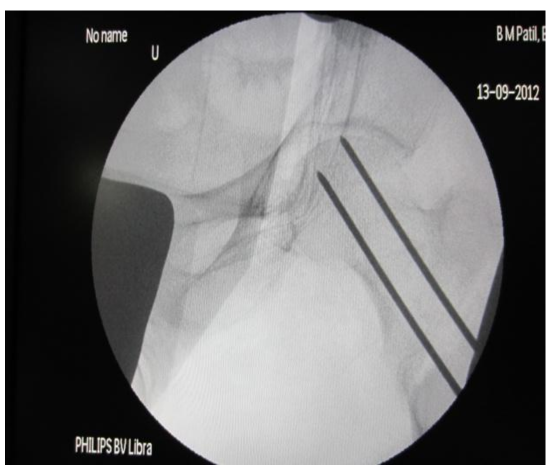


Fig no 23 Placing guide wire pins and confirmation under C-Arm

6. Inserting the screws after the final setting

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

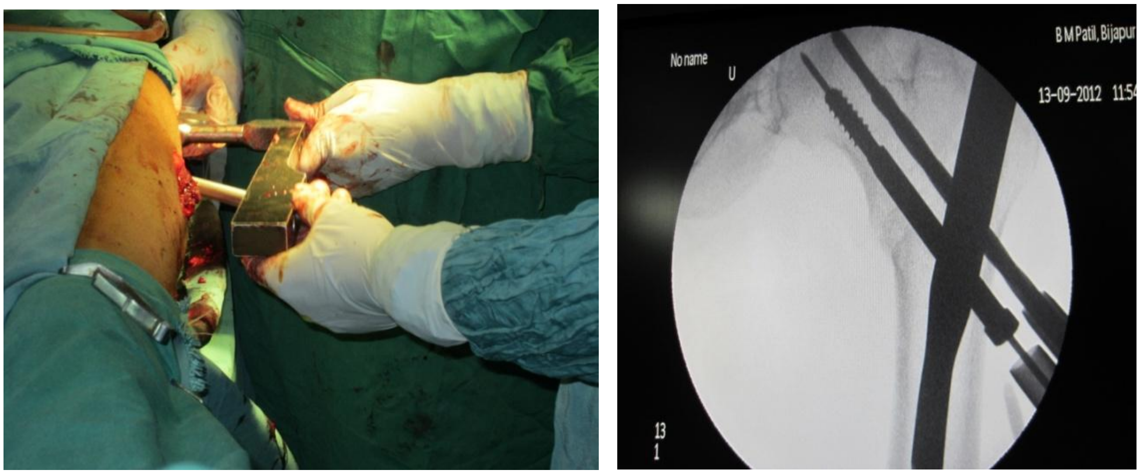


Fig no 24 Insertion of Proximal screws and confirmation under C-Arm

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

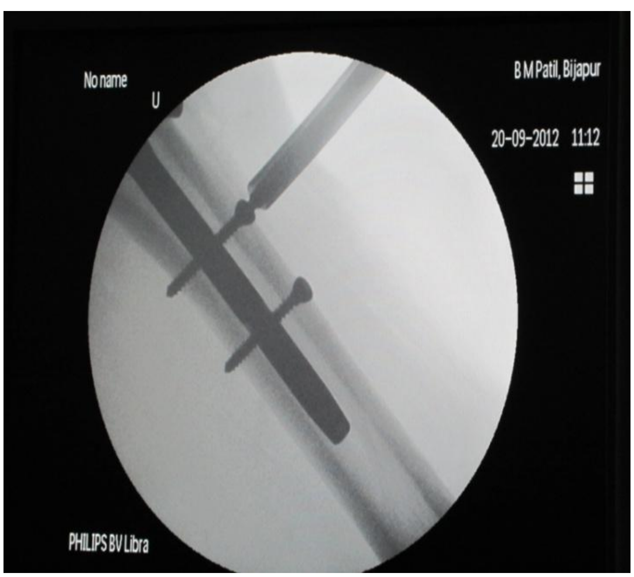


Fig no 25 Distal screw insertion

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.

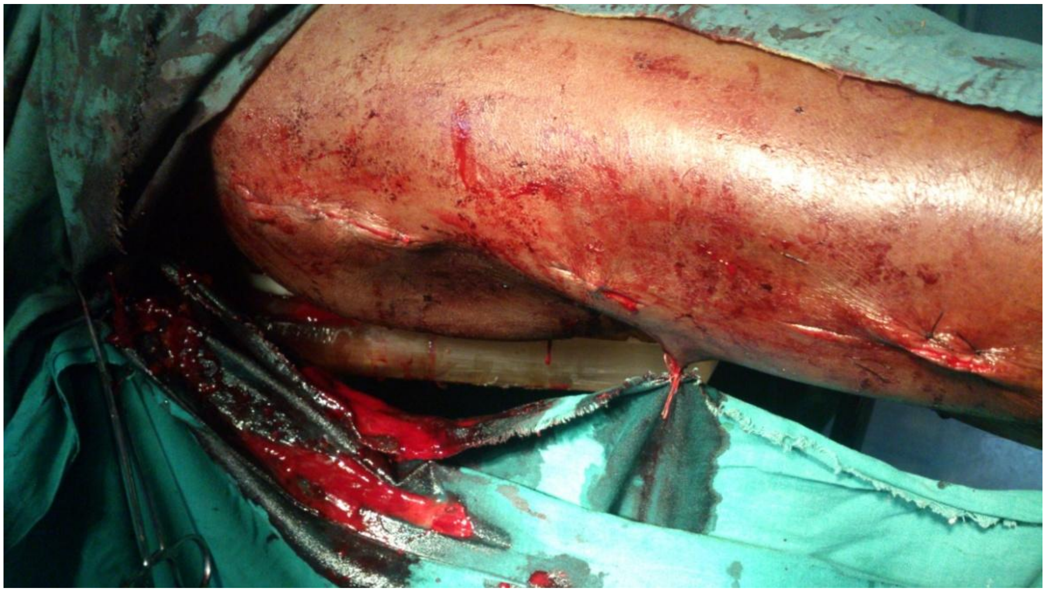


Fig no 26 Skin Closure

Following parameters were noted intra-operatively:

1. Total time of the surgery.

2. Blood loss: it was counted approximately by counting 50ml per mop used.

3. Radiation exposure.

POST OPERATIVE PROTOCOL

• The limbs were elevated on pillow and pts kept under observation in recovery room until stable then shifted to ward.

• IV antibiotics were continued for first 48 hours and then it was shifted to oral..

• Static quadriceps exercises were started on the fourth postoperative day.

• Active quadriceps and hip flexion exercise were started on 6^{th} and 7^{th} postoperative day.

• Dressing was done on 2nd, 5th and 8th post operative day.

• Sutures were removed on 12th post operative day.

• Patients were advised to walk non weight bearing walking on axillary crutches as soon as tolerable.

• Partial weight bearing walking was started at about 4 weeks post operatively.

• Full weight bearing walking was allowed after assessing for radiological & clinical union.

5. RESULTS AND OBSERVATION

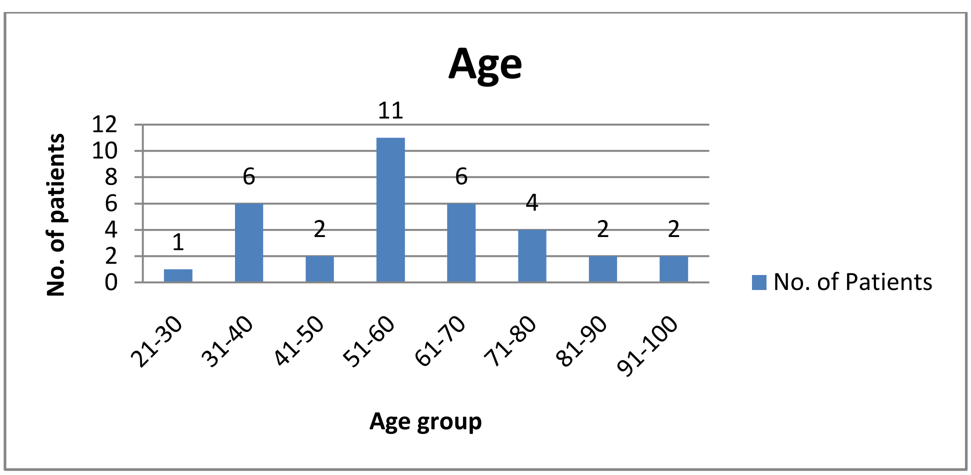
The study involved 34 confirmed cases of Intertrochanteric fractures of either sex from Oct 2011-August 2013. All the cases were treated with Intramedullary fixation "Proximal femoral nail". The analysis of the patient data, intraoperative data & postoperative outcome is as follows:

AGE

The study involved patients above 20 years of age. The age distribution was from 28 to 94 years. The average age was 57 years and the largest group of patients being from 51 to 60 years.

Age (yrs)	**No. of Patients**	**Percentage %**
21-30	**1**	2.94%
31-40	**6**	17.65%
41-50	**2**	5.88%
51-60	**11**	32.35%
61-70	**6**	17.65%
71-80	**4**	11.76%
81-90	**2**	5.88%
91-100	**2**	5.88%

Table – 1

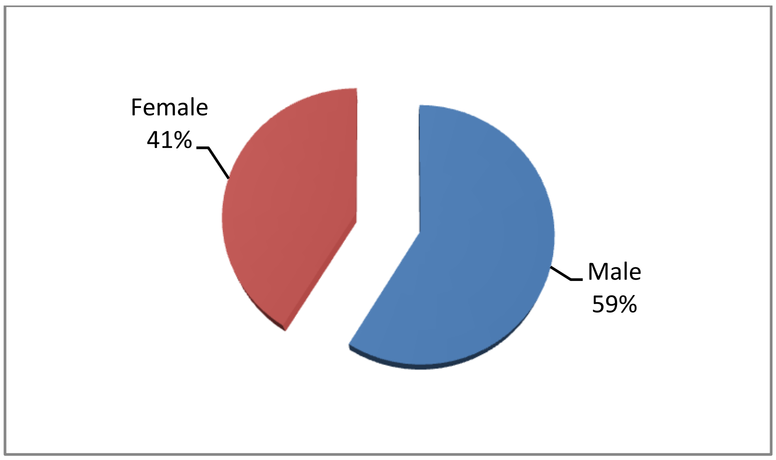


SEX

There were 20 males and 14 males in the study.

Table - 2

Sex	Number of cases	Percentage (%)
Male	20	59%
Female	14	41%

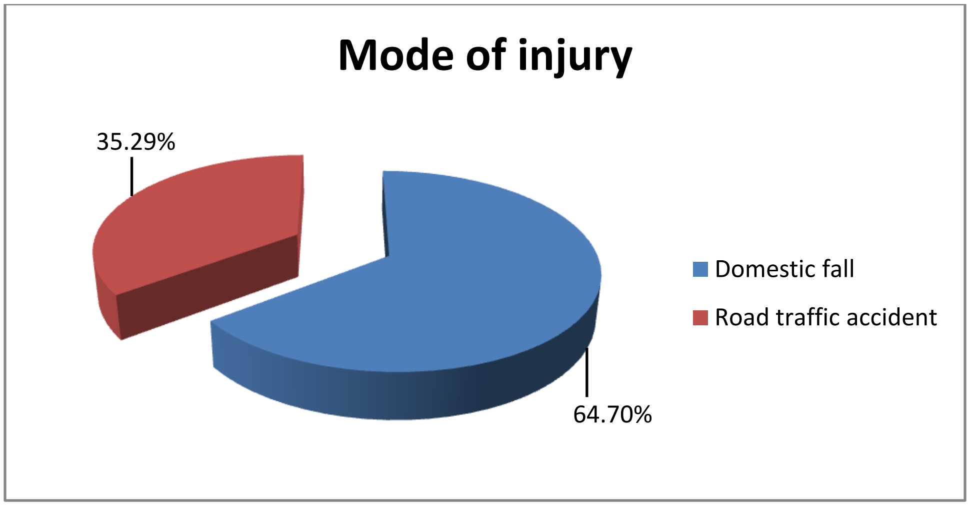


MODE OF INJURY

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

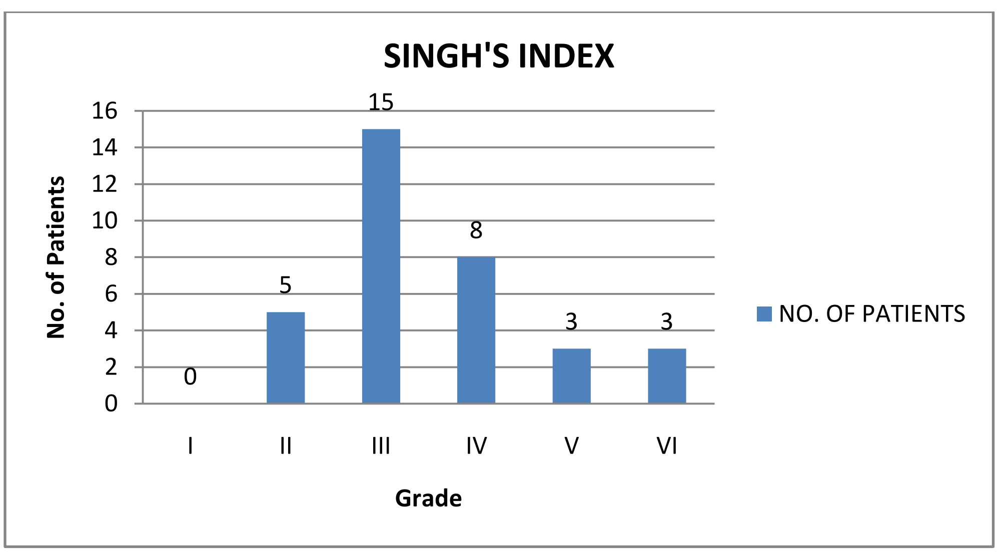
MODE OF INJURY	No of patients	Percentage (%)
Domestic fall	22	64.70%
Road traffic accident	12	35.29%



SINGH'S INDEX

GRADE	No of Patients	Percentage(%)
I	0	0%
II	5	14.70%
III	15	44.11%
IV	8	23.50%
V	3	5.80%
VI	3	5.80%

Table 4

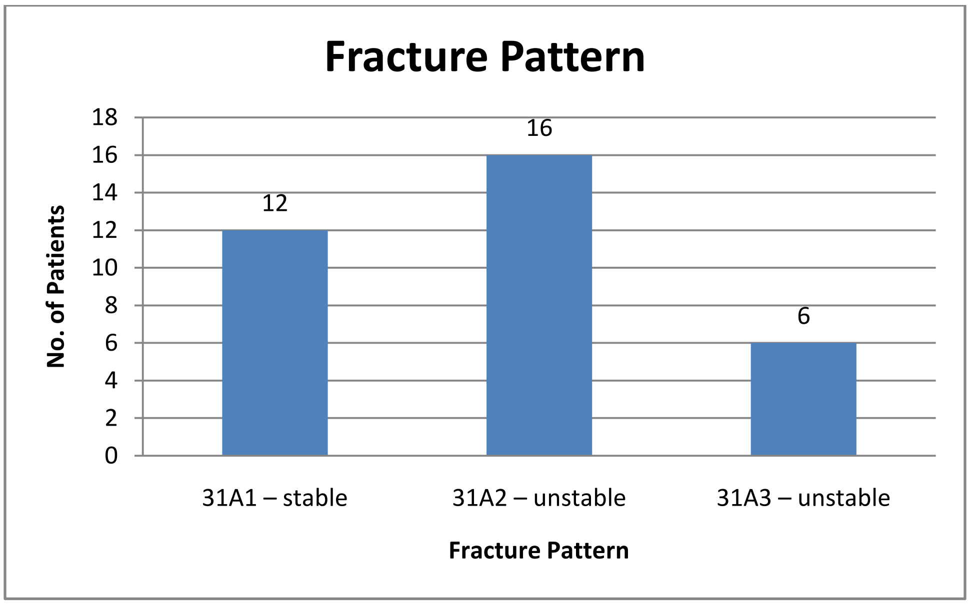


FRACTURE PATTERNS

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.

FRACTURE PATTERN	NO. OF PATIENTS	Percentage %
31A1 – stable	12	38%
31A2 – unstable	16	40%
31A3 – unstable (reverse oblique)	6	22%

Table - 6



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 mops so 81ml (50-150ml). 6 patients required intra operative blood transfusion as there preoperative hemoglobin was less. None required blood transfusion post-operatively.

RADIATION EXPOSURE

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

OPERATING TIME

Average operating time was 65mins (32min-95min) after anesthesia.

ASSOCIATED MEDICAL PROBLEMS:

Three patients (8.8%) were suffering from Hypertension , three patients (8.8%) suffering from Diabetes mellitus and two patients(5.8%) were having both Diabetes mellitus and Hypertension.

ASSOCIATED INJURIES :

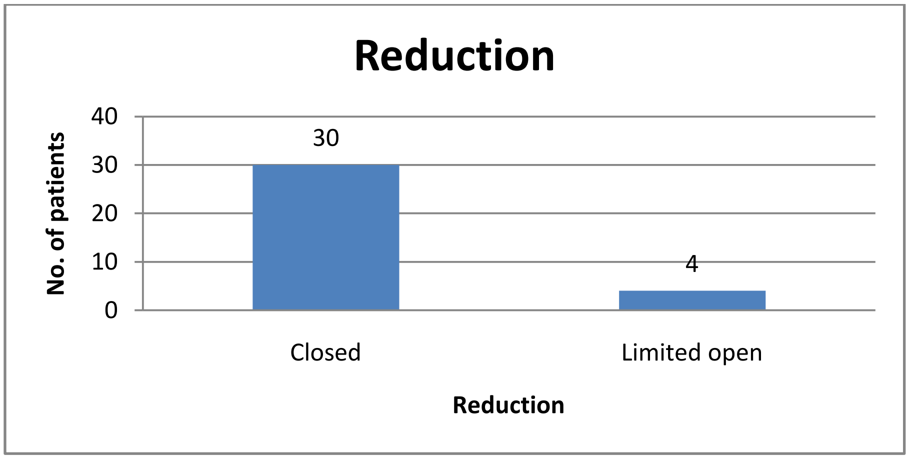
Two patients(5.8%) were having ipsilateral Distal end radius fracture and one patient (3%) from ipsilateral humerus shaft fracture

REDUCTION

Fracture was reduced anatomically by closed means. If that was not achieved then it was achieved by limited open reduction during surgery. Closed reduction was achieved in 30 patients (88.24%).

Table- 7

Reduction	No. of patients	(%)
Closed	30	88.24
Limited open	4	11.76



COMPLICATIONS

Intra – Operative complication

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

- . In four of our patient we had to do open reduction.
- . In two cases we failed to achieve anatomical reduction .
- . In one patient we failed to put derotation screw.
- We faced difficulty in distal locking in two patients.
- 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
- Jamming of Instruments in 2 patients
- No Breakage of drill bit

Table - 8

Sl . no	Complications	No of patients
1)	Difficulty in achieving closed reduction	4 (12%)
2)	failed to achieve anatomical reduction	2 (6%)
3)	failed to put derotation screw	1(3%)
4)	difficulty in distal locking in two patients	2 (6%)
5)	fixation of fracture in varus angulation	1 (3%)
6)	Fracture of lateral cortex	0 (0%)
7)	Jamming of Instruments	2 (6%)

Post operative complication:

Early :

- Shortening of 2mm is seen in 1 patients.
- No Rotation deformity seen.
- In one patient Superficial infection is seen.
- No cases of Deep infection.
- None suffered from Bed sores.
- No Mortality.

Table 9

Sl .no	complication	No of patients
1	Shortening	**1 (3%)**
2	Rotation deformity	**0 (0%)**
3	Superficial infection	**3 (9%)**
4	Deep infection	**0 (0%)**
5	Bed sores	**1 (3%)**
6	Mortality	**0 (0%)**

Late complications:

1.Implant failure

There were 2 (6 %) cases of implant failure in both cases revision surgery was required.

In 1 case the ‘Z’- effect of implant failure was seen and in another case breakage of the intramedullary nail is 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 .Mal-Union.

One patient had Mal union in my study

4. Greater trochanter splintering

It was seen in 1 (3%) patient but it did not cause any complication later and healed well.

Table - 10

Sl no	Complications	No of patients
1	Implant failure	2(6%)
2	Mal union	1(3%)
3	Non union	0(0%)
4	Greater trochanteric splintering	1(3%)

HOSPITAL STAY

The average hospital stay was 15.11 (10- 22) 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][29]

All the patients after union of fracture or after 16 wks 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 legged 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 legged 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 legged.

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 legged or squat.

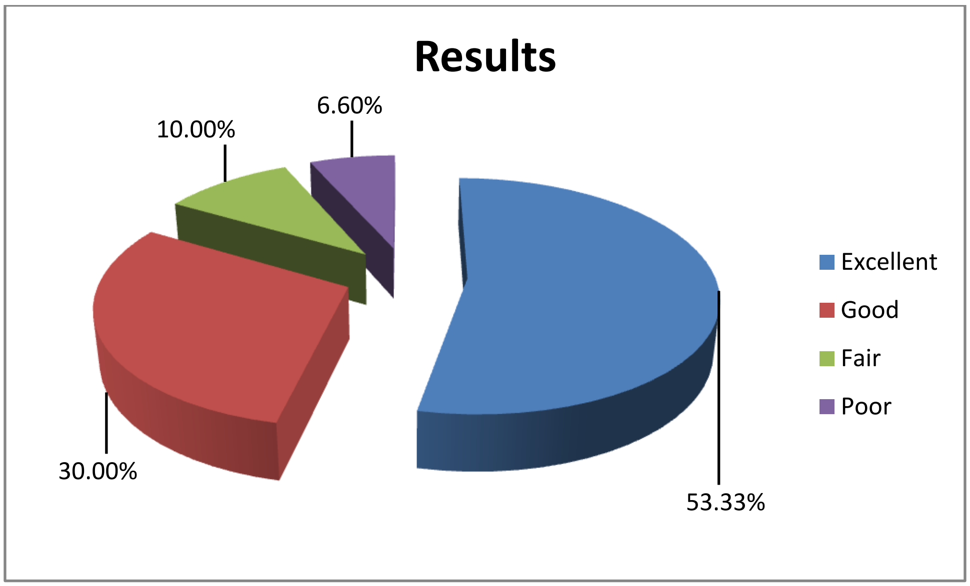
g. Patient cannot walk without walking aid.

h. Normal activities not resumed.

RESULTS ACCORDING TO KYLE'S CRITERIA

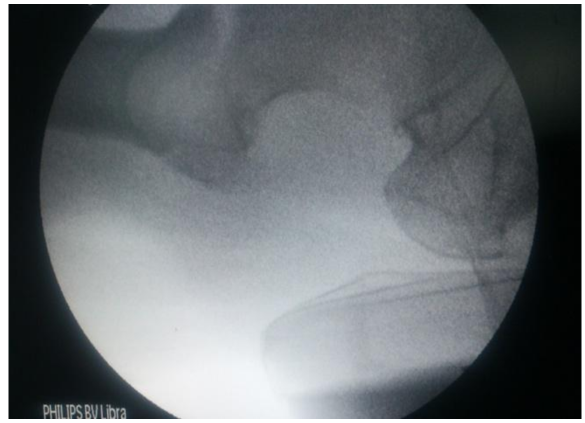
Table - 11

RESULTS	**Percentage**
Excellent	53.33% (16)
Good	30% (9)
Fair	10% (3)
Poor	6.6% (2)



CLINICAL PHOTOGRAPHS

Intra op reduction on fracture table AP view



Intra op reduction Lateral view

12th Post op day for suture removal

12th Post op day walking with help of walker

Case 1 :

Operative site

Flexion

SLRT

Squatting

Abduction at hip

Case 2

Operative site **Flexion at hip**

Flexion at hip

Rotations at hip


Abduction of hip

Extension of hip

Flexion at hip

Flexion at hip

Case 3

Sitting cross legg

Weight bearing on operative leg

Squatting

Radiographs Case 1

Pre op

Immediate Post op

Post op – 3 months

Post op – 6 months

Case 2 :

Pre op.

Immediate post op

Post op at 3 months

Post op at 6 months

Pre op

Immediate post op

Lat view of Immediate post op

At 3 months

Post op at 6 months

Complications :

Failure to insert distal screw

Implant breakage

Z effect

6. DISCUSSION

The successful treatment of Intertrochanteric fractures depends on many factors like[47]:

- Age of the patient
- Pts 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 34 patients of Intertrochanteric fractures were studied.

In our study the average age was 57 years which was comparable to Indian as well as western authors with similar study.

We had an 20 male patients and 14 female patients, this resembles many Indian studies

The most common mode of injury in our study was domestic fall 62%, 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 32% were stable fracture pattern and 68% 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 42% 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 65 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 Proximal femoral nailing.

The average hospital stay was 15.11 days. It was more in patients with co-morbid conditions and complications with highest being 22 days.

Total Post op complications in our study were 20%. We had "Z - effect" in 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 different size screws and fracture healed well after revision. This was comparable to W.M.Gadegone et al[12] it was slightly lower than their study.

One patient (3%) came with implant breakage this has been addressed with new same kind of implant.

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 9% 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[33] in our series we had 53.3% excellent, 30% good, 10 % fair and 6.6% poor results. It was similar to W.M.Gadegone et al[12] and pavelka et al[11] that the use of PFN may have a positive effect on the speed at which walking is restored.

In the series of 295 patients with trochanteric fractures treated with PFN by Domingo et al[48] 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 Proximal 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 24% 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 Proximal 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 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 favorable 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.[8]

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

The plate and screw device will weaken the bone mechanically. The common causes of fixation failure are instability of the fractures, osteoporosis, lack of anatomical reduction, failure of fixation device and incorrect placement of the screw.[49-50]

We found Proximal femoral nail to be more useful in unstable and reverse oblique patterns due to the fact that it has better axial telescoping and rotational stability. It has shown to be more biomechanically stronger because they can withstand higher static and several fold higher cyclical loading than dynamic hip screw. So the fracture heals without the primary restoration of the medial support. The implant compensates for the function of the medial column.[11]

The gamma nail is associated with specific complications[20] like anterior thigh pain, fracture at the tip of the nail.[51] But Proximal femoral nail is long and it has smaller diameter at the tip which reduces the stress concentration at the tip.[52]

Its position is near to the weight bearing axis so the stress generated on the implant is negligible. Proximal femoral nail also acts as a buttress in preventing the medialization of the shaft. The entry point of the Proximal femoral nail is at the tip of the greater trochanter so it reduces the damage to the hip abductors[53] unlike the nails which has entry through pyriformis fossa[54]. The hip screw and the anti rotation cervical screw of the Proximal femoral nail adequately compress the fracture, leaving between them adequate bone block for further revision should the need arise.

7. 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 Proximal femoral nail in Intertrochanteric fractures we can say that:

PROXIMAL 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 Proximal 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 PROXIMAL 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 Proximal Femoral Nail.

In our series of 34 cases there were 20 male and 14 female, maximum age of 94 yrs and minimum age of 28 yrs, most of the patients were between 51 to 60 yrs. Mean age of 57 yrs. 65% of cases were admitted due to Domestic fall and 35% 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 15.11 days and mean time of full weight bearing is 6 wks. Out of 34 cases 1 case expired after 4 months due to non orthopaedic cause and 3 cases were lost to follow up. Good to excellent results are seen in 83.3% cases, Fair in 10%, 6.6% case with poor results.

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ANNEXURE I

Ethical Committee
BIJAPUR-586103
OUT WARD
No 27/2011
Date 21-10-11
Shri B. M. PATIL Medical College

B.L.D.E. UNIVERSITY'S

SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103

INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 20-10-2011 *at* 10-30 am *to scrutinize the Synopsis/Research projects of postgraduate/undergraduate student/Faculty members of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis/Research project has been accorded Ethical Clearance.*

Title Management of intertrochanteric fractures of hip in adult treated with proximal femoral nail - A clinical study

Name of P.G./U.G. student/Faculty member Dr. Preetish Endigeri, Dept of Orthopaedics

Name of Guide/Co-investigator Dr. O.B. Pattanashetty Prof & HOD Orthopaedics

DR.M.S.BIRADAR,
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Chairman
Ethical Committee
BLDEA'S Shri. B.M. Patil
Medical College
Bijapur-586103

Following documents were placed before E.C. for Scrutinization

1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

ANNEXURE II

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR — 586103.

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

- Flexion
- Adduction
- Abduction
- Rotation

- Quadriceps
  - Wasting
  - Power

- Shortening

➢ Radiological

- Position of the in-implant
- Position of fragments

o 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

ANNEXURE III

SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR - 586103.

CONSENT FORM

TITLE OF RESEARCH: "MANAGEMENT OF INTERTROCHANTERIC FRACTURES OF HIP IN ADULTS TREATED WITH PROXIMAL FEMORAL NAIL"

Principle Investigator : DR. PREETISH ENDIGERI

P.G. Guide Name : DR. O. B. PATTANASHETTY M.S (ORTHO)

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

I) INFORMED PART

i. Purpose of study:

I have been informed that this study will test the effectiveness of one particular method of open reduction and internal fixation in intertrochanteric fracture of proximal femur. This method requires hospitalization.

ii. Procedure :

I will be selected for the treatment after the clinical study of my age, type of fracture, condition of bone seen in radiograph and after study of fitness for anaesthesia and surgery

.I will be admitted immediately. I will have to attend follow-up to OPD regularly. I will be assessed in physiotherapy department also.

iii. Risk and Discomfort:

I understand that I may experience some pain and discomfort during the post operative period and during the period of non- weight bearing ambulation. This condition is usually expected. These are associated with the usual course of treatment

iv. Benefits:

I understand that my participation in this study will have no direct benefit to me other than the potential benefit of treatment which is planned to heal my fracture in the shortest possible period and restore my function.

v. Alternatives:

I understand that, the various alternative modes of treatment available to me in this fracture pattern with their merits and demerits have been explained to me.

vi Confidentiality :

I have been assured that all information furnished to the doctor by me regarding my medical condition will be kept confidential at all times and all circumstances except legal matters.

vii. Requires for more information :

It has been made clear to me that I am free at all time under any circumstances to touch based with doctor by directly approaching or otherwise to satisfy any query doubt regarding any aspect of research concerns.

viii. Refusal or withdrawal of participation:

It has been made clear to me that participation in this medical research is solely the matter of my will and also that right to withdraw from participation in due course research at any time.

DR.O.B.PATTANASHETTY DATE:

II) CONSENT BY PATIENT

I , the undersigned ______________________ have been explained by Dr O. B. Pattanashetty in the language understood by me. The purpose of research and details of procedure that will be implemented on me. The possible risks and discomforts of surgery and anaesthesia have been understood by me. I have also been explained that participation in this medical research is solely the matter of my will and also that I have the right to withdraw from this participation at any time in due course of the medical research.

Signature of participant/patient date: time:

Signature of witness: date: time:

ANNEXURE IV

Key to master chart

1. Name :
2. IP. No : Hospital number of the patients
3. Sex : Sex of the patient
4. D.O.S: Date of surgery
5. MOI : Mode of the injury
    a. Domestic fall =D
    b. Road traffic accidents =R
    c. Other =O
6. SI : Singh's Index Grade I,II,III ,IV, V and VI
7. Side : Side of the injury Lt = Left , Rt = Right
8. Type of # : Type of fracture according to the AO Classification
    a. A1=31A1.
    b. A2=31A2.
    c. A3=31A3.
9. Ass Med problems : Associated medical problems.
    a. DM : Diabetes Mellitus.
    b. HTN : Hypertension.
10. Ass injuries : Associated injuries.
    a. D R # : Distal end radius fracture.
    b. Humerus # : Humerus fracture.

11. BL : Blood Loss occurred during surgery , according to number of mops used 1 mop= 50ml blood loss, 2 mops =100ml blood loss and 3 mops = 150 ml
12. RD : Radiaton by C-Arm at 63 gy rads in seconds
13. Imm Compl: Immediate complication
    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

ANNEXURE V

MASTER CHART

Sl no	Name	IP NO	Age	Sex	D/O/S	MOI	SI	SIDE	Type of #	Med Probl	Ass Injuries	BL	RD	ImmComp.	D compl	HS	Result
1	Sadappa Mongali	22545	60	M	26/10/11	D	III	Lt	31A2	DM	NIL	1	680	OR	SI	15	G
2	Basappa Hadimani	19205	52	M	16/11/11	R	IV	Rt	31A1	NIL	NIL	2	600	NIL	NIL	18	E
3	Prakash Korwar	19278	32	M	26/11/11	R	V	RT	31A3	NIL	NIL	2	690	Jamming	NIL	12	G
4	Madesh sajjan	25173	38	M	7/12/2011	R	V	Rt	31A2	NIL	NIL	1	700	Jamming	NIL	12	E
5	Danappa Kattimani	26367	81	M	16/02/2012	D	II	Lt	31A2	HTN	NIL	1	520	NIL	NIL	13	G
6	Basavaraj Kudashi	2813	28	M	23/02/2012	R	VI	Rt	31A2	NIL	NIL	1	500	NIL	NIL	15	E
7	Ratnamma Vaggar	3696	68	F	24/02/2012	D	III	Lt	31A1	NIL	D R #	2	420	NIL	NIL	13	G
8	Yamanawwa Gugihal	3792	65	F	21/02/2012	D	III	Rt	31A1	NIL	NIL	1	450	NIL	NIL	14	E
9	Bhimray Kotikar	9448	90	M	5/3/2012	R	II	Lt	31A2	HTN/DM	NIL	1	720	OR	BS & SI	20	F
10	Shantabai Patil	2938	55	F	5/3/2012	R	III	Rt	31A1	NIL	NIL	2	680	NIL	NIL	15	E
11	Kariyamma Janavar	5051	78	F	8/3/2012	D	III	Lt	31A2	NIL	Humerus shaft #	2	750	OR	SI	13	F
12	Shiranagouda Patil	6154	94	M	15/3/2012	D	II	Rt	31A1	NIL	NIL	1	500	NIL	NIL	22	NAF
13	Seethabai Mogli	6153	70	F	24/3/2012	D	III	Rt	31A2	NIL	NIL	1	610	NIL	NIL	12	G
14	Nimbewwa honi	8748	80	F	30/3/2012	D	III	Rt	31A1	HTN	NIL	1	650	NIL	NIL	12	G
15	Honappa Hosamani	6776	54	M	17/4/2012	D	IV	Lt	31A2	NIL	NIL	2	700	OR	NIL	12	E
16	Mallappa Badiger	6876	36	M	4/4/2012	R	VI	Rt	31A1	NIL	NIL	2	520	NIL	NIL	10	E
17	Siddappa Parragond	10603	64	M	21/05/2012	D	III	Rt	31A2	NIL	NIL	1	580	NIL	IF	11	P
18	Gangabai Jadhav	11742	40	F	29/5/2012	R	VI	Lt	31A1	NIL	NIL	2	640	NIL	NIL	12	NAF
19	Ningamma Murgod	13107	60	F	16/6/2012	D	III	Rt	31A1	NIL	NIL	1	480	NIL	NIL	11	E
20	Ningagewwa Monikar	14598	70	F	16/7/2012	D	III	Lt.	31A3	DM	D R #	2	600	NIL	SI	12	E
21	Dasgirsab Mulla	15896	65	M	25/7/2012	D	III	Rt	31A2	NIL	NIL	1	550	NIL	NIL	10	E
22	Lashibhai Dashawant	17304	57	F	11/8/2012	D	IV	Rt	31A2	NIL	NIL	2	710	VA	Short & MI	12	F
23	Neelawwa Gadag	18485	55	F	29/8/2012	R	IV	Lt	31A2	NIL	NIL	2	650	NIL	NIL	11	E
24	Balasaheb Kashiger	20096	75	M	13/9/2012	D	III	Lt	31A3	HTN/DM	NIL	2	730	NIL	NIL	18	E
25	Mahadev Kolekar	20025	35	M	12/9/2012	R	IV	Lt	31A1	NIL	NIL	1	580	NIL	GTS	16	G
26	Gangamma Patil	23412	85	F	22/10/2012	D	II	Lt	31A2	NIL	NIL	1	480	NIL	NIL	13	NAF
27	Dattatrayya Walikar	22881	59	M	22/10/2012	D	IV	Lt	31A3	NIL	NIL	1	450	NIL	NIL	17	E
28	Shantabhavi Kumbar	25753	60	M	8/11/2012	D	III	Lt	31A1	DM	NIL	2	510	NIL	IF	16	P
29	Suresh Biradar	26612	35	M	28/11/2012	R	V	Rt	31A1	NIL	NIL	2	660	DL	NIL	10	E
30	Fakirappa Chappaband	29931	60	M	22/12/2012	D	III	Rt	31A3	NIL	NIL	1	530	NIL	NIL	13	E
31	Devu Chavan	1621	80	M	28/1/2013	D	II	Lt	31A2	HTN	NIL	2	610	NIL	NIL	17	G
32	Rohit Bhushannavar	913	45	M	12/1/2013	R	IV	Rt	31A3	NIL	NIL	2	640	NIL	NIL	13	E
33	Basavaraj Budihal	5431	45	M	28/2/2013	R	IV	Lt	31A1	NIL	NIL	1	660	NIL	NIL	13	G
34	Shivappa Biradar	4151	60	M	15/2/2013	D	III	Lt	31A2	NIL	NIL	2	620	DL	NIL	15	NAF