# "COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES"

By

**DR. DHRUVEN S KOSADA**

DISSERTATION SUBMITTED TO

**SBKS MEDICAL INSTITUTE & RESEARCH CENTRE**

**SUMANDEEP VIDYAPEETH, PIPARIA, VADODARA**

In Partial Fulfillment of The Requirements For The Degree Of

**M.S.**

**In**

**ORTHOPEADICS**

**Under the Guidance of**

**DR. SARVANG M. DESAI**

**PROFESSOR**

**M.S., (ORTHO)**

**DEPARTMENT OF ORTHOPEDICS**

**SBKS MEDICAL INSTITUTE & RESEARCH CENTRE,**

**PIPARIA, VADODARA**

**YEAR 2015-2018**

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This is to certify that your study synopsis entitled: "Comparative Study of Ante grade Femoral Nailing vs. Proximal Femoral Nailing for the Treatment of Proximal Femoral Fractures" Research Project was done by **"Dr. Dhruvensinh Kosada"** (PG Student. Dept of Orthopedics. S.B.K.S MI & RC. Dhiraj Hospital. Piparia. Waghodiya road. Vadodara-391760. Gujarat) and it was conducted to the satisfaction of the Sumandeep Vidyapeeth Institutional Ethics committee.

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I hereby declare that this dissertation / thesis entitled **"COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES**" is a bonafide and genuine research work carried out by me under the guidance of **Dr. Sarvang M. Desai (professor and head of unit department of orthopaedics)**

**Date:** **Signature of the candidate**

**Place:Piparia, Vadodara** **Dr.Dhruven S Kosada**

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I express my sincere thanks to the Member Secretary of Institutional Ethics Committee (Human) of SUMANDEEP VIDYAPEETH for permission to carry out and providing facilities for the present study.

**Dr.Dhruven S. Kosada**

# ABSTRACT


**TITLE: "COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES"**

**BACKGROUND**

For unstable intertrochanteric femoral fractures, the treatment options are innumerous, though the implant choice is debatable. In our institute we use proximal femoral nail and antigrade femoral nail for the treatment of unstable intertrochanteric femoral fractures.

**AIM & OBJECTIVE**

- To study and compare the clinical results and functional outcome of various implant used for treatment of unstable intertrochanteric fractures routinely used in our institute Proximal femoral nail and Antegrade femoral nail.
- To review the available literature concerning these implants for treatment of Unstable Intertrochanteric Fractures.

**MATERIALS AND METHOD:**

We have operated total 40 cases with unstable intertrochanter fracture. We have treated patient with proximal femoral nailing and antigrade

femoral nailing.Clinical outcome and function results were evaluated by salvati Wilson hip score.

**RESULT:**

We have operated total 40 cases with proximal femoral nailing and antegrade femoral nailing in unstable intertrochanteric fracture. average union time was in AFN (13.5 weeks) and in PFN(11.9 weeks). We have achieved 70% of excellent result in both. But fair result in PFN 10% and 15% in AFN.

**CONCLUSION:**

With strict adherence to anatomical reduction, proper fixation and proper in time regular physiotherapy protocol, We get satisfactory results in all cases treated by cephalocondylar nail.

Normally antegrade femoral nail (AFN) is entered just lateral and distal to tip of greater trochanter which makes it vulnerable to pass through the fracture site, thus creating a gap between proximal and distal fragment.

Thus, we suggest that though antigrade femoral nail is good implant for subtrochanteric fracture element.

It's use in intertrochanteric fracture has got inferior outcome compared to proximal femoral nail thus making proximal femoral nail more preperable implant for treatment of intertrochanteric fracture.

# INDEX

# INTRODUCTION

Hip fractures are among the most devastating injuries, especially in the elderly and the impact of these fractures goes far beyond immediate clinical considerations and extends into the domains of medicine, rehabilitation, psychiatry, social work and medical economics.

The incidence of intertrochanteric fractures is gender and race dependent varying from country to country.

The statistics of hip fracture in India is not well collated. However, the incidence of hip fractures in India 1325/100000 per year. Nearly nine out of ten hip fractures occur in patients older than sixty five years of age and about three out of four occur in women1attributing mainly due to post-menopausal osteoporosis Approximately half of these injuries are intertrochanteric fractures occurring at an annual rate of sixty - three per 1,00,000 in elderly women and thirty four per 1,00,000 in elderly men.

Unstable fracture patterns are (1) reverse obliquity fractures, (2) trans trochanteric fractures, (3) fractures with a large posteromedial fragment implying loss of the calcar buttress, and (4) fractures with sub trochanteric extension[1].

Before the introduction of suitable fixation devices in 1960s, treatment for intertrochanteric fractures was necessarily non operative, which was not uncommonly associated with high complication rates due to prolonged bed rest, resulting in high mortality rates[2]. Operative management consisted of fracture reduction, stabilization and fixation with a rigid stable implant, permitting early mobilization thus helping in minimizing the compications[2] such as venous thrombosis, pulmonary complications,

pressure sores and generalized deconditioning. Hence surgical fixation of intertrochanteric femur fractures remains the standard care; however the best method of surgical fixation is still debatable[3].

Techniques of operative fixation have changed dramatically since the 1960s in order to address the problems associated with early fixation devices.

The problems encountered were more common in treatment of unstable trochanteric fractures and resulted in the evolution of fixed angle nail plate device to the sliding nail plate device to intramedullary nail devices.

Intertrochanteric fracture fixation with a dynamic hip screw and side plate device has long been the gold standard[4], nonetheless mechanical and technical failures continue to occur in as many as 6% to 18% of cases [5,6]. Furthermore, a common problem with use of a dynamic hip screw in unstable fracture patterns is excessive settling of the fracture, leading to medialization of the femoral shaft and lateralization of greater trochanter [6,7,8]. This varus collapse leads to shortening of the limb length and lever arm of the abductor mechanism of the hip, leading to abnormal hip biomechanics [8,9]. It also results in implant pullout, cutout and hip joint penetration.

Hence new implant designs such as intramedullary nails have recently challenged the compression hip screws as the best method of treatment for unstable intertrochanteric fractures. The intramedullary nails claims to offer potential advantages in the form of more efficient load transfer, decrease of tensile strain of the implant. This in turn decreases the risk of implant failure with added advantage of controlled fracture impaction intra-operatively, less of soft tissue damage, blood loss and also saves operative time, anesthesia, resulting in decreased overall morbidity .

Nevertheless the results of most studies that have compared intramedullary hip screws and sliding hip screws have revealed no significant differences with respect to operating time, duration of hospital stay, infection rate, wound complications, implant failure, screw cut-out , or screw sliding [11,12].

In view of these considerations, the present study evaluates the functional results and clinical outcome of Unstable Trochanteric Fractures treated with various modalities in our institute.

# AIM & OBJECTIVE

- To study and compare the clinical results and functional outcome of various implant used for treatment of unstable intertrochanteric fractures routinely used in our institute i.e. Proximal femoral nail and Antegrade femoral nail.

- To review the available literature concerning these implants for treatment of Unstable Intertrochanteric Fractures.

# REVIEW OF LITERATURE

Proximal femoral fractures are one of the commonest fractures encountered in orthopaedic trauma practice (about 3 lakh per year[93] with mortality rate of 4.5%-22%[94]) particularly in elderly people due to obvious reasons.

For centuries, fractures have healed without use of any implants. Treatment of fracture is an ancient science with records dating back to the Egyptian Mummies.

Fracture healing is actually not be a healing process, rather it is a process of bone regeneration, bone unites by its own constituents, as oppose to soft tissues healing, where it leaves a scar of new connective tissue to replace inured tissues.

Fractures of the proximal femur were known since the days of civilization without scientific background but the efforts to treat them scientifically were established from the days of Hippocrates, where they were treated by traction, manipulation, reduction & immobilization to achieve fracture union. But problem of alignment and angulation were still problem.

Ambrose Pare (1510)[95] must be given the credit as the first physician to diagnose a fracture of hip and distinguished it from a dislocated hip. His treatment includes rest and splint.

Sir Astley Cooper (1822)[26] was the first to have given the accurate description of fracture occurring at upper end of femur and who has recognised extra capsular from intra capsular fractures many decades before the discovery of x-rays.

Percival Pott at the end of 18th century was the first to stress the need of exerting traction in treating the fractures of upper end of femur.

Hibbs (1902)[97] treated subtrochanteric fractures conservatively in the position of flexion, abduction and external rotation stating that it improves the reduction by bringing distal fragment into alignment with proximal fragment.

Steinmann (1907)[98]devised method of skeletal traction through tibia below tibial tuberosity and applying longitudinal traction through the pin. This is known as Steinmann pin.

Invention of tri-flanged nail for internal fixation of fractures of femur by Smith Peterson (1925) was the major breakthrough in field of internal fixation devices. It controlled rotational instability. But these were discarded due to poor mechanical strength and when fracture collapse they use to penetrate through head.

Thornton (1937)[110] added an adjustable side plate to the Smith Peterson nailand thus made it possible to use it for fractures of trochanter.

G.Kuntscher (1942)[99],used Cloverleaf Nail for the treatment of subtrochanteric fractures.

Boyd and Griffin (1949)[18], Fielding and Magliato (1966), Zickel (1976), suggested and stressed that these types of fracture should be treated surgically to get better outcome. Proximal femoral fractures are still burning problems for orthopaedic surgeons as it has got un-acceptably high failure rate. Hence the interest in development of improvements in management of these fractures remains high.

Proximal femoral extracapsular fractures occur in the transitional zone which is in between the femoral neck and the femoral shaft[100]. These fractures may involve both greater and the lesser trochanter. In transitional zone, there is condensation of cortical bone at inferior aspect of neck of femur which is known as calcar. Review of

Literature situated at poster medial aspect of the neck of femur. This is strongest part of bone in the body after dentine.This distributes the stresses of activity of daily leaving (ADL).Consequently, the stability of intertrochanteric fractures depends on the preservation and fixation of the poster medialcortical buttress[101].Osteonecrosis is uncommon asthese fractures usually do not disturb the blood supply of proximal aspect of femur.Moreover,because transitional area of bone is highly vascular. So complications such as non-union is very rare[101].

About 50% of all proximal femoral fractures are intertrochanteric in nature. The mortality rates associated with these fractures varies from 10% to 30% within the first year of injury.

Koval and Zuckerman[29], in an extensive study of functional recovery After fracture of the hip, state that the factors influencing morbidity and mortality are best understood in three stages:

- The patient status before the fracture (like pre exiting disease, mobility, etc,)
- Pre-operative management.
- Post-operative care.

These are the main predictors for the outcome of fracture. Surgeons should take these thing under consideration before embarking on the operation.

Zuckerman et al.examined the effect of interval between injury and internal fixation on mortality. He concluded that patients with two or fewer comorbidities will be benefited by internal fixation of the hip within 2 days after admission, whereas delay in treatment to improve the comorbid conditions for surgery was beneficial for patients with three or more comorbidities.

Mervyn Evans (1951)[44] classified fractures into stable and unstable group thusputting emphasis on stability of the fracture which is very important for deciding line of management and improving the ultimate outcome. Stable fracture has got good prognosis. The fracture line is also an important factor for final outcome.

Raymond and Tronzo[45] described new classification of these fracture into 5 different types keeping in mind the anatomy of fracture and stability, weather good reduction is possible or not. His classification is the most accepted one today.

Jewett (1952)[46] published his paper recommending that all hip fractures be treated with 135 degree nail plate device. He has also developed the fixed angled nail plate which was initially biflanged and later on changed to triflanged. Owing to the fact that they do not allow controlled collapse and impaction at the fracture site, without penetration of the femoral head, so they are not in use now.

Taylor G.M. (1955) was the first to talk about various deformities resulting from fractures. He stated that varus deformity is symptomatic when the neck shaft angle is less than 120 degrees.

Clawson DK (1959)[47] with help of Richards manufacturing company invented the sliding compression screw devise which is the second major breakthrough in the field of internal fixation devices for fractures.

Sarmiento (1963)[48] introduced the technique of valgus osteotomy to obtain stability in unstable fractures.

Dimon and Hugston (1964)[49]have suggested an easier way of achieving stability, the medial displacement technique.

Weismann et.al (1964) were fixing the lesser trochanter in order to achieve medial buttress and anatomical reduction of fracture while Wardie (1967)has stated that reduction and fixation of displaced lesser trochanter fragment to femoral shaft in order to provide a stable buttress for reduction to proximal fragment is difficult, time consuming and often unsuccessful.

Singh (1970)[66] introduced the method of examining the degree of osteoporosis by x-ray evaluation of trabecular pattern of proximal femur. This is important as fixation of proximal fragment and fracture stability depends on bone quality.

Ender (1970)[102] introduced multiple flexible Condylocephalic nails.

Harrington (1975)[103] recommended use of methyl methacrylate cement to reinforce the internal fixation in osteoporotic bone. It does improve the fixation, but is associated with increased incidence of infection and delayed implant loosening.

Green et.al (1986) and Sterm et.al (1987)[105] have presented a series of comminuted fractures treated with Leinbach prosthesis and concluded that it is recommended for the elderly patients with comminuted fractures.

Use of intramedullary hip devices for treatment of fractures was started in 1980's. Since then there has been several modifications in design of intra-Medullary implants.

S.C.Halderin (1992) published paper on the Gamma nail for pertrochanteric fractures.

Shepherd F Rosenblun, Joseph D Zukerman, Fredrerick J Kummer and Benjamin Tam published a report on biomechanical evaluation of the Gamma nail in 1992.

In 1994, Gargan M F, Gundle R, Simpson A[106]. H claimed that there is no benefit of osteotomy and therefore recommended anatomical reduction and fixation by the sliding hip screw in most cases.

In 1994, Blatter et al studied about treatment of the pertrochanteric and subtrochanteric fractures of the femur with DCS.

In 1994 an author studied about pertrochanteric and subtrochanteric fractures of the femur treated with Zickel nail. It is not recommended by them any more for treatment of pertrochanteric and subtrochanteric fractures.

In 1994 Cole studied about intramedullary nail and lag screw fixation of proximal femur fractures. The vector nail has been introduced as an alternative form of fixation for complex proximal femur fractures.

In 1995, Butt M.S, Krikler S J , Nafie, Ali M.S[107]studied the comparisons of Gamma Nail and DHS and found that clinical and radiological union results with both implants were the same but the rate of complication with Gamma Nail was higher. Hence they do not recommend Gamma Nail for the treatment of peritrochanteric fractures.

In 1995, M.R.Baumgaertner, S.L.Curtin, D.M.Lindskog and J.M.Keggi[108] had developed a simple method to describe the position of the lag screw. In this the tip apex distance (TAD) is the sum of the distance from the tip of lag screw to the apex of the femoral head on anterior posterior and lateral view after controlling the magnification. In their study, to determine the value of this measurement in prediction of the so called cut out of the lag screw the average tip apex distance is 24 mm for successfully treated fractures.

In 1997 the AO/ASIF developed the proximal femoral nail (PFN) as an intramedullary device for the treatment of unstable pertrochanteric, intertrochantericand subtrochanteric femoral fractures in order to overcome the deficiencies of the extramedullary fixation of these fractures. This nail has the following advantages compared to extramedullary implant-such as decreasing the movement arm, can be inserted by closed technique, this retains the fracture hematoma an important consideration in fracture healing, decreases blood loss and infection, minimizes the soft tissue dissection and wound complications. In a clinical multicenteric study, authors reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws.

Herrera et al (2002) [55] compared trochanteric fractures treated with the Gamma nail or the Proximal Femoral nail and concluded that there were no Signify cant differences in the use of either nail in terms of the recovery of previous functional capacity nor in terms of the time required for fracture healing. With regard to the more significant technical complications recorded, shaft fractures and the cutting-out phenomenon were more common with the use of the Gamma nail, while secondary varus occurred at a greater rate when using the PFN.

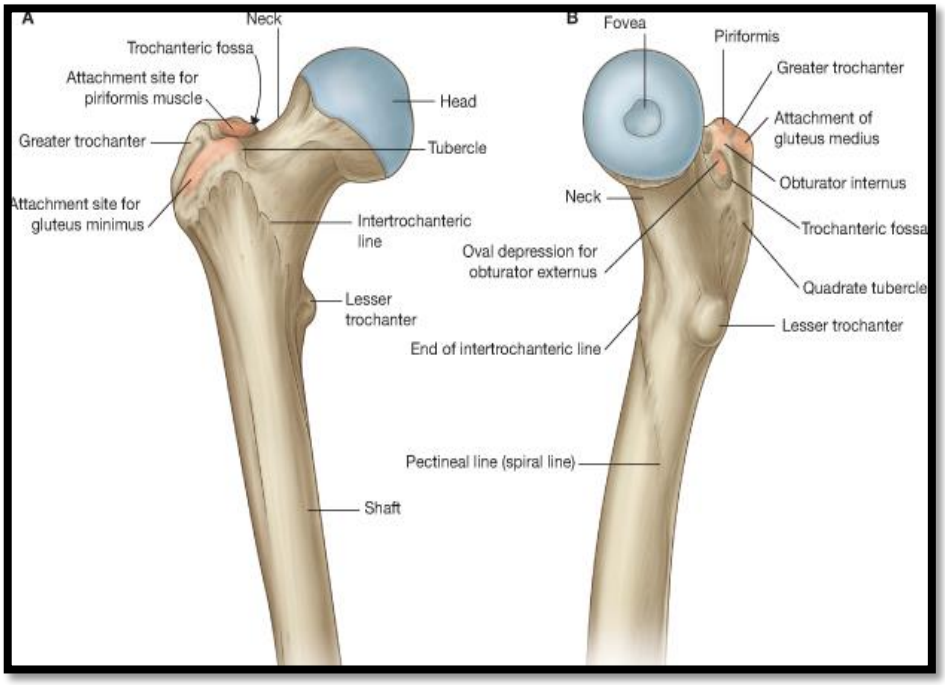
In 2000 AO/ASIF introduced Antegrade Femoral Nail in Germany, bringing some changes to the preexisting third generation nails. The nail's proximal funnel diameter was reduced, the mediolateral bent was increased and both the hip screws were made of the same diameter.

A year later CHRISTIAN BOLDIN et al [57] in his study concluded that proximal Femoral Nail is a good minimally invasive implant for unstable proximal femoral fractures.

In 2008, MSG BALLAL[59] emphasized that good reduction with minimal dissection, use of appropriate length of nail and proper positioning of the nail and screws are necessary to avoid failure or revision with Proximal Femoral Nail.

# ANATOMY OF PROXIMAL FEMUR[60]

The femur is the longest and strongest bone of the body and like all long bones consists of a shaft and two ends. It articulates at its upper end with the acetabulam and at its lower end with both the patella and the tibia. The upper end of the femur comprises a head, a neck, a greater and a lesser trochanter.




The head of the femur is rather more than half a 'sphere' and is directed upwards, medially and slightly anteriorly. The neck is about 5cm long, connects the shaft, it is a stout bar of bone, roughly pyramidal in shape and flattened anteriorly. The long axis of the neck makes an angle of about 120 – 130 degrees with the long axis of the shaft and is termed the neck shaft angle. This arrangement allows greater mobility at the hip joint and enables the lower limb to swing clear of the pelvis. Anteriorly, at the junction of the shaft and the neck is a rough bony ridge, the intertronchanteric line. It begins in a tubercle at the upper and medial part of the anterior surface of the greater trochanter and is directed inferomedially where it joins

the spiral line, which becomes continuous with the medial lip of the lineaaspera. Posteriorly a prominent ridge of bone, the intertrochanteric crest joins the posterior aspect of the greater trochanter. On the upper part of the crest is a round protuberancecalled the quadrate tubercle[13].

The greater trochanter is large quadrangular laterally positioned and irregular. The upper posterior margin overhangs the trochanteric fossa. The greater trochanter provides insertion for most of the muscles of gluteal region. The upper border of the greater trochanter gives insertion to the piriformis and the medial surface to the common tendon of obturator internus and two gemelli. The gluteus minimus is inserted into the rough impression on its anterior surface. The gluteus medius is inserted into the oblique and flattened strip on its lateral surface. The area behind the insertion is covered by the deep fibres of gluteus maximus with the trochanteric bursa interposed. The trochanteric fossa receives the insertion of the obturator externus.

The lesser trochanter is a conical eminence, which projects medially and backwards from the shaft at its junction with lower and posterior part of the neck. It gives attachment to the psoas major on its summit and iliacus at its base. The shaft of the femur is narrower in its middle, it expands a little as it is traced upwards, but it widens appreciably near the lower end of the bone. In its middle one third of the shaft possesses three surfaces (anterior, lateral and medial) and three borders [posterior, lateral and medial]. In its upper one third, the shaft presents a fourth surface which is directed backwards and is called the posterior surface. This is bounded medially by the spiral line which is continuous above with the lower end of the intertrochanteric line and below with the medial lip of lineaaspera. On the lateral side the surface is bounded by gluteal tuberosity which extends upwards to the root of the

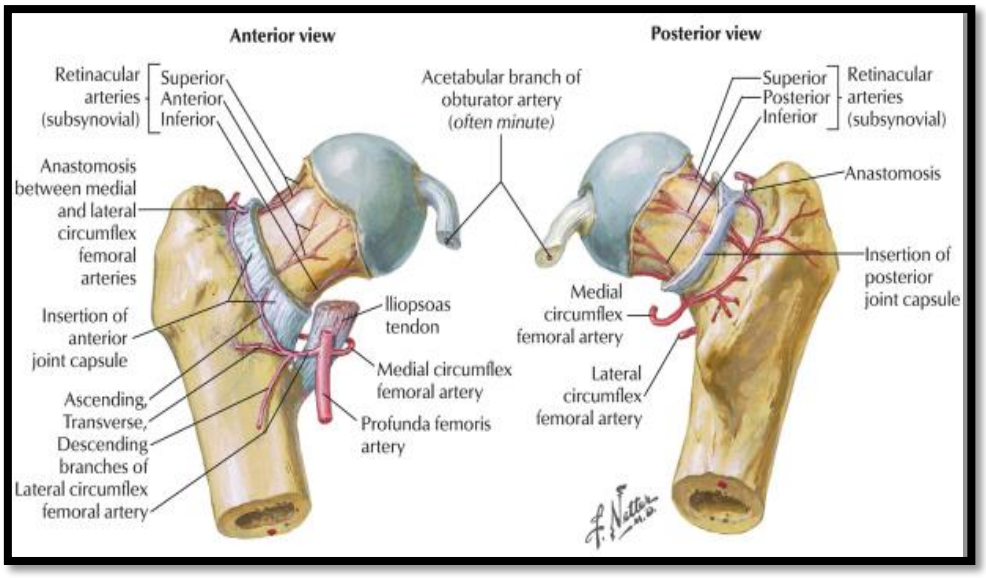
greatertrochanter and is continuous below with the lateral lip of lineaaspera. In its lower third also the shaft possesses a fourth surface, the popliteal surface of the femur. The lateral and anterior surface of the shaft provides attachment in their upper 3⁄4th for the vastus intermedius. The medial surface is devoid of muscular attachments and is covered by the vastus medialis. The medial edge of the tuberosity provides insertion for the pubic fibres of the adductor magnus. The lateral lip of lineaaspera gives origin to the vastus lateralis and medial lip to the vastus medialis. In addition, the lineaaspera gives attachment to the adductor longus, the intermuscular septa and the short head of biceps femoris. The posterior surface of the upper third receives the insertions of the pectineus and the adductor brevis[14].

**BLOOD SUPPLY:**

The description of adult vessels is based on the work of Trueta and Harnington (1953). Since the vascular pattern established during the phase of growth is not replaced at maturity, but persists throughout in life, the basic arrangement is one of anepiphyseal and metaphysea outline the anastamotic arrangement around the upper femur[15].

Corck described the blood supply to the proximal end of the femur, which he divided into three major groups.

a. An extracapsular arterial ring located at the base of the femoral neck.
b. Ascending cervical branch of the
c. Arteries of the ligamentum teres




The extracapsular arterial ring is formed posteriorly by large branch of medial femoral circumflex artery and anteriorly by branch from lateral femoral circumflex artery. The ascending cervical branches of retinacular vessels, ascend on the surface of the femoral neck in an anterior, posterior, medial and lateral groups.

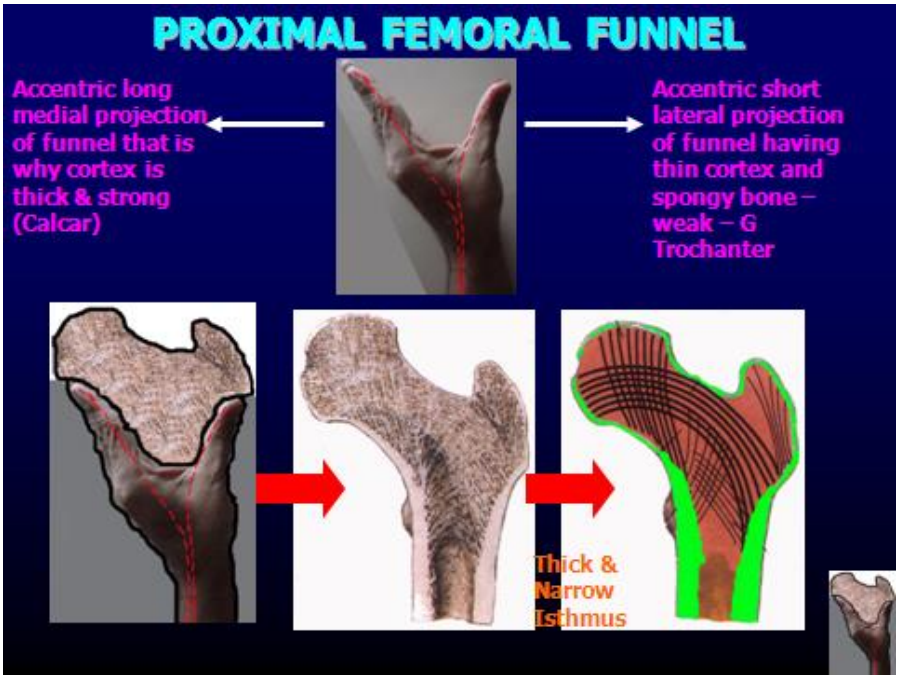
The lateral vessels are most important. Their proximity to the surface of the femoral neck makes them vulnerable to injury in femoral neck fractures. As the articular margin of the femoral head is approached by these ascending cervical vessels, a second less distinct ring of vessels is formed, commonly referred to by Chung as the sub synovial intra-articular arterial ring. It is from this ring of vessels that vessels penetrate the head and are referred to as epiphyseal arteries, the most important being the lateral epiphyseal arterial group supplying the lateral weight bearing portion of the femoral head. These epiphyseal vessels are joined by inferior metaphyseal vessels and vessels of the ligament teres. Blood supply to the femur like that of all tubular bones, is by the way of metaphyseal, periosteal and endosteal supply. The periosteal supply is related to the multiple muscle origins from the shaft

of the femur the nutrient arteries perforatethe femoral shaft along the lineaaspera. The arteries are derived from perforating branches of profounda femoris artery.

**STRUCTURE:**

The shaft of the femur is roughly tubular compact bone, with a large medullary cavity. The wall of the cylinder is thick in middle third of the shaft but above and below , the wall becomes thinner while medullary cavity is gradually filled with trabecular bone, the upper and lower ends of the shaft and the articular extremities consists of trabecular bone, invested by a thin compact layer.

The pertrochanteric and subtrochanteric area can be a site of stress concentration owing to the short radius of curvature at this site. When bone has insufficient opportunity to turnover and remodeling as in metabolic bone disease this may be a site of pathologic fracture.

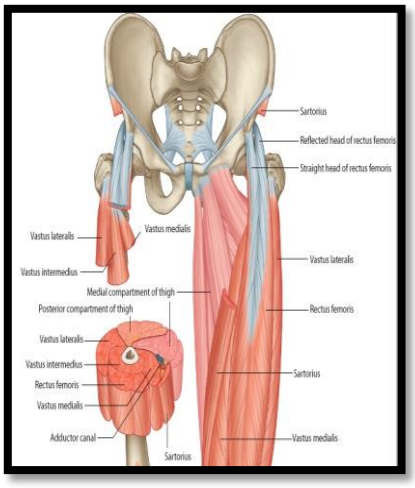


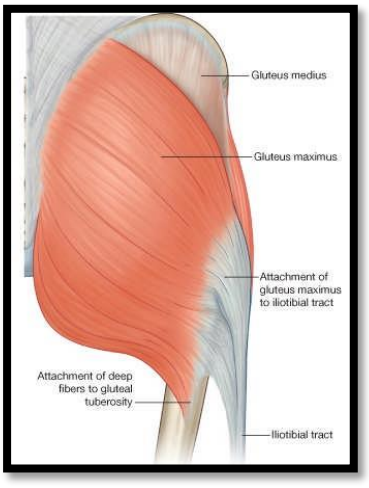

In 1957, Harley and Griffin clarified the definition of the calcar femorale, as a dense vertical plate of bone within the femur, which originates in the posteromedial

portion of the shaft, under the lesser trochanter, and radiates laterally through the cancellous tissues towards the greater trochanter[16].

**MUSCULAR FORCES:**

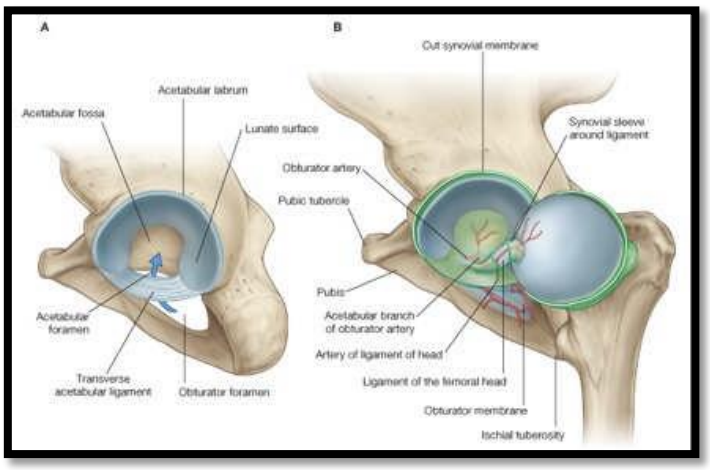
The upper end of the femur is surrounded by a mass of powerful muscles. Inclusion of muscle forces necessary during single leg support adds to the complexity of the problem and can increase the stress to much higher values. On the other hand, some muscles such as the tensor fascia lata, may act to partially neutralize bending forces under certain conditions. In a normal hip, the strong gluteal muscles abduct and the powerful psoas flexes and rotates. These forces are balanced by the adductor and hamstrings. With a subtrochanteric fracture, the forces are unbalanced and the unopposed muscular action produces the characteristic abduction, rotation and flexion deformity described by Froimson. The same muscle forces act upon the fixation device after operation. These forces have been shown to generate high forces on the femoral head even when the patient is in bed, which in turn cause stresses in the subtrochanteric area as shown by Koch. Rydell has demonstrated that muscular pull for merely flexing or extending the hip in bed caused as much pressure on the femoral head as did slow walking with or without crutches[15].

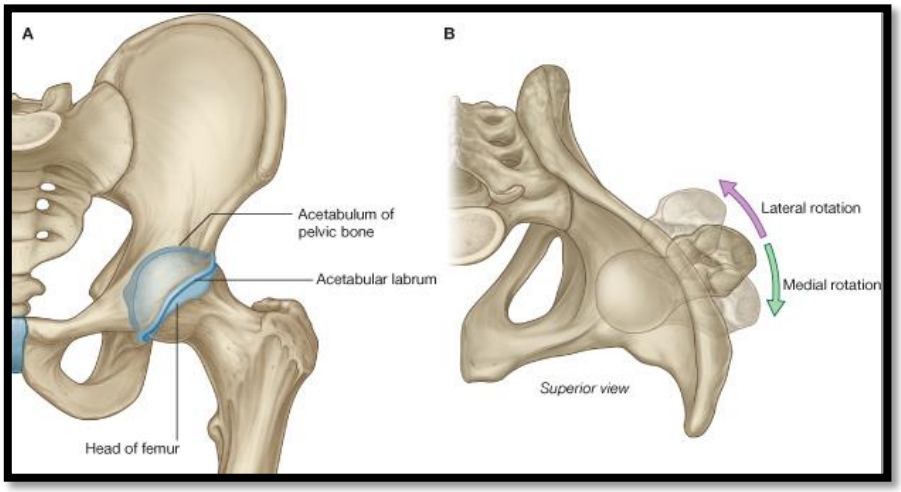


**MEDIAL BUTTRESS AND CROSS-SECTIONAL AREA :**

The medial wall or the so-called medial buttress explodes, because of the great compressive forces. When the medial buttress is absent and the cross sectional area bearing load is minimum, all the stress is concentrated on the plate at the fracture site. This results in fatigue fracture of the implant and non-union. Therefore, the anatomy and functional continuity of the bone at the fracture site should be established by fixing fracture pieces by lag screws, circlage wires, etc., and the medial wall should be reconstructed by massive bone grafting. Thus, the cross sectional area to bear the load is increased and less force acts on the plate. Hence, integrity of the medial wall of the proximal femur is very important[15].



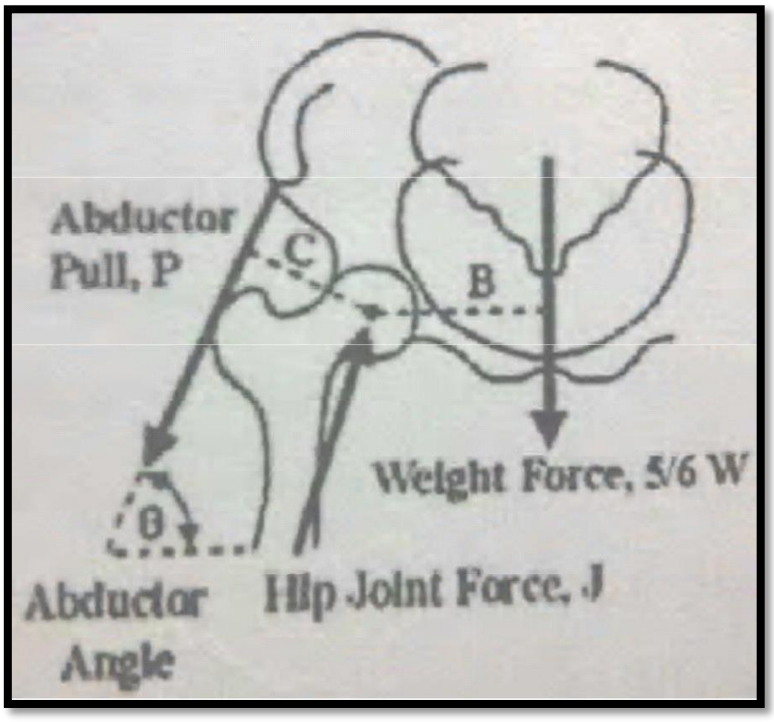
## BIOMECHANICS OF PROXIMAL FEMUR

Forces applied to the hip during ambulation produces stresses in the proximal femur because of combined effects of axial, bending and torsional loads.

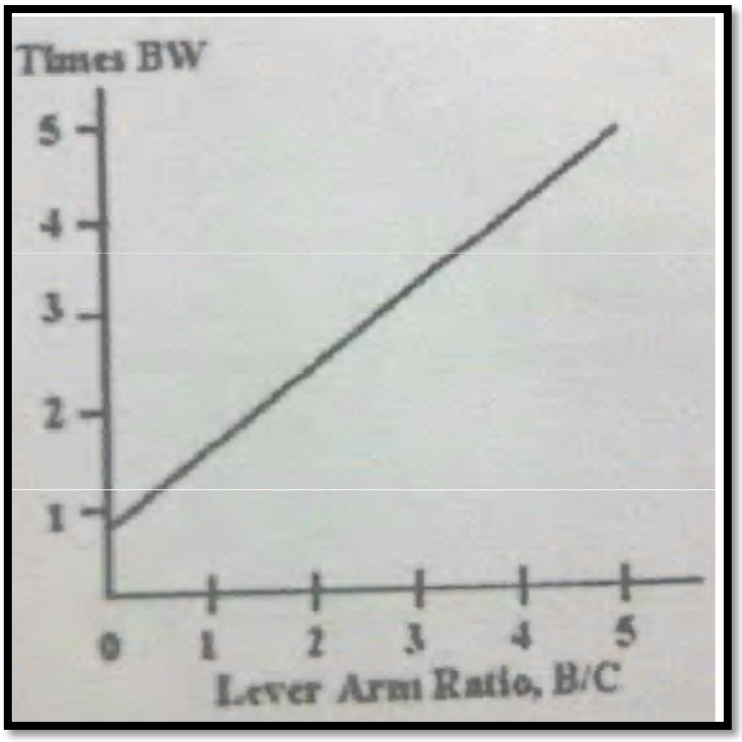
Normally the proximal femur is loaded, so that the medial cortex is compressed and the lateral cortex is under tension.

Forces on the hip are :

1. Compressive forces generated by gluteus medius
2. Body weight
3. Joint reaction force
4. Bending stress.
5. Shear stress
6. Torque transmitted by the shaft (neck is offset from the shaft which is the main cause of bending force )




Hip is kind of first degree lever with unequal lever arms




Hip joint reaction force as a function of lever arm ratio

To be in equilibrium, the joint reaction force must equal to forces to muscular force of body weight.

The reaction force at the hip result form

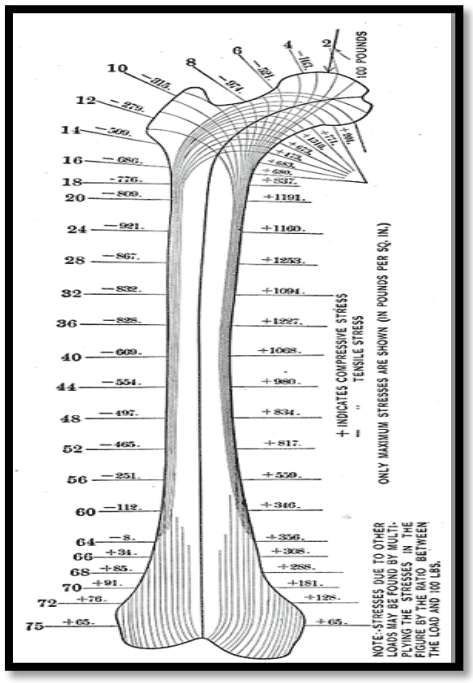
- Compressive forces of body weight
- Force generated by muscles that cross the hip

Koch showed that forces greater than 1200 Lb/sq.ft. ind. would be generated by a 200 Lb man . Major compressive stresses in the femur are greatest in the medial 1 to 3 inches below lesser trochanter (subtrochanteric region) which is the most stressed region in the body of human.

Tensile stresses about 25% less occur at lateral cortex slightly proximally. These high compressive forces medially, explain the high degree of communition and implant failures in this region if the posteromedial continuity is not restored.

Pressure from normal gait may reach 5-7 times body weight or higher and significant pressures approaching this can occur with supine SLR or getting on and off the bed.

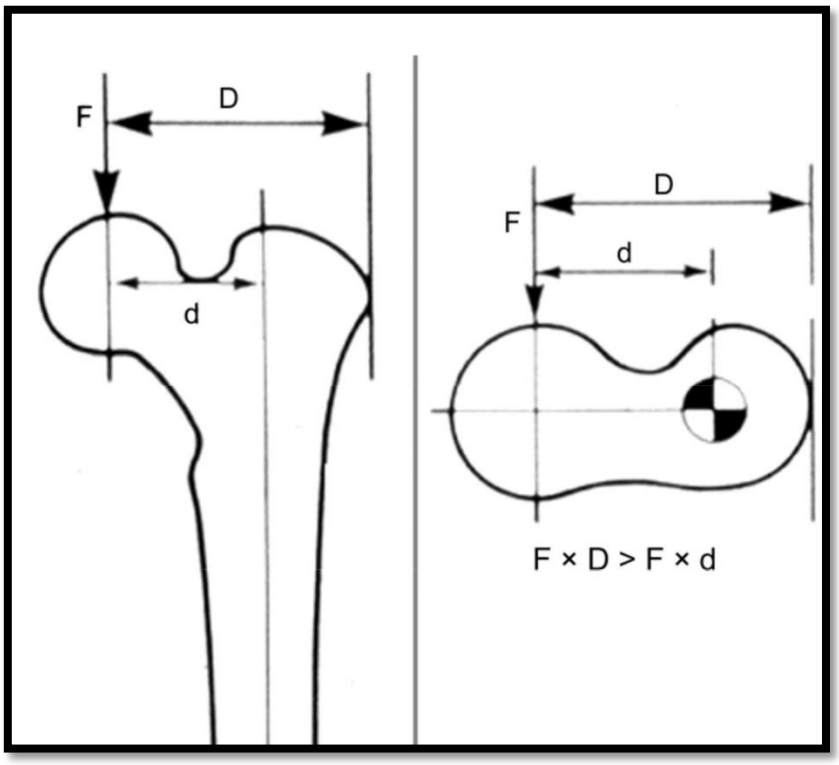
Bending moment = F.(Body weight ) × D (distance of implant from centre of femur head).




The unique biomechanical environment also favours intramedullary fixation compared to the extramedullary fixation, as the former device helps to decrease the moment arm and hence, the stress on the implants.

Extracapsular fractures (intertrochanteric and subtrochanteric fractures) primarily involve cortical and compact cancellous bone. Because of the complex stress configuration in this region and its nonhomogeneous osseous structure and geometry, fractures occur along the path of least resistance through the proximal femur[17]. The amount of energy absorbed by the bone determines whether the fracture is a simple (two-part) fracture or is characterized by a more extensive comminuted pattern.

## BIOMECHANICS OF IMPLANTS




To correctly apply sliding fixation devices for these fractures, it is essential to understand the mechanics of the devices and the forces that they must withstand. The magnitude and direction of the force exerted across the hip joint are dictated by body weight and the muscles acting on the hip. Pauwels[18] and others [19, 20, 21, 22] showed that the forces acting on the hip in single-limb stance amount to about three times the body weight applied at an angle of 159Â° to the vertical plane. This same force acts on any hip fixation device placed across the fracture site.

A sliding device that has a screw-plate angle closest to this force vector allows optimal sliding of the hip screw and impaction of the fracture. The closer the nailplate angle is to the resultant force across the hip, the more force is available to assist impaction [23]. Devices of lower angles are subject to lower forces parallel to the sliding axis of the device and greater forces perpendicular to the axis; these perpendicular

forces act to jam or bend the device, thereby preventing impaction. Technically, however, the surgeon cannot place the sliding device at an angle greater than 150Â°. It is desirable mechanically to place the sliding fixation device at as high an angle as clinically possible and still maintain placement of the fixation device in the center of the femoral head to prevent cutout. Fixation of the medial fragment, particularly if it is large, allows bony impaction and creates a stable osteosynthesis with less shortening. For this reason, in addition to bony impaction with a higher-angle device,inter-fragmentary fixation of a large medial fragment is desirable when possible.

The need to position the nail at the ideal angle should not overshadow the need for a secure purchase in the center of the femoral head [24]. If you cannot effectively place a high-angle device deep into the center of the femoral head, use a lower-angle device to obtain optimal placement in the head. The lower-angle devices must be used in patients who are small and have varus hips. Most sliding devices are available in 5Â° increments at the nail-plate junction; in unstable fractures, select the highest angle that allows center head placement. This optimizes both fixation of the fracture and ease of sliding the device, allowing impaction of the fracture fragments.

INTERNAL FIXATION IS ALWAYS A RACE BETWEEN BONY UNION AND IMPLANT FAILURE

**EPIDEMIOLOGY**

Hip fractures have a bimodal age distribution: Approximately 97% occur in patients over 50 years of age (the incidence increases with age), and only 3% in patients under 50. In the latter group, they occur most commonly between 20 and 40 years of age, usually in men, and are due to high-energy trauma associated with sports and industrial and motor-vehicle accidents [25, 26]. In this young group, most hip fractures are subtrochanteric or basicervical. In contrast, fractures of the hip in patients between 40 and 50 years of age usually occur in alcoholics or patients with multiple medical diseases, whose fractures are related to osteoporosis.

Half of all hip fractures are intertrochanteric. The mortality rates associated with these fractures varies from 10% to 30% within the first year of injury[27]. One year after hip fracture, the life expectancy of the patient returns to the normal value for the age group.

Fractures in the elderly are serious injuries, often occurring in the terminal years of life, and they have a major impact on society, our health care system, and the cost of care[30].

Martin et al. attributed the exponential increase in incidence with increasing age to a gradual decline in physical activity, which contributes to the bone loss29.

At 1 year after a hip fracture, mortality rates in elderly people range from 14% to 36%. The highest risk of mortality occurs in the first 6 months after fracture; after 1 year the mortality rate approaches that of persons who have not sustained a hip fracture.

Age at the time of fracture does not necessarily correlate with a higher mortality rate. Systemic illnesses, however, such as congestive heart failure, coronary artery disease, diabetes mellitus, chronic obstructive pulmonary disease, and rheumatoid arthritis have been shown to increase the mortality rate.

Koval and Zuckerman[29], pointed out other preoperative factors that worsened the prognosis, including cerebral dysfunction in the form of chronic organic brain syndrome, cerebral vascular disease, or psychiatric illness; and permanent habitation in an institution as opposed to a home. An increased mortality rate after fracture of the hip is associated with male sex, advanced age, untreated or poorly controlled systemic disease, cerebral dysfunction, institutionalization, internal fixation before control of medical comorbidities, and post operative complications.

Zuckerman et al[31]. examined the effect of timing of internal fixation on mortality. They concluded that patients with two or fewer comorbidities benefited by internal fixation of the hip within 2 days after admission, whereas delay to better treat comorbidities and better prepare the patient for surgery was beneficial for patients with three or more comorbidities.

# CLASSIFICATION

A useful classification not only identifies the fracture pattern but serves as a definite guide to treatment and prognosis.

Several attempts have been made to classify these fractures. BOYD and GRIFFIN[32] in classifying trochanteric fractures referred to type 3 and 4 as subtrochanteric fractures.

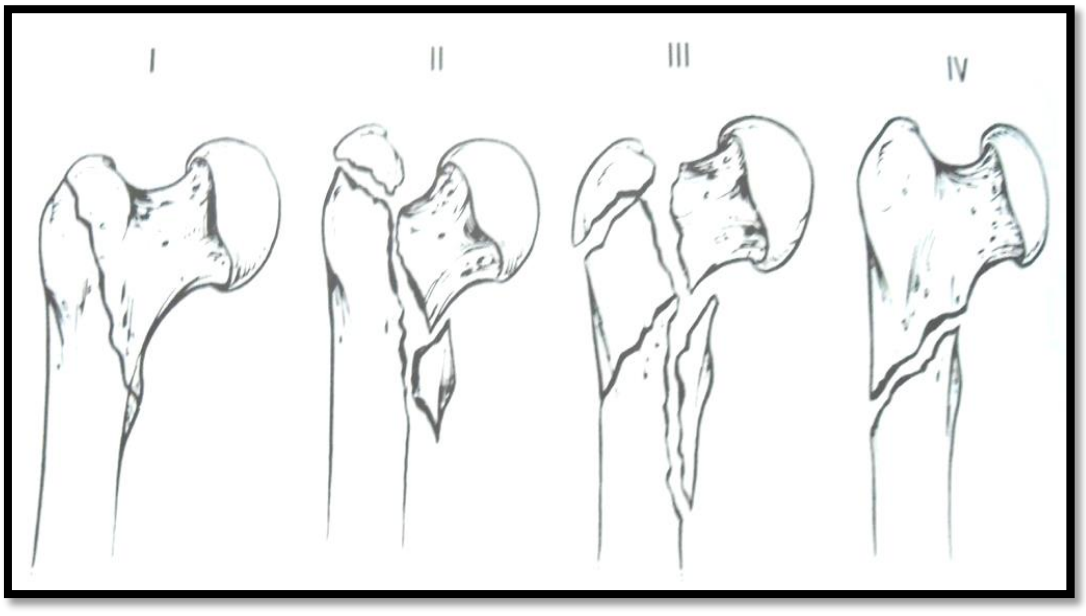
**BOYD AND GRIFFIN CLASSIFICATION**

TypeI:non-displaced intertrochanteric fractures.

TypeII :Communitted intertrochanteric fracture

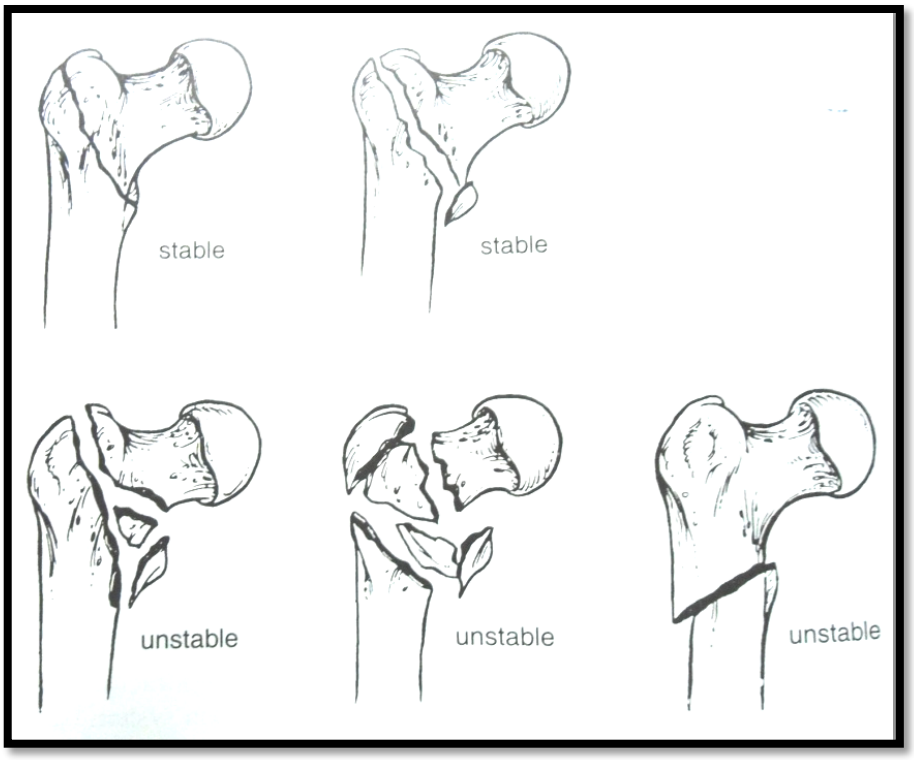
TypeIII:intertrochanteric fractures with subtrochanteric extension

Type IV:oblique fractures of proximal femur(reverse oblique)



**EVANS CLASSIFICATION**

Evans[33] observed that the key to a stable reduction is restoration of posteromedial cortical continuity. He accordingly divided intertrochanteric hip fractures into two types differentiated by the status of this anatomic area. In stable fracture patterns, the posteromedial cortex remains intact or has minimal comminution, making it possible to obtain a stable reduction. Unstable fracture patterns, on the other hand, are characterized by greater comminution of the posteromedial cortex. Although they are inherently unstable, these fractures can be converted to a stable reduction if medial cortical opposition is obtained. Evans further observed that the reverse obliquity pattern is inherently unstable because of the tendency for medial displacement of the femoral shaft.



Type I : Fracture line extends upwards and outwards from lesser thochantor.

Type II : The obliquity of the major line is reversed, so that it extends outwards and downwards from the lesser trochanter. Type 2 fractures have a tendency towards medial displacement of the femoral shaft because of the pull of adductor muscle.

**COMPREHENSIVE (AO/OTA ALPHANUMERIC) FRACTURE CLASSIFICATION[34]**

31-A Femur, proximal trochanteric

31-A1 Peritrochanteric simple

31-A1.1 Along intertrochanteric line

31-A1.2 Through greater trochanter

31.A1.3 Below lesser trochanter

31-A2 Peritrochantericmultifragmentary

31-A2.1 With one intermediate fragment

31-A2.2 With several intermediate fragments

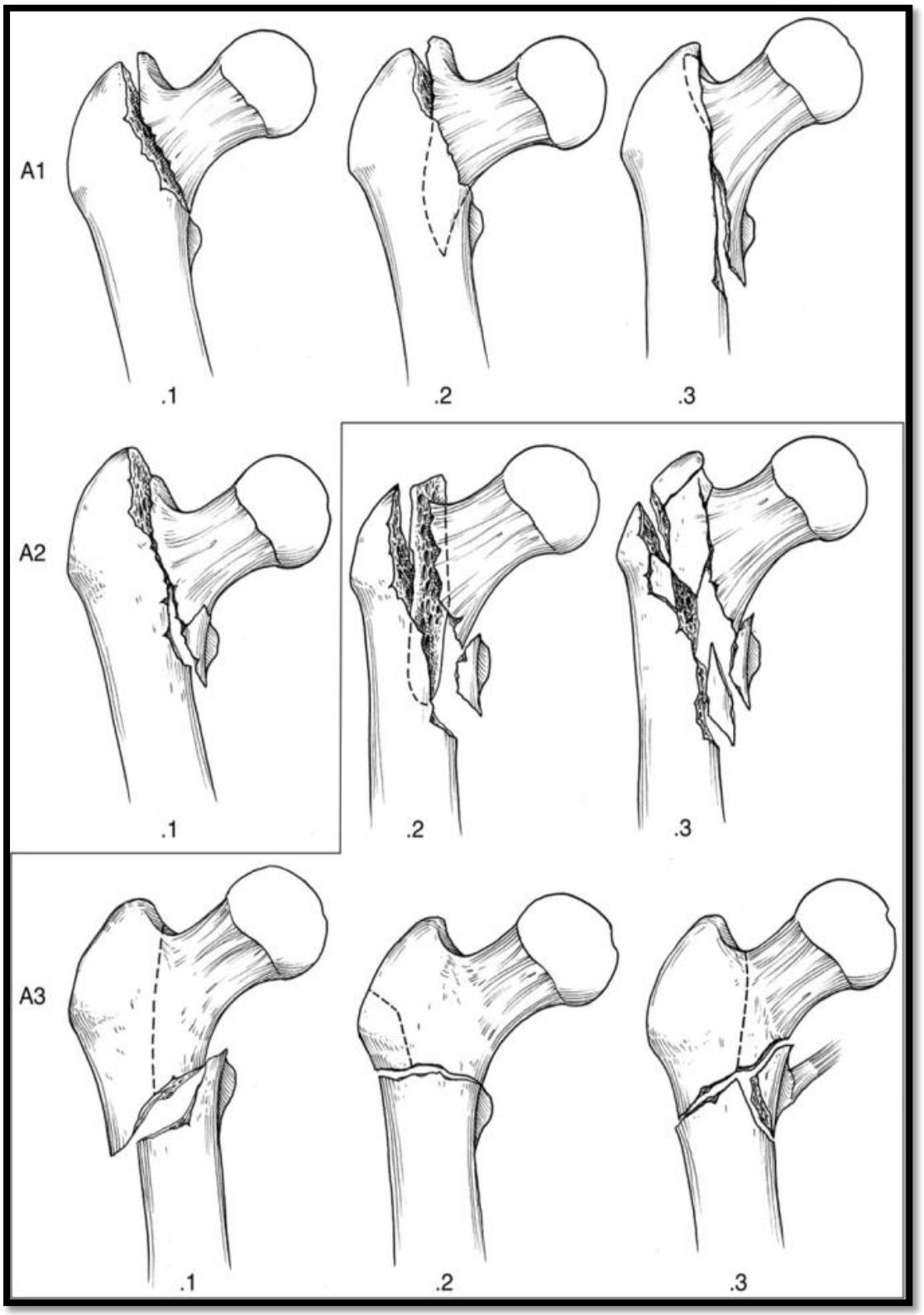
31-A2.3 Extending more than 1 cm below lesser trochanter

31-A3 Intertrochanteric

31-A3.1 Simple oblique

31-A3.2 Simple transverse

31-A3.3 Multifragmentary


A1
.1
.2
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A2
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A3
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TRONZO'S CLASSIFICATION (1973)[35]

Type 1: Incomplete Fractures With or Without

type 2: Uncomminuted Fractures, Displacement; Both Trochanters Fractured

Type 3: Comminuted Fractures, Large Lesser Trochanter Fragment; Posterior Wall Exploded; Neck
Type 3 Varient : As Above, Plus Greater Trochanter Fractured Off and separated.

Type 4: Posterior Wall Exploded, Neck spike displaced outside shaft Beak Impacted In Shaft.

Type 5: Reverse Oblique Fracture, with Or Without Greater Trochanter Separation.

**MANAGEMENT OF TROCHANTERIC FRACTURES IN ADULTS**

Trochanteric fractures can be managed in two ways-

1. Conservative or Non-operative method.

2. Operative method.

II. OPERATIVE MANAGEMENT:

The treatment of choice of intertrochanteric fractures ideally should be operative, employing some form of internal fixation.

The goals of operative treatment are:

- Strong and stable fixation of the fracture fragments.
- Early mobilization of the patient.
- Restoration of the patient to his or her pre-operative status at the earliest.

Kaufer, Matthews and Sonstegard[37] have listed the variables that determine the strength of the fracture fragment –implant assembly.

The Variables are –

- Bone Quality.
- Fracture Geometry.
- Reduction.
- Implant Design.
- Implant Placement.

The bone quality and fracture geometry, are beyond the control of the surgeon. Therefore the surgeon has within his control, the quality of reduction, the choice and placement of implant to achieve a stably reduced and internally fixed intertrochanteric fracture.

**EVOLUTION OF SURGICAL TECHNIQUES:**

Until the 20th century, trochanteric fractures were treated conservatively and in addition to fracture union they were generally associated with high complications. Surgical fixation of intertrochanteric fractures remains the standard of care; however the best method of surgical fixation is debatable.

Intramedullary Nails:

To decrease the amount of displacement in unstable fracture and during the healing process, intramedullary devices such as Gamma nail & intramedullary hip screw (IMHS) were developed48.

First generation (Standard Gamma- nail) intramedullary nail provided three point fixation and the medial location of the implant provided a more efficient load transfer and reduced the risk of mechanical failure[9]. Gamma nail ensured controlled fracture impaction, lesser operative time and blood loss.

Bridle et al[50] found that in study of hundred patients two had femoral shaft fractures with use of 16 mm nails. Some patients also complained of thigh pain.

Rosenblumet al[9] also found decreased sliding of the screw in comparison with that of sliding hip screw constructs.

Femoral shaft fracture was a complication of the use of first-generation intramedullay nails, with rates ranging from 2.2% to 17% [12,50,51,52] approximately four times greater than that seen with compression hip screw[3].

Thigh pain has been reported to occur in 17% of patients treated with a firstgeneration nail[53]. Hardy et al[54] found a relationship between thigh pain and use of two distal interlocking screws.

**SECOND GENERATION NAIL:**

Limitations and complications of the first generation intramedullary nails led to changes in the implant geometry such as Trochanteric Gamma Nail (TGN) with reduced valgus bend to 40 from 100, decreased distal diameter of 11 mm from 16 mm and shortened length of 180 mm from 200 mm to decrease the stress concentration at their tip[1].

Other second generation nails of similar design (single lag screw into the head) include IMHS, Trochanteric Femoral Nail (TFN).

The rate of peri-implant fracture improved between 0 - 4.5% but the rate of femoral cutout of 2.5% to 8.3% did not improve3, because the second generation nails also required greater forces to initiate sliding than the sliding hip screw[55].

Lochet al[56] showed that the sliding plate required less force to generate sliding than the second generation intramedullary devices.

No significant difference was found in frequency of implant related complications between the dynamic hip screw and second generation intramedullary devices[3].

Most studies comparing the Gamma nail with dynamic hip screw found no differences regarding intra operative complications and implant failure. However patients treated with a Gamma nail were at increased risk of femoral shaft fracture at nail tip and at the insertion sites of the distal locking bolts[55].

**THIRD GENERATION NAILS:**

These incorporate multiple lag screws into the femoral head. Multiple points of fixation theoretically provide better rotational control of unstable fractures compared with a single lag screw. Smaller diameter of proximal section of the nail because of smaller diameter screws is helpful in reducing the amount of gluteus medius tendon injury.

Theoretical concerns about smaller diameter screws are, screw cutout directly related to their decreased diameter that could be exacerbated by screw bending. Such bending can prevent sliding of the lag screw[3].

Some of third generation nails:

Trochanteric antegrade nail (TAN),

Proximal femoral nail (PFN),

Antegrade femoral nail (AFN),

In 1996 the AO/ASIF developed the proximal femoral nail (PFN) as an intramedullary device for the treatment of unstable per-, intra- and subtrochanteric femoral fractures in order to overcome the deficiencies of the extramedullary fixation of these fractures. This nail has the following advantages compared to extramedullary implants such as decreasing the moment arm, insertion by a closed technique, retains the fracture hematoma, an important consideration in fracture healing, decreasing blood loss and infection, minimizing the soft tissue dissection and wound complications[56].

In a clinical multimember study, authors reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws[56].

Herrera. et al compared trochanteric fractures treated with the Gamma nail or the Proximal Femoral nail and concluded that there were no significant difference in the use of either nail in terms of the recovery of previous functional capacity, nor in terms of the time required for fracture healing. With regard to the more significant technical complications recorded, shaft fractures and the cutting-out phenomenon were more common with the use of the Gamma nail, while secondary varus occurred at a greater rate when using the PFN[57].

Douspaet al[58] concluded that PFN is a method of choice in trochanteric fractures, namely in high subtrochanteric fractures.

Banan et al[59] concluded that the PFN is a good choice for trochanteric and subtochanteric fractures and also the use of the PFN for unstable trochanteric fractures is very encouraging.

Boldinet al[60] prospective study of proximal femoral fractures treated with PFN on fifty - five patients, concluded that PFN being a intramedullary device is the method of choice in treatment of unstable pertrochanteric femoral fractures.

Schipperet al[61] concluded both PFN and gamma nail had comparable results except that PFN has less intraoperative blood loss and concluded that pitfalls and complications were similar and mainly surgeon or fracture related, rather than implant related.

Fogagnoloet al[62] concluded that PFN is a suitable implant for unstable fractures, but the high re-operation rate precludes its routine use for every peritrochanteric fracture.

In 2000 AO/ASIF introduced Antegrade Femoral Nail in Germany, bringing some more changes to the preexisting third generation nails. The nail's proximal funnel diameter was reduced, the medio-lateral bent was increased and both the hip screws were made of the same diameter and were given in built ante version.

In 2007 AO/ASIF devised PFNA (Proximal femoral nail Anti-rotation) with a single unique spiral blade, which was said to give more rotational stability than PFN.

Unfortunately use of intramedullary fixation devices can result in an increased risk of intraoperative and postoperative femoral fractures and carries a significant learning curve for proper instrumentation.

In unstable trochanteric fractures in patients with severely osteoporotic bone, some authors have suggested the use of Polymethylmethacrylate (PMMA) to augment the fixation and improve the stability.

The Alta expandable dome plunger is a modified sliding hip screw designed to improve fixation of the proximal fragment by facilitating cement intrusion into the femoral head. Cement is kept away from the plate barrel so that the device's sliding potential is maintained. The method of insertion is similar to that of the sliding hip screw, except that the dome unit is manually pushed into the pre-reamed femoral neck and head proximal fixation is achieved as the plunger is then advanced, expanding the dome in the cancellous bone of the femoral head and extruding the contained cement.

**PROSTHETIC REPLACEMENT:**

Prosthetic replacement for intertrochanteric fractures has not gained widespread support.

The indications for primary prosthetic replacement remains ill defined. Most authors cite elderly, debilitated patients with a comminuted, unstable intertrochanteric fracture in severely osteoporotic bone, as the primary indication for prosthetic replacement.

The indications for primary prosthetic replacement as per Kenneth J. Koval[2] are-

1. Symptomatic ipsilateral degenerative hip disease, where a total hip replacement is ideal.
2. Attempted open reduction and internal fixation that cannot be performed because of extensive comminution and poor bone quality, where the procedure should be aborted and a hemiarthroplasty should be carried out.

Primary prosthetic replacement is much more extensive and invasive procedure than internal fixation, with the potential for increased morbidity and complications including prosthetic dislocation. Furthermore, the cost of the prosthesis is high.

Hence, prosthetic replacement is a useful technique only for the occasional patient with an intertrochanteric non-union or failure of fixation or severely osteoporotic bone.

**EXTERNAL FIXATORS[63]:**

The application of external fixators in the management of intertrochanteric fractures is simple, safe and economical. It is method of choice in high-risk geriatric patients.

Loosening of the whole implant thus leading to lack of confidence of patient while mobilizing.

PROGNOSIS AND COMPLICATIONS

PROGNOSIS

The prognosis for each of the three major categories of hip fractures is entirely different. Intertrochanteric fractures usually unite if reduction and fixation are properly done, and although malunions may be a problem, late complications are rare.

A wide area of bone is involved, most of which is cancellous, and both fragments are well supplied with blood. Fractures of the neck of the femur are intracapsular and involve a constricted area with comparatively little cancellous bone and a periosteumthat is thin or absent. Although the blood supply to the distal fragment is sufficient, the blood supply to the femoral head may be impaired or entirely lacking; for this reason, osteonecrosis and later degenerative changes of the femoral head or non-union often follow femoral neck fractures. The substance of the bone in the subtrochanteric region changes consistency as it progresses from the vascular cancellous bone of the intertrochanteric region to the less vascular diaphyseal cortical bone of the proximal shaft. Subtrochanteric fractures are associated with high rates of nonunion and implant fatigue failure because of the greater mechanical stresses in this region.

**COMPLICATIONS**

**Loss of Fixation**

Fixation failure with either a sliding hip screw or an intramedullary hip screw is most commonly characterized by varus collapse of the proximal fragment with cutout of the lag screw from the femoral head (Fig. 45-34) [64]. The incidence of fixation failure is reported to be as high as 20% in unstable fracture patterns[64]; rarely is it reported to

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In some cases, with good bone stock, repeat internal fixation combined with a valgus osteotomy and bone grafting can be considered. However, in most elderly individuals, conversion to a calcar replacement prosthesis is preferred.

**OTHER COMPLICATIONS**

Osteonecrosis of the femoral head is rare following intertrochanteric fracture[24, 69, 70, 71, 72]. No association has been established between location of theimplant within the femoral head and the development of ON, although one should avoid the posterior superior aspect of the femoral head because of the vicinity of the lateral epiphyseal artery system.

Laceration of the superficial femoral artery by a displaced lesser trochanter fragment has been reported[73] as well as binding of the guide pin within the reamer,

resulting in guide pin advancement and subsequent intra-articular or intrapelvicpenetration[74].

Periprosthetic fractures were more common with the first-generation short trochanteric Gamma nails, likely due to the large distal diameter (up to 16 mm), larger proximal bend, and large distal screws. Periprosthetic fracture rates as high as 17% have been reported[75]. With the newer design there has been a substantial drop in periprosthetic femur fractures, but it remains a concern. Missed distal interlocking with the short trochanteric nails can occur, despite the targeting device. With full length nails, impingement of the distal aspect of the nail on the anterior femoral cortex can occur , secondary to a mismatch of the nail curvature and femoral bow. Newer nail designs have partially corrected the mismatch to reduce the incidence of nail penetration through the anterior cortex. Nail breakage can occur with either the long or short trochanteric nails. Failure typically occurs at the lag screw site as this represents the area of maximal stress and thinnest metal. Hardware failure is usually the result of a nonunion or delayed union which leads to fatigue failure of the nail.

# CLASSIFICATION

A useful classification not only identifies the fracture pattern but serves as a definite guide to treatment and prognosis.

Several attempts have been made to classify these fractures.BOYD and GRIFFIN[32] in classifying trochanteric fractures referred to type 3 and 4 as subtrochanteric fractures.

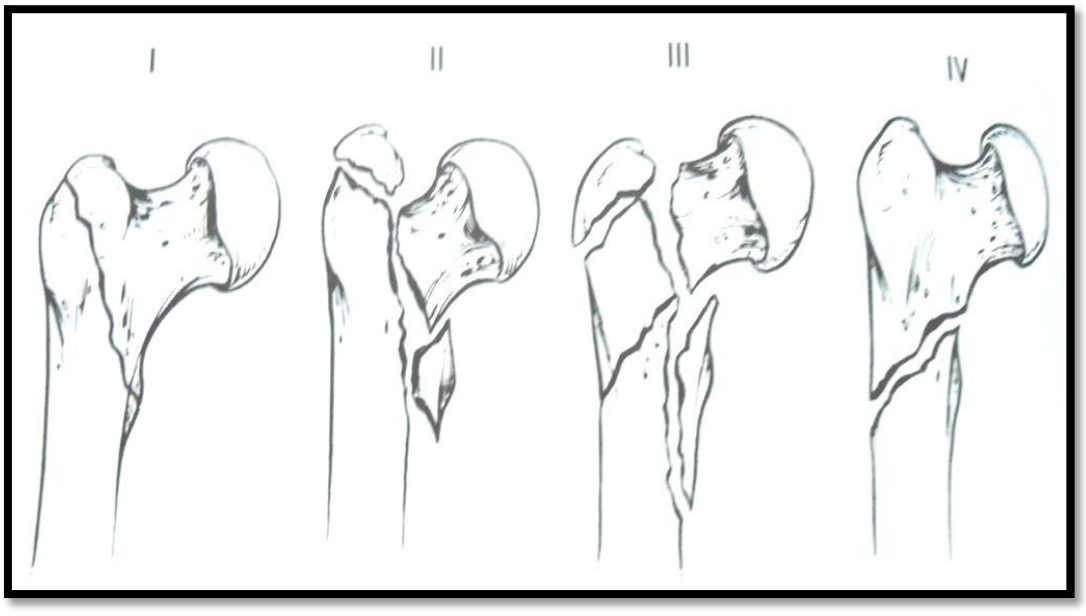
**BOYD AND GRIFFIN CLASSIFICATION**

TypeI:non-displaced intertrochanteric fractures.

TypeII :Communitted intertrochanteric fracture

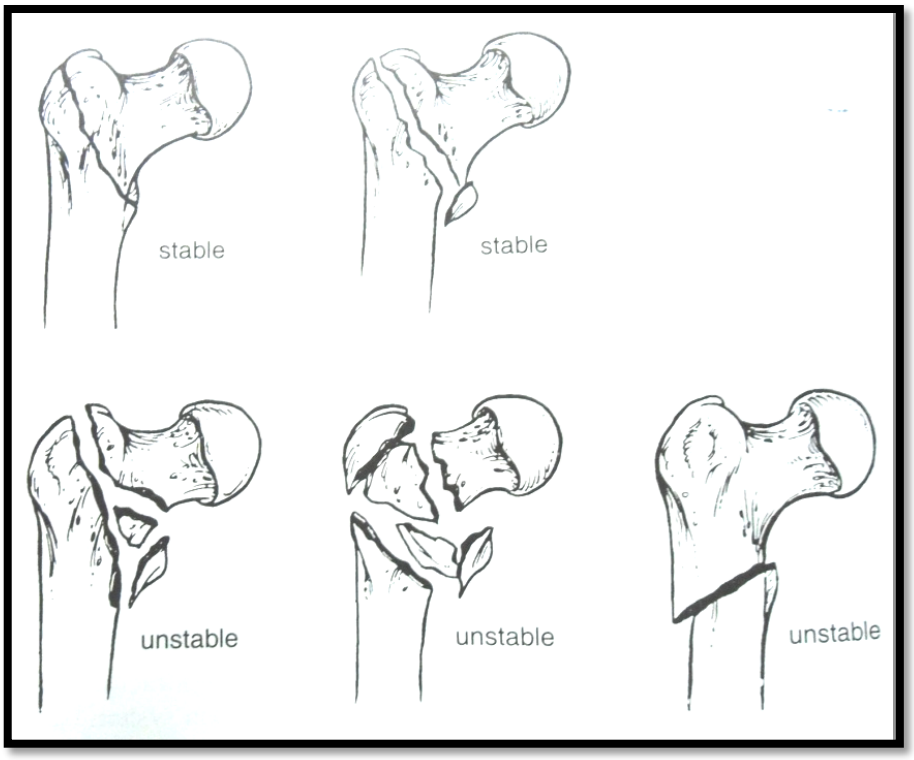
TypeIII:intertrochanteric fractures with subtrochanteric extension

Type IV:oblique fractures of proximal femur(reverse oblique)



**EVANS CLASSIFICATION**

Evans[33] observed that the key to a stable reduction is restoration of posteromedial cortical continuity. He accordingly divided intertrochanteric hip fractures into two types differentiated by the status of this anatomic area. In stable fracture patterns, the posteromedial cortex remains intact or has minimal comminution, making it possible to obtain a stable reduction. Unstable fracture patterns, on the other hand, are characterized by greater comminution of the posteromedial cortex. Although they are inherently unstable, these fractures can be converted to a stable reduction if medial cortical opposition is obtained. Evans further observed that the reverse obliquity pattern is inherently unstable because of the tendency for medial displacement of the femoral shaft.



Type I : Fracture line extends upwards and outwards from lesser thochantor.

Type II : The obliquity of the major line is reversed, so that it extends outwards and downwards from the lesser trochanter. Type 2 fractures have a tendency towards medial displacement of the femoral shaft because of the pull of adductor muscle.

**COMPREHENSIVE (AO/OTA ALPHANUMERIC) FRACTURE CLASSIFICATION[34]**

31-A Femur, proximal trochanteric

31-A1 Peritrochanteric simple

31-A1.1 Along intertrochanteric line

31-A1.2 Through greater trochanter

31.A1.3 Below lesser trochanter

31-A2 Peritrochantericmultifragmentary

31-A2.1 With one intermediate fragment

31-A2.2 With several intermediate fragments

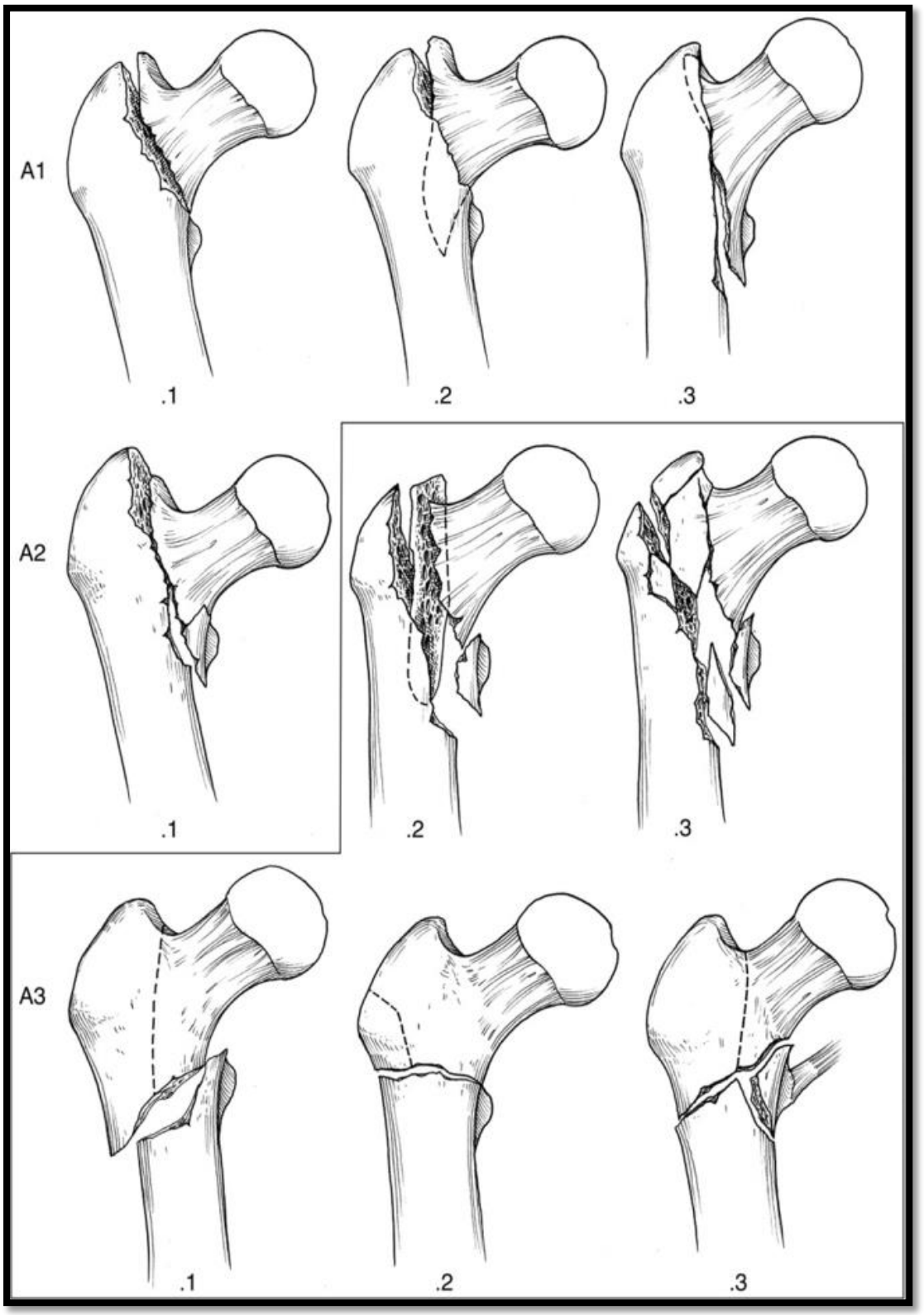
31-A2.3 Extending more than 1 cm below lesser trochanter

31-A3 Intertrochanteric

31-A3.1 Simple oblique

31-A3.2 Simple transverse

31-A3.3 Multifragmentary


A1
.1
.2
.3
A2
.1
.2
.3
A3
.1
.2
.3

TRONZO'S CLASSIFICATION (1973)[35]

Type 1: Incomplete Fractures With or Without

type 2: Uncomminuted Fractures, Displacement; Both Trochanters Fractured

Type 3: Comminuted Fractures, Large Lesser Trochanter Fragment; Posterior Wall Exploded; Neck
Type 3 Varient : As Above, Plus Greater Trochanter Fractured Off and separated.

Type 4: Posterior Wall Exploded, Neck spike displaced outside shaft Beak Impacted In Shaft.

Type 5: Reverse Oblique Fracture, with Or Without Greater Trochanter Separation.

**MANAGEMENT OF TROCHANTERIC FRACTURES IN ADULTS**

Trochanteric fractures can be managed in two ways-

1. Conservative or Non-operative method.

2. Operative method.

II. OPERATIVE MANAGEMENT:

The treatment of choice of intertrochanteric fractures ideally should be operative, employing some form of internal fixation.

The goals of operative treatment are:

- Strong and stable fixation of the fracture fragments.
- Early mobilization of the patient.
- Restoration of the patient to his or her pre-operative status at the earliest.

Kaufer, Matthews and Sonstegard[37] have listed the variables that determine the strength of the fracture fragment –implant assembly.

The Variables are –

- Bone Quality.
- Fracture Geometry.
- Reduction.
- Implant Design.
- Implant Placement.

The bone quality and fracture geometry, are beyond the control of the surgeon. Therefore the surgeon has within his control, the quality of reduction, the choice and placement of implant to achieve a stably reduced and internally fixed intertrochanteric fracture.

**EVOLUTION OF SURGICAL TECHNIQUES:**

Until the 20th century, trochanteric fractures were treated conservatively and in addition to fracture union they were generally associated with high complications. Surgical fixation of intertrochanteric fractures remains the standard of care; however the best method of surgical fixation is debatable.

Intramedullary Nails:

To decrease the amount of displacement in unstable fracture and during the healing process, intramedullary devices such as Gamma nail & intramedullary hip screw (IMHS) were developed48.

First generation (Standard Gamma- nail) intramedullary nail provided three point fixation and the medial location of the implant provided a more efficient load transfer and reduced the risk of mechanical failure[9]. Gamma nail ensured controlled fracture impaction, lesser operative time and blood loss.

Bridle et al[50] found that in study of hundred patients two had femoral shaft fractures with use of 16 mm nails. Some patients also complained of thigh pain.

Rosenblumet al[9] also found decreased sliding of the screw in comparison with that of sliding hip screw constructs.

Femoral shaft fracture was a complication of the use of first-generation intramedullay nails, with rates ranging from 2.2% to 17% [12,50,51,52] approximately four times greater than that seen with compression hip screw[3].

Thigh pain has been reported to occur in 17% of patients treated with a firstgeneration nail[53]. Hardy et al[54] found a relationship between thigh pain and use of two distal interlocking screws.

**SECOND GENERATION NAIL:**

Limitations and complications of the first generation intramedullary nails led to changes in the implant geometry such as Trochanteric Gamma Nail (TGN) with reduced valgus bend to 40 from 100, decreased distal diameter of 11 mm from 16 mm and shortened length of 180 mm from 200 mm to decrease the stress concentration at their tip[1].

Other second generation nails of similar design (single lag screw into the head) include IMHS, Trochanteric Femoral Nail (TFN).

The rate of peri-implant fracture improved between 0 - 4.5% but the rate of femoral cutout of 2.5% to 8.3% did not improve3, because the second generation nails also required greater forces to initiate sliding than the sliding hip screw[55].

Lochet al[56] showed that the sliding plate required less force to generate sliding than the second generation intramedullary devices.

No significant difference was found in frequency of implant related complications between the dynamic hip screw and second generation intramedullary devices[3].

Most studies comparing the Gamma nail with dynamic hip screw found no differences regarding intra operative complications and implant failure. However patients treated with a Gamma nail were at increased risk of femoral shaft fracture at nail tip and at the insertion sites of the distal locking bolts[55].

**THIRD GENERATION NAILS:**

These incorporate multiple lag screws into the femoral head. Multiple points of fixation theoretically provide better rotational control of unstable fractures compared with a single lag screw. Smaller diameter of proximal section of the nail because of smaller diameter screws is helpful in reducing the amount of gluteus medius tendon injury.

Theoretical concerns about smaller diameter screws are, screw cutout directly related to their decreased diameter that could be exacerbated by screw bending. Such bending can prevent sliding of the lag screw[3].

Some of third generation nails:

Trochanteric antegrade nail (TAN),

Proximal femoral nail (PFN),

Antegrade femoral nail (AFN),

In 1996 the AO/ASIF developed the proximal femoral nail (PFN) as an intramedullary device for the treatment of unstable per-, intra- and subtrochanteric femoral fractures in order to overcome the deficiencies of the extramedullary fixation of these fractures. This nail has the following advantages compared to extramedullary implants such as decreasing the moment arm, insertion by a closed technique, retains the fracture hematoma, an important consideration in fracture healing, decreasing blood loss and infection, minimizing the soft tissue dissection and wound complications[56].

In a clinical multimember study, authors reported technical failures of the PFN after poor reduction, malrotation or wrong choice of screws[56].

Herrera. et al compared trochanteric fractures treated with the Gamma nail or the Proximal Femoral nail and concluded that there were no significant difference in the use of either nail in terms of the recovery of previous functional capacity, nor in terms of the time required for fracture healing. With regard to the more significant technical complications recorded, shaft fractures and the cutting-out phenomenon were more common with the use of the Gamma nail, while secondary varus occurred at a greater rate when using the PFN[57].

Douspaet al[58] concluded that PFN is a method of choice in trochanteric fractures, namely in high subtrochanteric fractures.

Banan et al[59] concluded that the PFN is a good choice for trochanteric and subtochanteric fractures and also the use of the PFN for unstable trochanteric fractures is very encouraging.

Boldinet al[60] prospective study of proximal femoral fractures treated with PFN on fifty - five patients, concluded that PFN being a intramedullary device is the method of choice in treatment of unstable pertrochanteric femoral fractures.

Schipperet al[61] concluded both PFN and gamma nail had comparable results except that PFN has less intraoperative blood loss and concluded that pitfalls and complications were similar and mainly surgeon or fracture related, rather than implant related.

Fogagnoloet al[62] concluded that PFN is a suitable implant for unstable fractures, but the high re-operation rate precludes its routine use for every peritrochanteric fracture.

In 2000 AO/ASIF introduced Antegrade Femoral Nail in Germany, bringing some more changes to the preexisting third generation nails. The nail's proximal funnel diameter was reduced, the medio-lateral bent was increased and both the hip screws were made of the same diameter and were given in built ante version.

In 2007 AO/ASIF devised PFNA (Proximal femoral nail Anti-rotation) with a single unique spiral blade, which was said to give more rotational stability than PFN.

Unfortunately use of intramedullary fixation devices can result in an increased risk of intraoperative and postoperative femoral fractures and carries a significant learning curve for proper instrumentation.

In unstable trochanteric fractures in patients with severely osteoporotic bone, some authors have suggested the use of Polymethylmethacrylate (PMMA) to augment the fixation and improve the stability.

The Alta expandable dome plunger is a modified sliding hip screw designed to improve fixation of the proximal fragment by facilitating cement intrusion into the femoral head. Cement is kept away from the plate barrel so that the device's sliding potential is maintained. The method of insertion is similar to that of the sliding hip screw, except that the dome unit is manually pushed into the pre-reamed femoral neck and head proximal fixation is achieved as the plunger is then advanced, expanding the dome in the cancellous bone of the femoral head and extruding the contained cement.

**PROSTHETIC REPLACEMENT:**

Prosthetic replacement for intertrochanteric fractures has not gained widespread support.

The indications for primary prosthetic replacement remains ill defined. Most authors cite elderly, debilitated patients with a comminuted, unstable intertrochanteric fracture in severely osteoporotic bone, as the primary indication for prosthetic replacement.

The indications for primary prosthetic replacement as per Kenneth J. Koval[2] are-

1. Symptomatic ipsilateral degenerative hip disease, where a total hip replacement is ideal.
2. Attempted open reduction and internal fixation that cannot be performed because of extensive comminution and poor bone quality, where the procedure should be aborted and a hemiarthroplasty should be carried out.

Primary prosthetic replacement is much more extensive and invasive procedure than internal fixation, with the potential for increased morbidity and complications including prosthetic dislocation. Furthermore, the cost of the prosthesis is high.

Hence, prosthetic replacement is a useful technique only for the occasional patient with an intertrochanteric non-union or failure of fixation or severely osteoporotic bone.

**EXTERNAL FIXATORS[63]:**

The application of external fixators in the management of intertrochanteric fractures is simple, safe and economical. It is method of choice in high-risk geriatric patients.

Loosening of the whole implant thus leading to lack of confidence of patient while mobilizing.

PROGNOSIS AND COMPLICATIONS

PROGNOSIS

The prognosis for each of the three major categories of hip fractures is entirely different. Intertrochanteric fractures usually unite if reduction and fixation are properly done, and although malunions may be a problem, late complications are rare.

A wide area of bone is involved, most of which is cancellous, and both fragments are well supplied with blood. Fractures of the neck of the femur are intracapsular and involve a constricted area with comparatively little cancellous bone and a periosteumthat is thin or absent. Although the blood supply to the distal fragment is sufficient, the blood supply to the femoral head may be impaired or entirely lacking; for this reason, osteonecrosis and later degenerative changes of the femoral head or non-union often follow femoral neck fractures. The substance of the bone in the subtrochanteric region changes consistency as it progresses from the vascular cancellous bone of the intertrochanteric region to the less vascular diaphyseal cortical bone of the proximal shaft. Subtrochanteric fractures are associated with high rates of nonunion and implant fatigue failure because of the greater mechanical stresses in this region.

**COMPLICATIONS**

**Loss of Fixation**

Fixation failure with either a sliding hip screw or an intramedullary hip screw is most commonly characterized by varus collapse of the proximal fragment with cutout of the lag screw from the femoral head (Fig. 45-34) [64]. The incidence of fixation failure is reported to be as high as 20% in unstable fracture patterns[64]; rarely is it

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# MATERIAL AND METHODS

In this series we have studied 40 patients with UNSTABLE INTERTROCHANTERIC FRACTURE FEMUR with the implants which are routinely used in our institute for such fractures from Jan 2016 to June2017 at Dheeraj General Hospital, Piparia, Vadodara. We have used Proximal Femoral Nail in 20 cases and Antegrade Femoral Nail in 20 cases.

**Inclusion criteria**

- Patients with Unstable Intertrochanteric fractures Type 3,4,5 as per Tronzo's.

**Exclusion criteria**

- Stable intertrochanteric fractures TYPE-1,2 per Tronzo's Classification
- Isolated Sub trochanteric fractures
- Patients with pathological fractures.
- Patients with open fractures
- Patients with associated neurovascular complications

**PROTOCOL**

- Patient's complete history and details noted.
- Thorough clinical examination of patient was done to rule out any other associated injuries. The affected limb was thoroughly examined to rule out vascular or neurological injury. Ipsilateral knee examined for associated injury.
- History taken regarding any other co-morbid diseases.
- Patients were evaluated regarding pre-injury mobility status.

- Anteroposterior radiograph of pelvis showing both hips and cross table lateral view of involved proximal femur were obtained. On the basis of fracture geometry, the fracture was classified using Tronzo Classification.
- To minimize discomfort of displaced fracture, affected limb was immobilized by giving upper tibial skeletal traction or ankle traction of 15 -20 pounds.
- Routine proper care in the form of Analgesics, antibiotics and immobilization taken for any other associated fracture or injury.

**PREOPERATIVE PREPARATIONS**

- All the patients underwent complete routine medical and anesthetic check up for preoperative assessment, which included blood investigation, chest x-ray and ECG.
- According to the reports necessary actions were taken.
- After anesthesia fitness, the patients were posted for surgery as early as possible with the fulfillment of following requirements:
- Written and informed consent for surgery and anesthetic risk was taken and also the pt was explained about our study for which Patient Information Sheet was provided and a separate consent was taken for participating in the study.
- One to two units blood in reserve depending on patients Hb level.
- Inj Ceftriaxone 1 gm IV were administered preoperatively 1hr prior to surgery

**IMPLANT USED FOR FRACTURE FIXATION**

**A. PROXIMAL FEMORAL NAIL (P.F.N.)**

PFN is one of the newer designs for intramedullary fixation for proximalfemoral fractures. Devised by AO/ASIF in year 1996.Designed to stabilize and improve prognosis of all fractures by a sound application of the established intramedullary principle.

PFN has following components :

- Intramedullary rod/nail passed through proximal femur (cephalocondylic). Broader proximal diameter (14mm) and gradually tapering.
- A self tapping lag screw 8mm passed through the proximal part of the nail into the neck and head of femur.
- A self tapping 6.4mm hip pin, also passed through the nail into the neck n head of femur.
- Both these screws are passed with the help of a jig or targeting device.
- Distal locking screw 4.9mm with option for both static or dynamic hole.

**Advantages:**

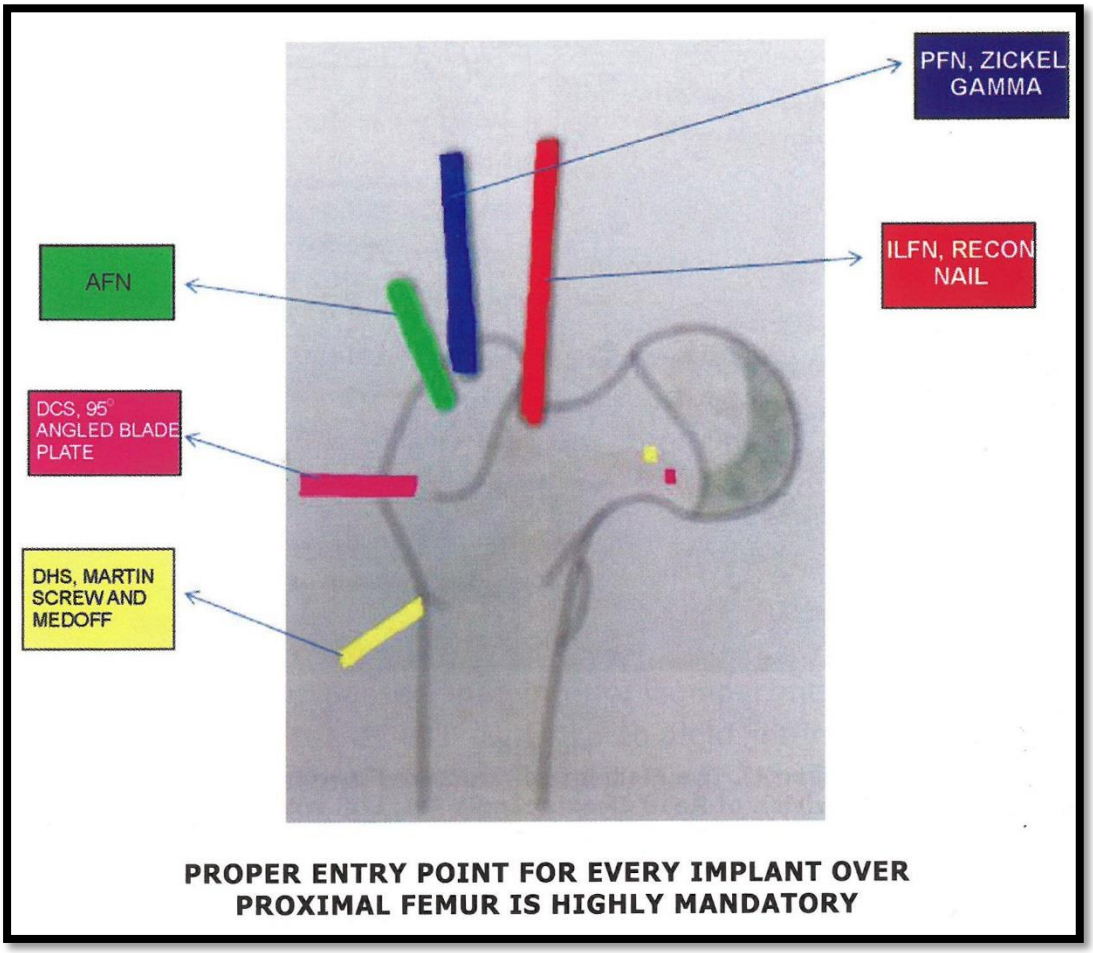
Having all the advantages of an intramedullary fixation as discussed earlier

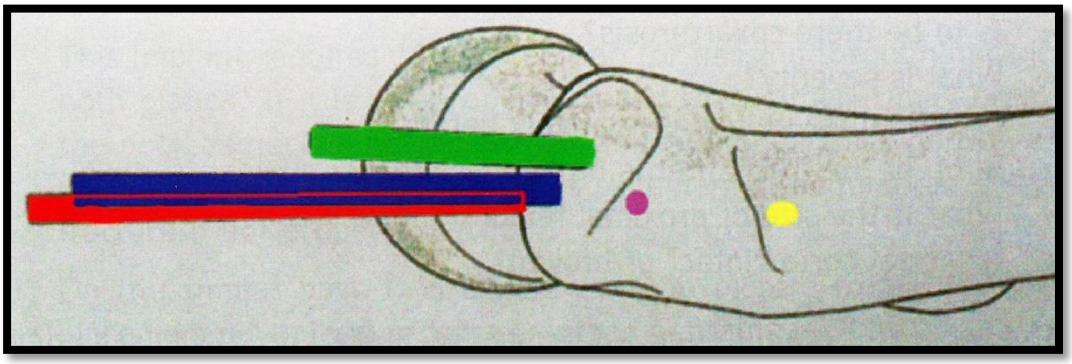
- Load sharing device
- Closed procedure therefore less blood loss, less surgical trauma, lesser risk of infection , preserves fracture hematoma.
- Paralleling biomechanics of fracture fixation.

**Disadvantages:**

- Broad proximal diameter, unsuitable for Asian proximal femur.
- Neck occupancy is high
- Unequal diameter of the two hip screws at times prevent collapse

- Short nail often cause thigh pain and have reported to cause fracture of the shaft at the tip of the nail due to stress riser

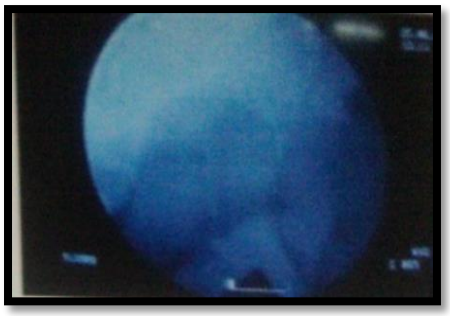


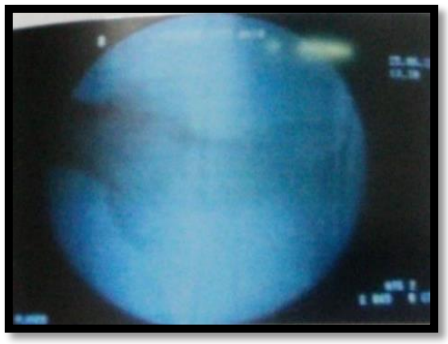

**(Proximal Femoral Nail With Complete Instrumentation Set)**

## OPERATIVE IMAGES

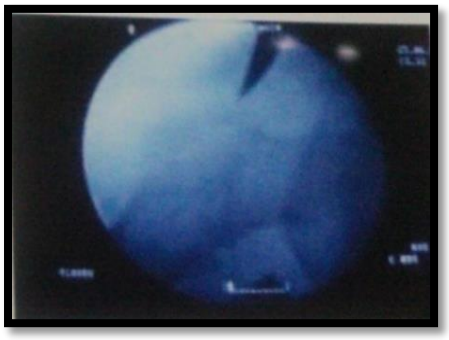
**BEFORE REDUCTION**



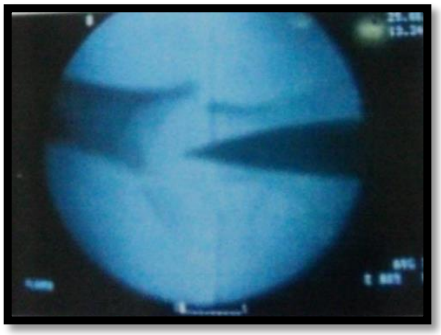
**POST REDUCTION-AP VIEW**



**POST REDUCTION –LAT VIEW**



**AWL INSERTION AP**



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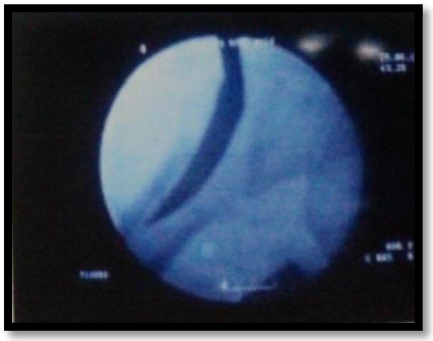

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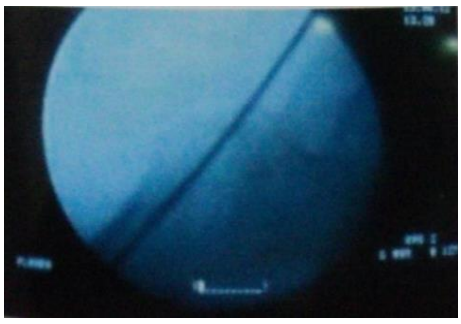

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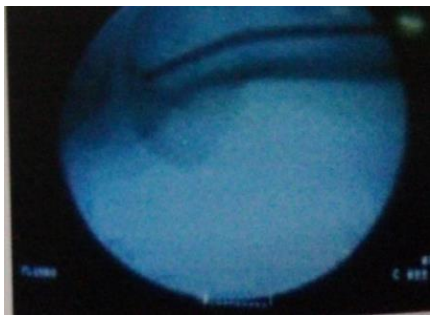
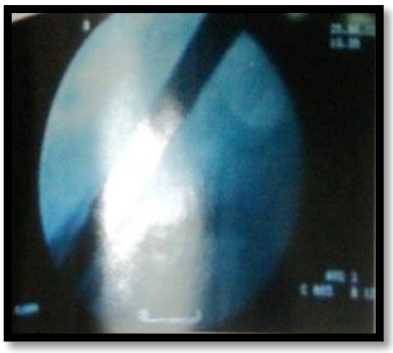
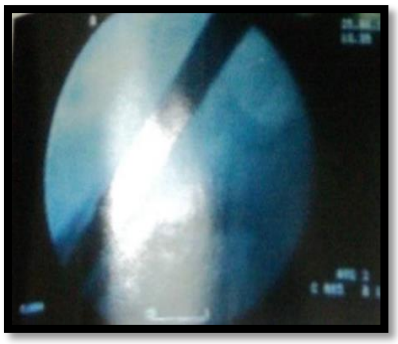


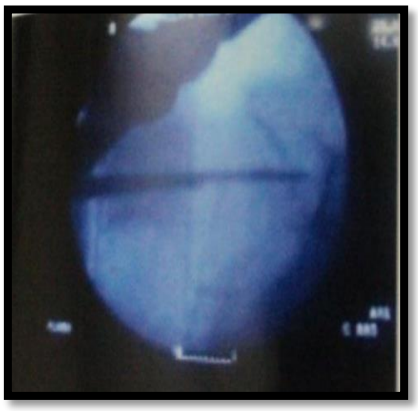
**INSERTION TILL KNEE LATERAL**



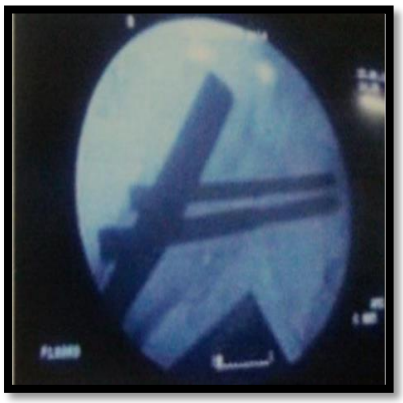
**NAIL INSERTION**



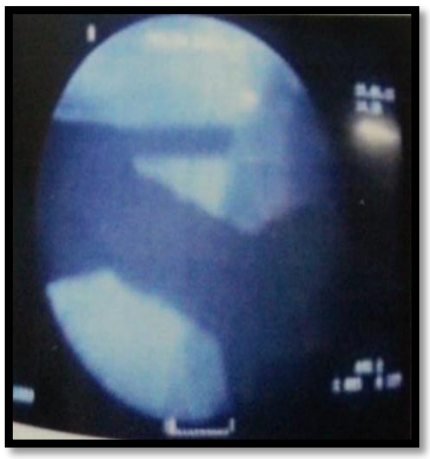
**NAIL INSERTED**



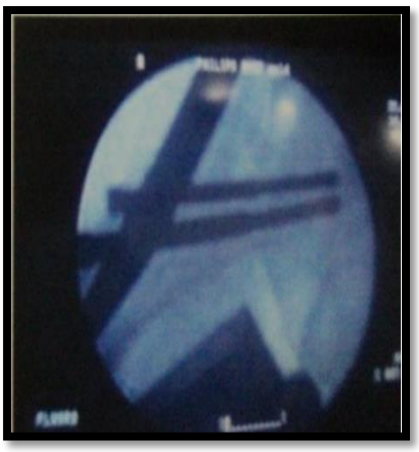
**GUIDE PIN LATERAL VIEW**



**AFTER SCREW INSERTION**



**FINAL IMAGE LAT VIEW**



**FINAL IMAGE**

## B. ANTEGRADE FEMORAL NAIL (A.F.N.)

AFN is a still more newer design in 3rd generation nails. It is more like a variant to PFN with few significant changes which help it overcome lot of drawbacks of PFN. AFN has less proximal diameter(13 mm), greater mediolateral bent (6 degree) and also increased curvature of the nail (1500mm diameter) to match the femoral curve. Two hip screws are both of the same diameter, with in-built ante version of 10 degrees. Devised by AO/ASIF but is easily available with the local implant supplier.

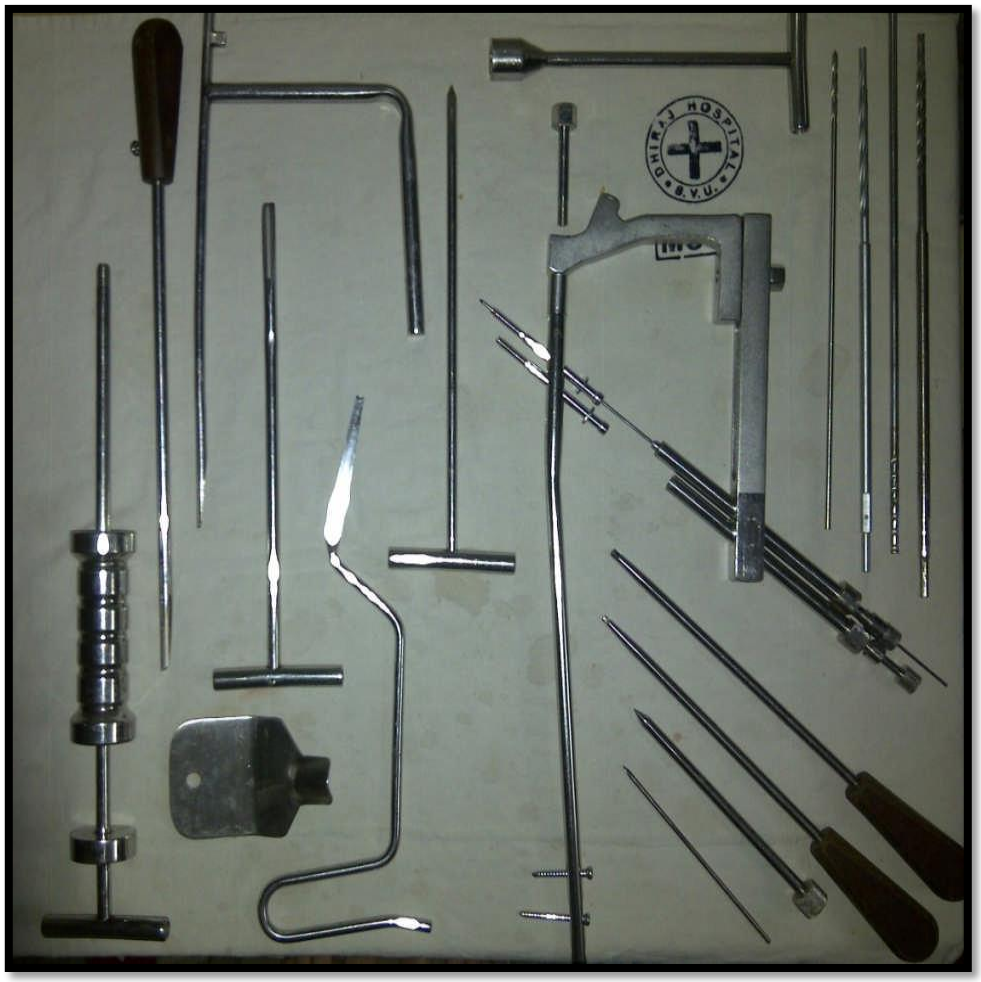
AFN has following components :

- Intramedullary rod/nail passed through proximal femur (cephalocondylic) proximal diameter (13mm) and gradually tapering distally.
- 2self tapping canulated hip screwsof 6.4mm diameter passed through the proximal part of the nail into the neck and head of femur. Both these screws are passed with the help of a jig or targeting device.
- Washers to be applied with the hip screws
- Distal locking screw 4 mm with option for both static and dynamic hole
- End Cap of various sizes to be put on proximal end of the nail.

**Advantages:**

- All the advantages of intramedullary implant as discussed earlier.
- Lesser proximal diameter (13mm) ,suits Indian femurs.
- Increased medio-lateral bent makes the entry point to be just lateral to the tip of the trochanter, thus sparing the important vasculature around the tip and also in cases of fractured greater trochanter entry becomes through the fracture site .

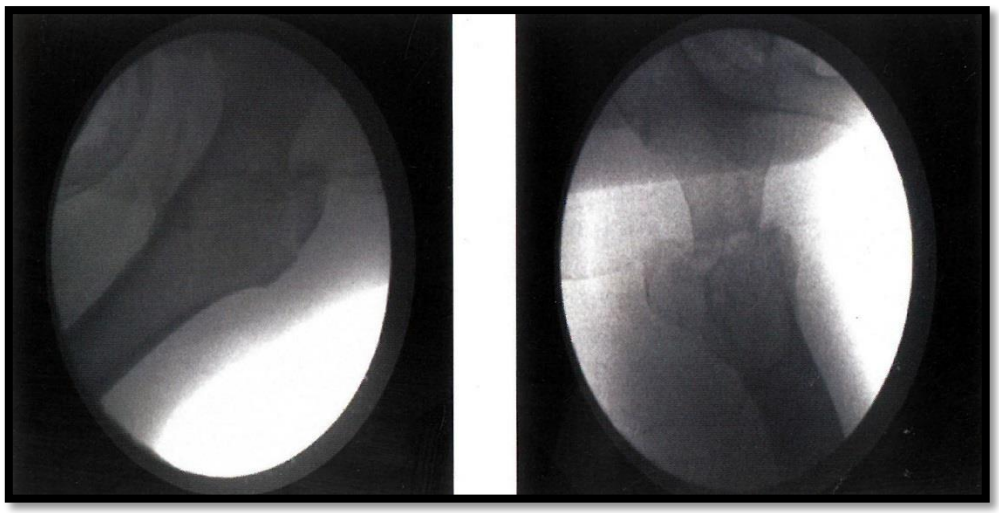
- The increased medio-lateral bent also gives the fracture a desired valgus reduction.
- The two hip screw with less and same diameter give an advantage of less neck occupancy and obey the law of parallelism.
- The inbuilt anteversion of the hip screw provide absolute correct placement of the screws in the neck.
- The washers when used with the hip screws provide greater compression.
- Usage of end cap provides extra length to the nail in cases where the nail gets buried and also helps in the removal of nail..



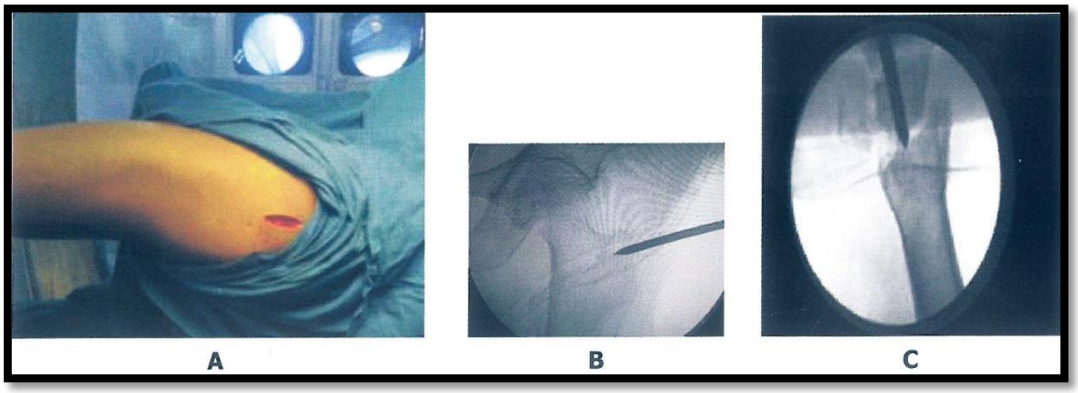

**(Antegrade Femoral Nail With Complete Instrumentation Set )**

**OPERATIVE PROCEDURE OF OUR INDIAN MADE AFN AS PER OUR DESIGN**

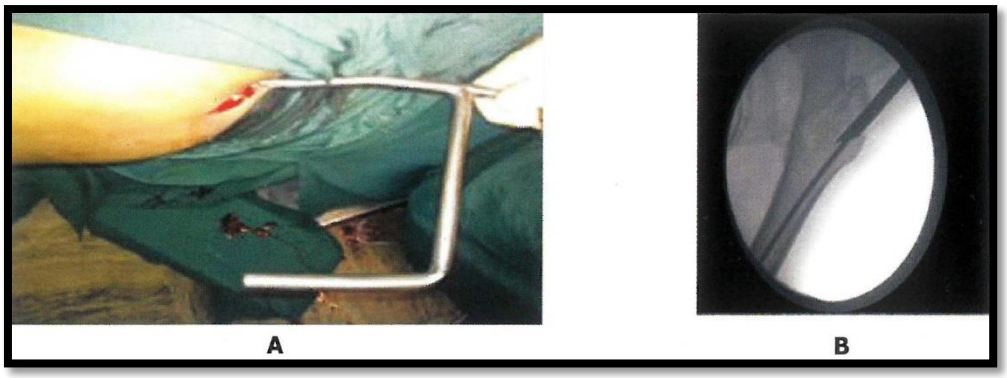
**PUT OPPOSITE HIP INTO WIDE ABDUCTION AND DO 10 15$^{O}$ OF ADDUCTION OF AFFECTED SIDE TO MAKE TROCHANTER PROMINENT FOR EASY ENTRY, PUT IITV BETWEEN TWO LEGS SURGEON AND ASSISTNAT WITH TROLLY SHOULD REMAIN ON LATERAL TO AFFECTED SIDE WHICH GIVES EASY ACCESS ON TV.**



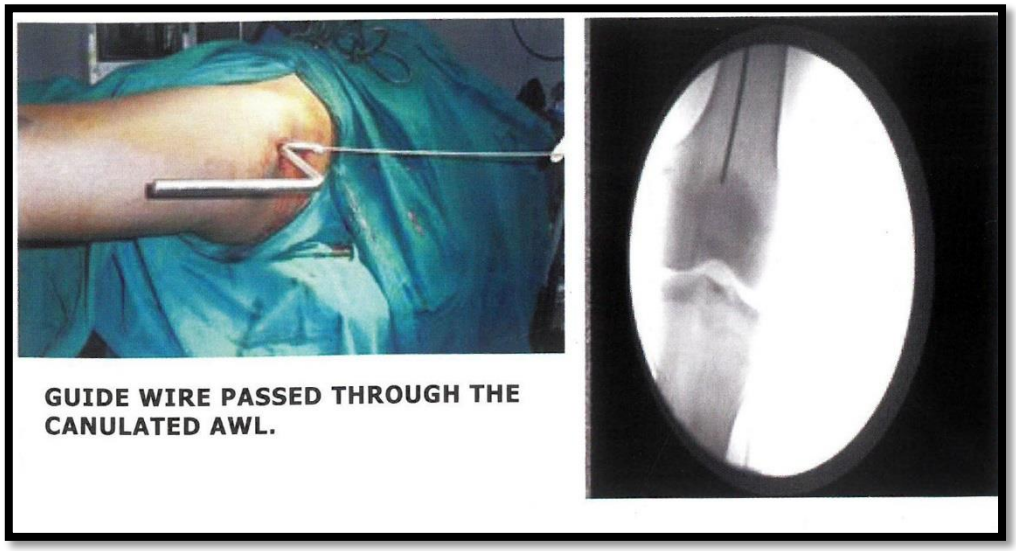
**AP and lateral view on IITV after reduction**

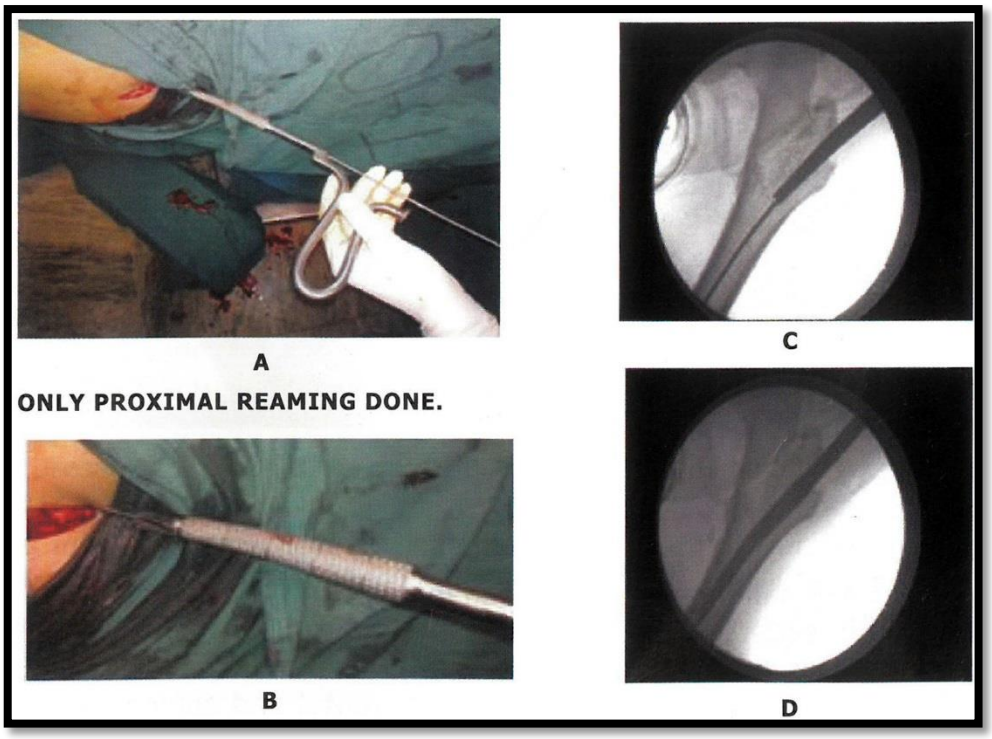



**Entry point :** Just lateral to TIP of Greater Trochanter Confirmation awl entry in both planes under IITV. If fracture line extending into the trochanter then pass awl through fracture site.

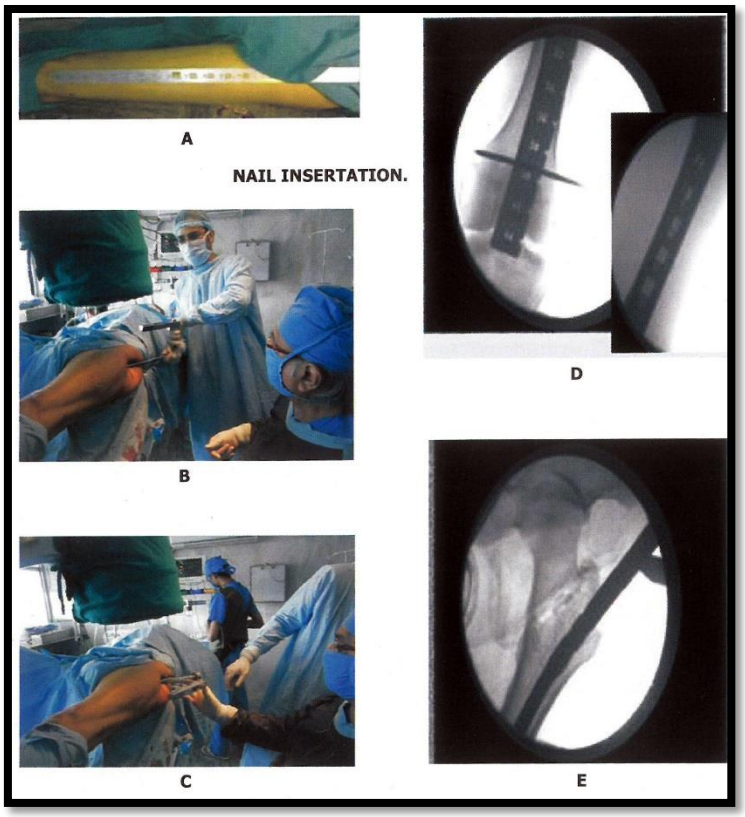



Specially Prepared Canulated AWL with 6$^{o}$ Lateral bent is passed throught the entry and guide wire is passed in medullary canal of shaft and furter negotiation of cannulated awl upto isthmus and then awl reoved keeping the guide wire inside.



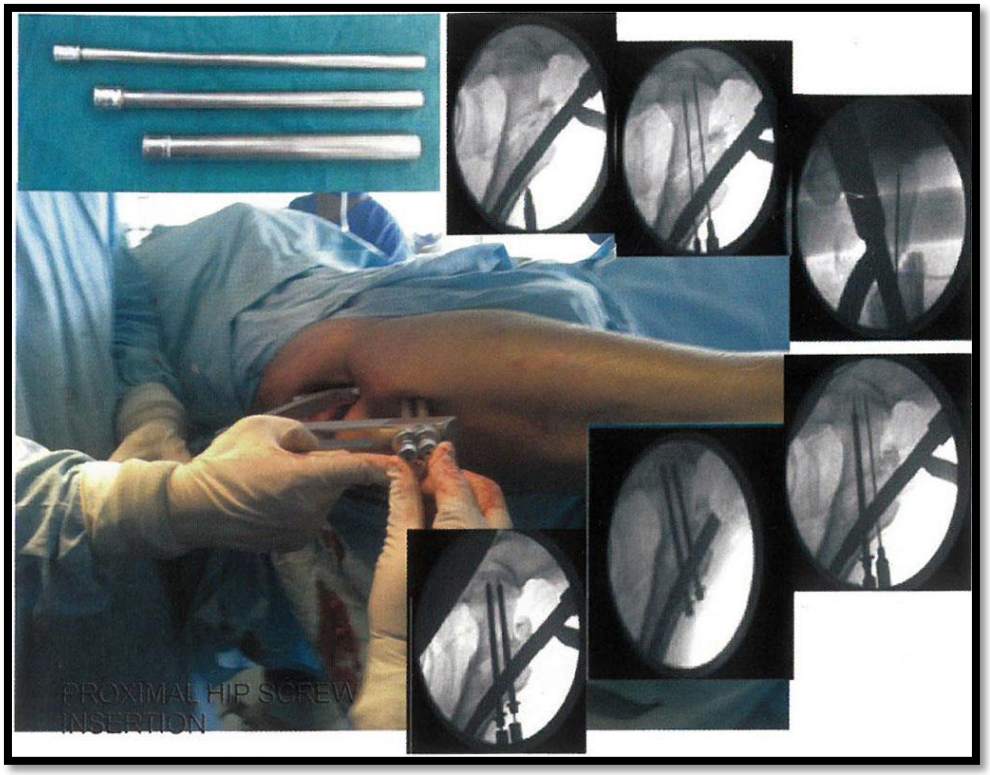



Wedening of only proximal entry in the trochanter with serrated cannulated awl.

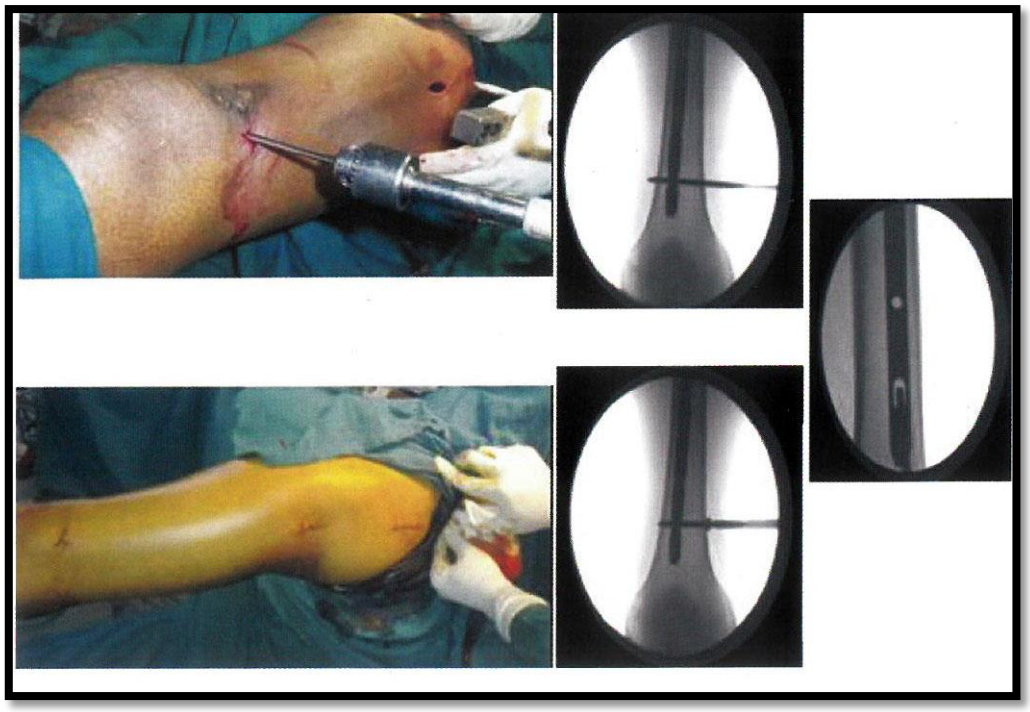



Measurment of nail length

Decided nail attached to jig and inserted in 90$^{o}$ upwardd rotation in to accommodate lateral bent in the trochanter by biological curve (anterior bowing) of nail in the trochnanter and as the nail progresses the jig will rotate to horizontal and comes parallel to shaft.




Put two outer sleeves in jig hole and then put a cente pin for guide pin and confirm the position of guide pin in the neck and confirm by IITV in two planes ap and lateral. Jig is narrow so that it do not obstruct the lateral view of neck. HIp screws are two and both are cannulated cannulated cancellous with diameter of 6.4 mm. It helps in preventing rotation at fracture site. cut washers are used for putting over guide wire before negotiating cannulated screw over the guide wire before negotiating cannulated screw over the guide wire to achieve compression at the site of fracture. Hip screws are having two types of thread 16 and 32 mm. So we can achieve collapse or compression even in low transcrevical and basi-cervical variety of fractures. After rfemoving central sleeve after confirming positions of two guide wires, reaming is done with tapering reamer via second sleeve and hip screw is passed.



**Distal Locking**: Freehand technique
Distal locking is done by free hand technique either is static or dynamic hole. Whole procedure is completed with 3 small incisions of 2-3 CMS size.

**POST-OPERATIVE MANAGEMENT PROTOCOL:**

- Analgesic: only first day perentral analgesic administered followed by oral NSAID/tramadol upto 10-14 days depending upon patient's tolerance.
- Antibiotics: Inj. Ceftriaxone given for 5days and Inj. Amikacin was given for 3 days. Then if required continued on oral antibiotic
- Physiotherapy: active physiotherapy started from first post-operative day itself
- In form of static quadriceps exercises and then as per patients pain tolerance, knee bending exercises stated from second day. As soon as complete extension and flexion is achieved, the patient is made to stand with support of walker.
- As soon as patient is comfortable standing, Non weight Bearing Walking is started. Further on depending on the fracture geometry and type of fixation patient is gradually made to touch the affected side toe on ground followed by Partial weight bearing.

- Postoperative hospital stay: All the patients were discharged by the 12thpost operative day after suture removal.

**ASSESMENT:**

Pre-operative patient's demographic profile, pre-injury mobility, fracture pattern, medical profile, delay in operation and total hospital stay were recorded. Intra-operative data like type and quality of reduction, type of implant with details, blood loss, time of operation, incision size and fluoroscopy were recorded. Post operative complications like infection, starting of mobilization and severity pain were noted.

After discharge patients were assessed clinically and radiologically at 6th, $12^{th}$ weeks; then monthly up to union of fracture, followed by every 3 months .In every follow up visit patients were assessed clinically for hip/thigh pain, walking ability,abnormal gait/ limp (abductor lurch, short limb gait), ,limb length discrepancy( shortening), any deformity, range of movement at hip and knee joint ,muscle strength and ability to squat and sit cross-legged. Radiographs were taken to assess union and to calculate the neck shaft angle of the operated hip. The hip joint congruency and the implant status with any evidence of implant failure were looked for.

- Fracture union was defined as that period between injury and full weight bearing with a roentgenographical evidence of healing of fracture(
- Characterized by 3/4cortical bridging and fading of fracture lines on 2 views) and absence of pain.
- Delayed union was considered present if roentgenographs did not demonstrate fracture consolidation by 9 months.

- Malunion was defined as limb shortening or lengthening greater than 1 cm, 10 degree angulation in any plane or rotational malignment greater than 15 degree and neck shaft angle difference of more than 5 degree.

The functional and clinical outcome in terms of amount of pain, ability to walk, walking distance, muscle power, range of movement of the affected hip, participation in daily routine activities, ability to squatand sit cross-legged were assessed using MODIFIED **SALVATI AND WILSON SCORING SYSTEM (**with added criteria as per Indian customs.) Annexure – III.

# OBSERVATIONS & RESULTS

We had studied 40 cases of close extracapsular proximal femur fractures treated with proximal femoral nailing and anti-grad femoral nailing. The primary aim of the study is to critically evaluate the results of proximal femoral nailing for proximal femur fractures with reference to clinical, radiological and functional parameters in the time frame December 2015 to September 2017. Following observations were made from the study.

## TABLE-1 : AGE DISTRIBUTION OF PATIENTS OPERATED WITH PFN AND AFN

| Age | No of patients | Percentage(%) |
|---|---|---|
| **18-30 years** | **7** | **17.5%** |
| **31-40 years** | **2** | **5%** |
| **41-50 years** | **8** | **20%** |
| **51-60 years** | **5** | **12.5%** |
| **61-70 years** | **7** | **17.5%** |
| **71-80 years** | **10** | **25%** |
| **81-90 years** | **1** | **2.5%** |
| **TOTAL** | 40 | **100%** |

In present study, age varied from 18 to 90 years.Out of all 45% of the patients belong to the age group of 61 to 90 years. Average age was 55.1years.

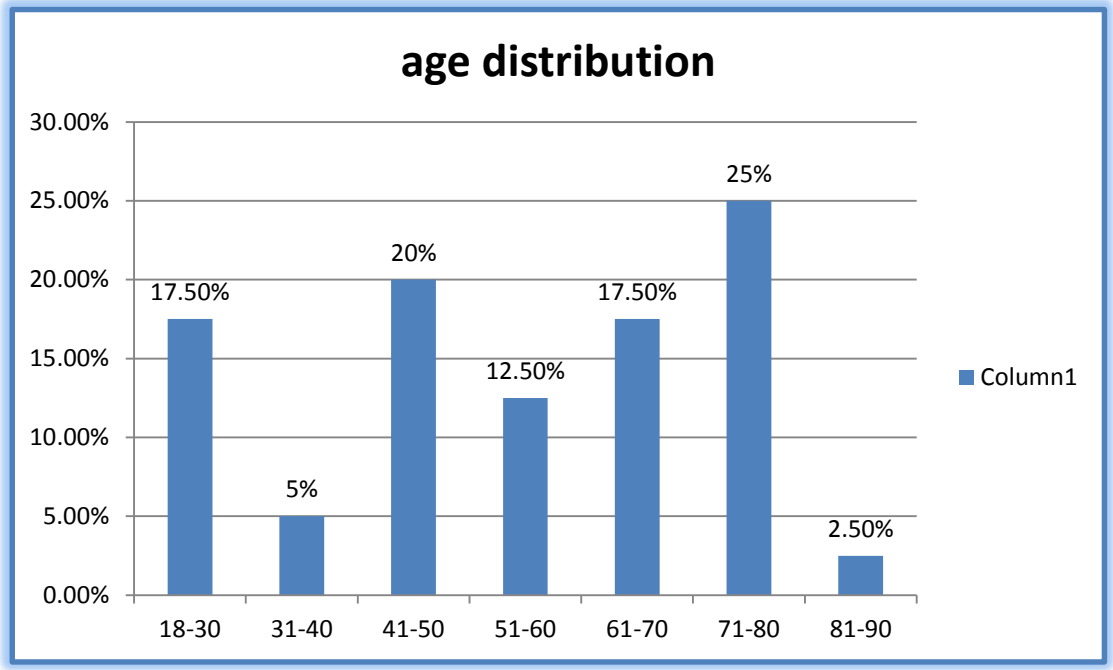

age distribution
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
17.50%
5%
20%
12.50%
17.50%
25%
2.50%
18-30
31-40
41-50
51-60
61-70
71-80
81-90
Column1

**TABLE-2 : GENDER DISTRIBUTION OF PATIENTS**

**OPERATED WITH PFN AND AFN.**

| GENDER | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **MALE** | 25 | 62.5% |
| **FEMALE** | 15 | 37.5% |
| **TOTAL** | 40 | 100% |

In our study, we observed that out of 40 cases included in the study, male 25 patients(62.5%)were male and only 15 patients(37.5)were female.

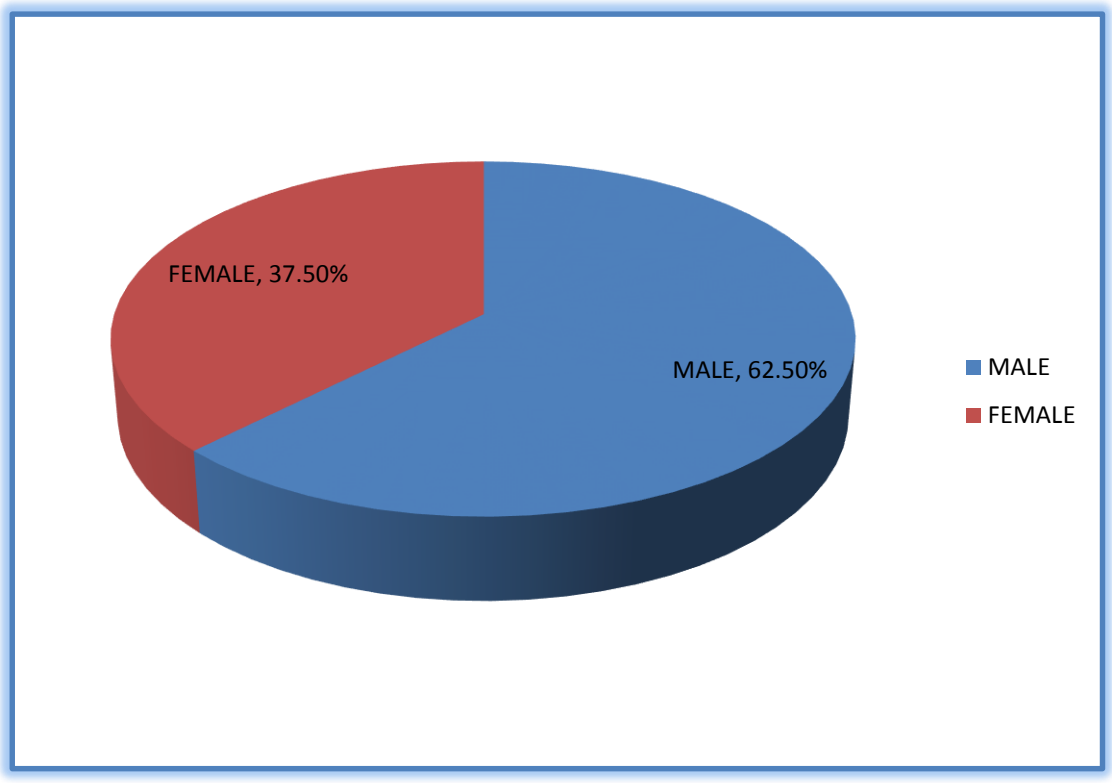


**TABLE-3 : OCCUPATION DISTRIBUTION OF PATIENTS OPERATED WITH PFN AND AFN.**

| OCCUPATION | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **FARMER** | 10 | 25% |
| **HOUSEWIFE** | 12 | 30% |
| **LABOURER** | 10 | 25% |
| **RETIRED** | 2 | 5% |
| **DRIVER** | 6 | 15% |
| **TOTAL** | 40 | 100% |

In our study , there was predominance of farmer housewife labourer.

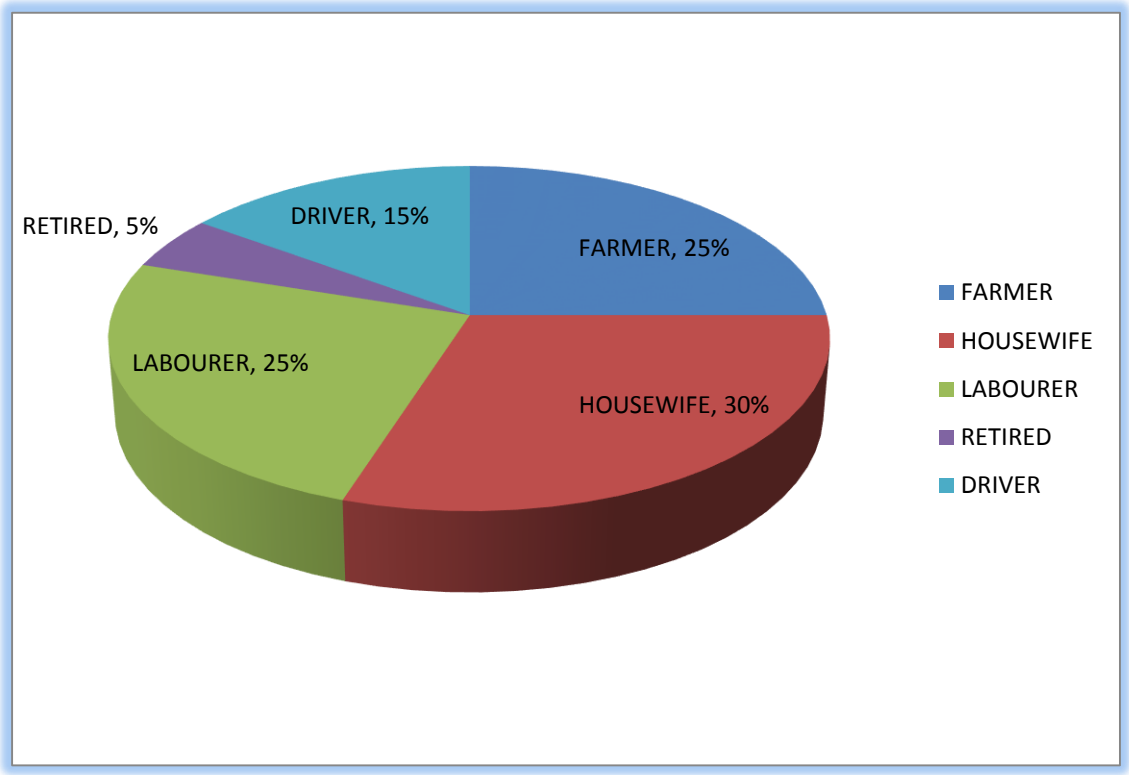


**TABLE-4:SIDE OPERATED WITH PFN AND AFN**

| SIDE | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **RIGHT** | 20 | 50% |
| **LEFT** | 19 | 47.5% |
| **BILATERAL** | 1 | 2.5% |
| **TOTAL** | 40 | 100% |

In our study, out of 40 patients 19 of them had fractures on left side and 20 of them on right side and 1 case was bilateral.

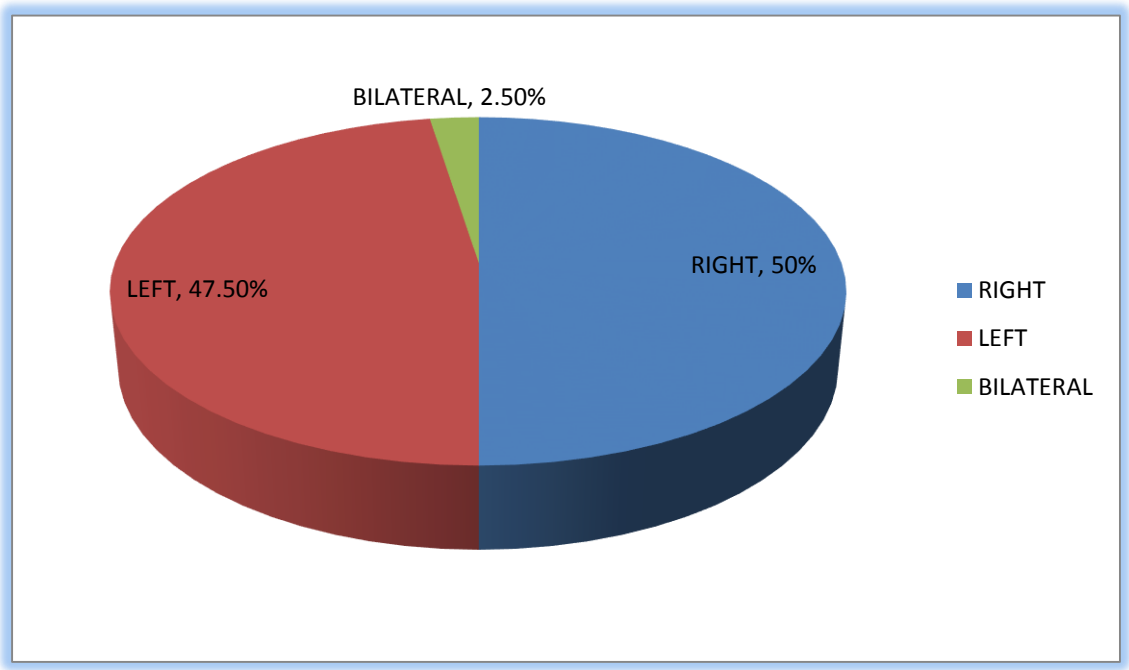
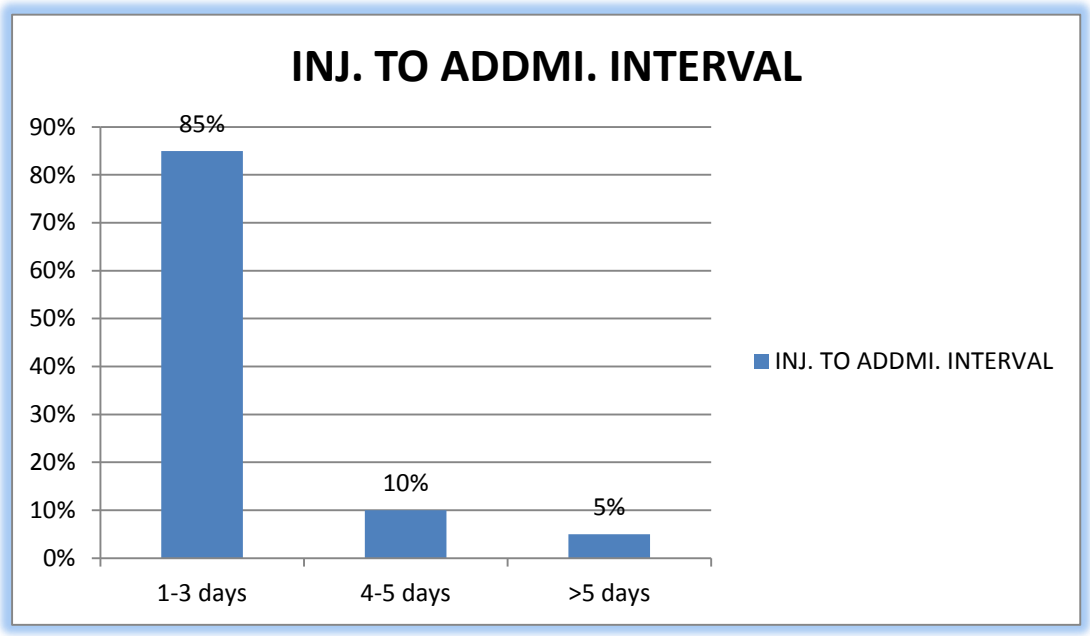


**TABLE-5: INTERVAL BETWEEN INJURY ADMISSION**

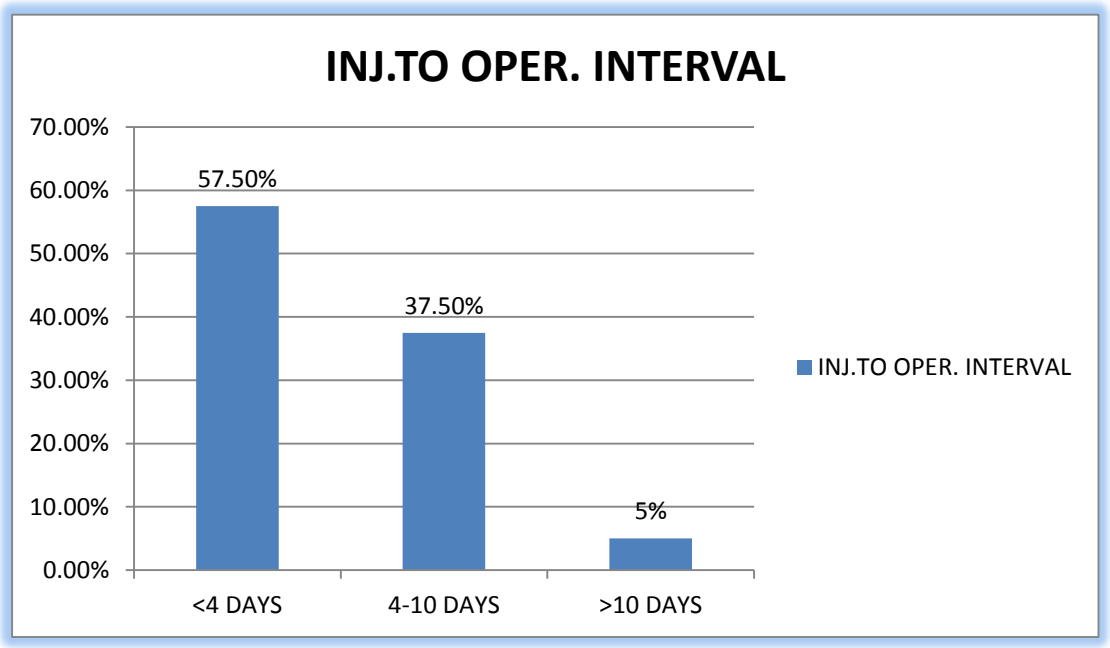
| INTERVAL | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **1-3 days** | 34 | 85% |
| **4-5 days** | 4 | 10% |
| **>5 days** | 2 | 5% |
| **TOTAL** | 40 | 100% |




Most of patient admission1 to 3day after injury of unstable trochanter fracture.

**TABLE-6: INTERVAL BETWEEN INJURY TO OPERATION TIME**

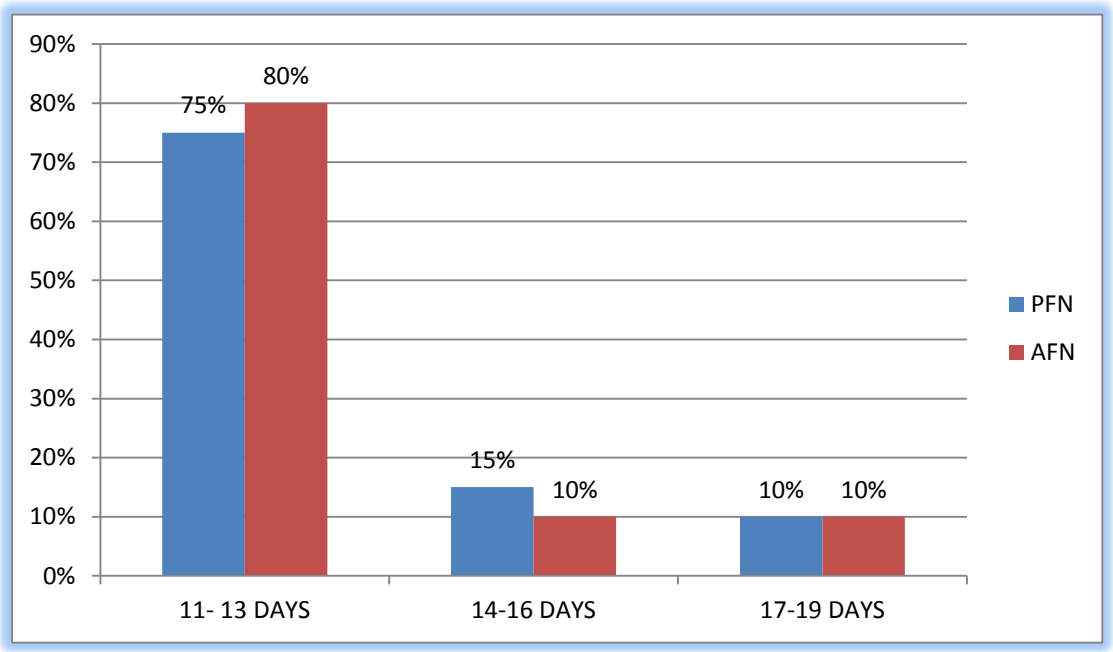
| INTERVAL | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **<4 days** | 23 | 57.5% |
| **4-10 days** | 15 | 37.5% |
| **>10 days** | 2 | 5% |
| **TOTAL** | 40 | 100% |




Most of the cases were treated within 4 days and delay in surgery was because of late presentation of patients to us.

**TABLE-7: HOSPITAL STAY OF PFN AND AFN PATIENT**

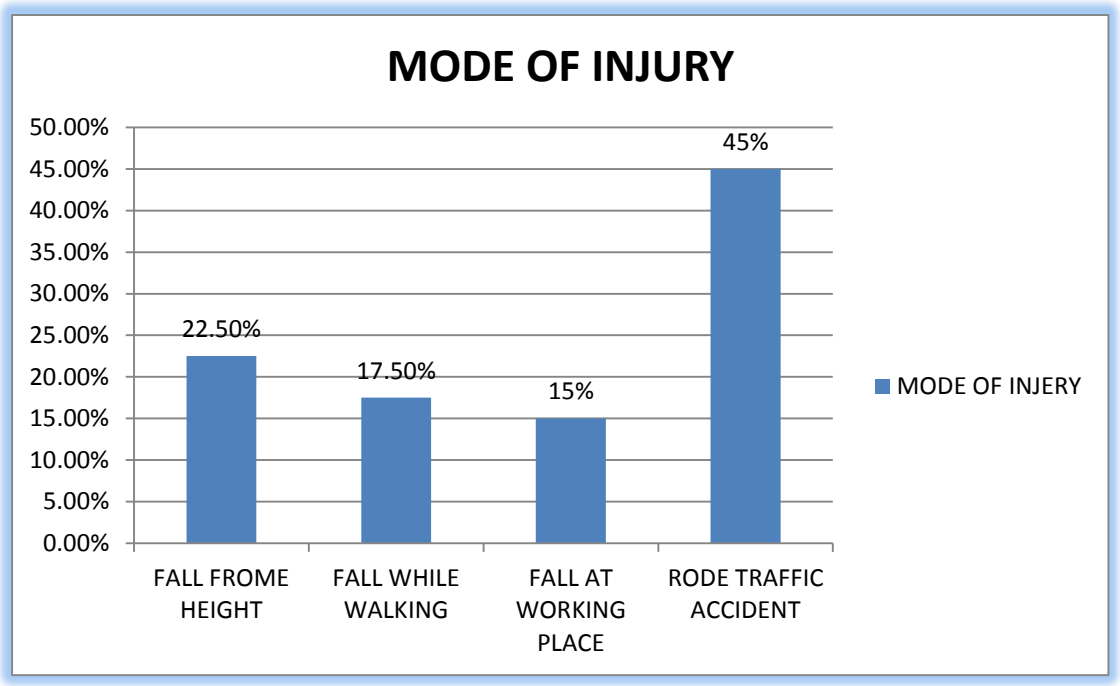
| HOSPITAL STAY (DAYS) | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **11-13 days** | 15(75%) | 16(80%) |
| **14-16 days** | 3(15%) | 2(10%) |
| **17-19 days** | 2(10%) | 2(10%) |
| **TOTAL** | 20(100%) | 20(100%) |




Hospital stay after sugery of unstable intertrochanter fracture treated with AFN and PFN was equal.

**TABLE 8: MODE OF INJURY IN PFN AND AFN**

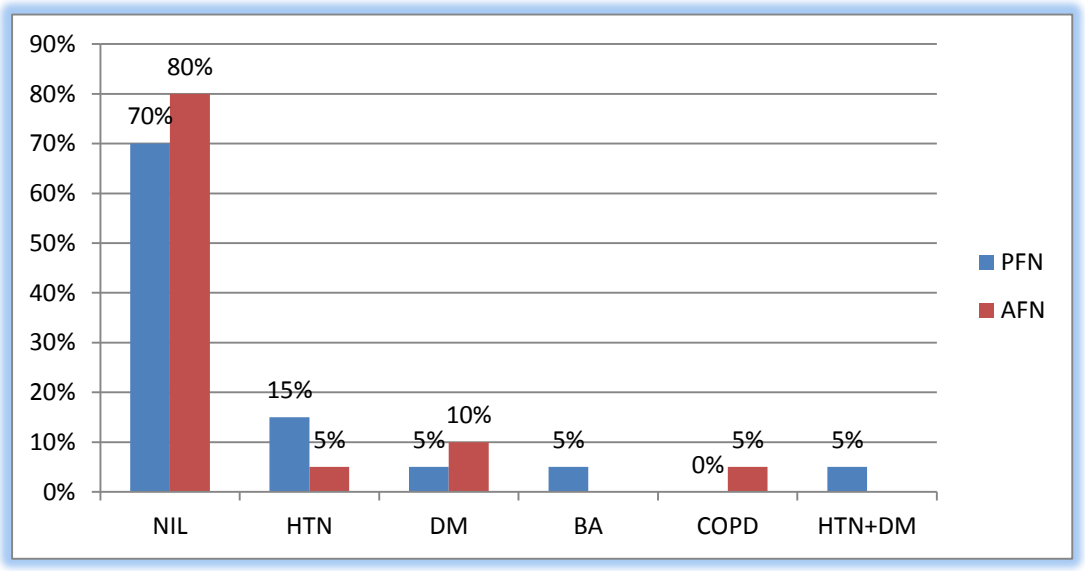
| MODE OF INJURY | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **FALL FROM HEIGHT** | 9 | 22.5% |
| **FALL WHILE WALKING** | 7 | 17.5% |
| **FALL AT WORKING PLACE** | 6 | 15% |
| **RTA** | 18 | 45% |
| **TOTAL** | 40 | 100% |




Road traffic accident 45% is most common injury in our study. Fall from hight 22.5% is second most common injury in our study.

## TABLE 9: ASSOCIATED MORBID ILLNESS

| ILLNESS | NO. OF PATIENTS(PFN) | NO. OF PATIENTS(AFN) |
|---|---|---|
| **NIL** | 14(70%) | 16(80%) |
| **HYPER TENTION** | 3(15%) | 1(5%) |
| **DIABETIS MALLITUS** | 1(5%) | 2(10%) |
| **BRONCHIAL ASTHAMA** | 1(5%) | - |
| **COPD** | - | 1(5%) |
| **HYPER TENTION + DIABETES MELLITUS** | 1(5%) | - |
| **TOTAL** | 20(100%) | 20(100%) |




In our study , intratrochanteric fracture treated with afn associated morbidities 4 patients and treated with pfn associated morbidities 3 patients.

In our study , intratrochanteric fracture treated with afn associated morbidities 4 patients and treated with pfn associated morbidities 3 patients.

## TABLE-10 CLASSIFICATION OF FRACTURES

All intertrochanteric fractures were classified as **TRONZO'S CLASSIFICATION.**

## TABLE-10A CLASSIFICATION OF FRACTURES PFN AND AFN

| CLASSIFICATION (TRONZO'S CLASSIFICATION) | NO OF PATIENTS(PFN) | NO OF PATIENTS(AFN) |
|---|---|---|
| **TRONZO'S TYPE 3** | 12(60%) | 7(35%) |
| **TRONZO'S TYPE 4** | 8(40%) | 12(60%) |
| **TRONZO'S TYPE 5** | 0(0%) | 1(5%) |
| **TOTAL** | 20(100%) | 20(100%) |

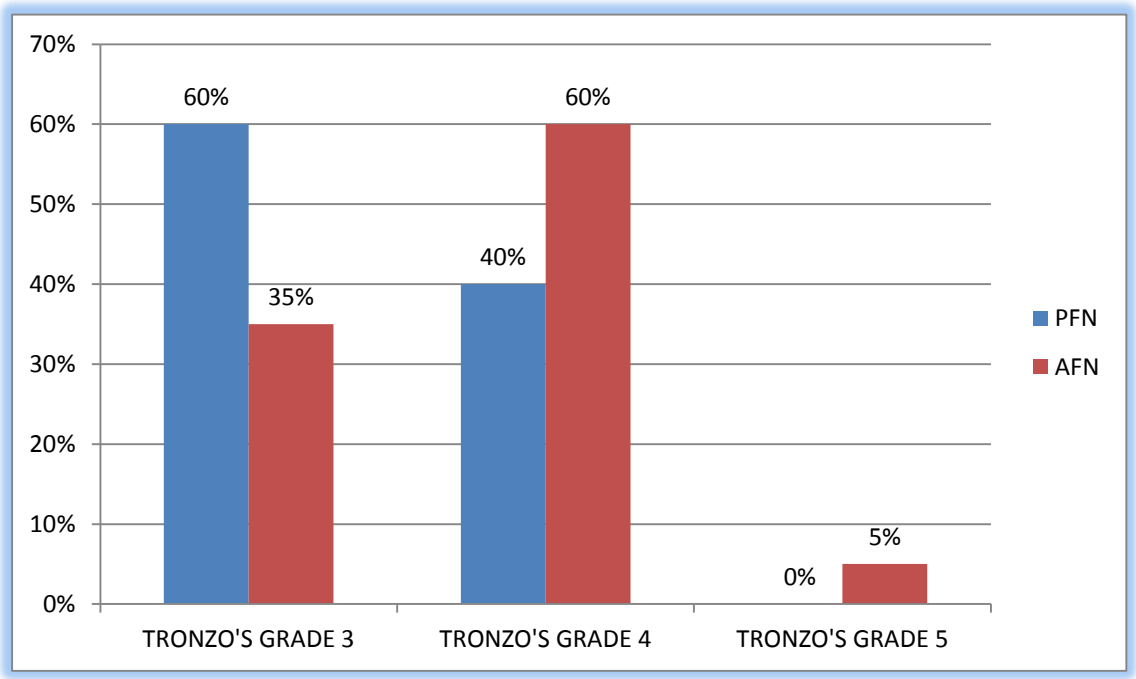
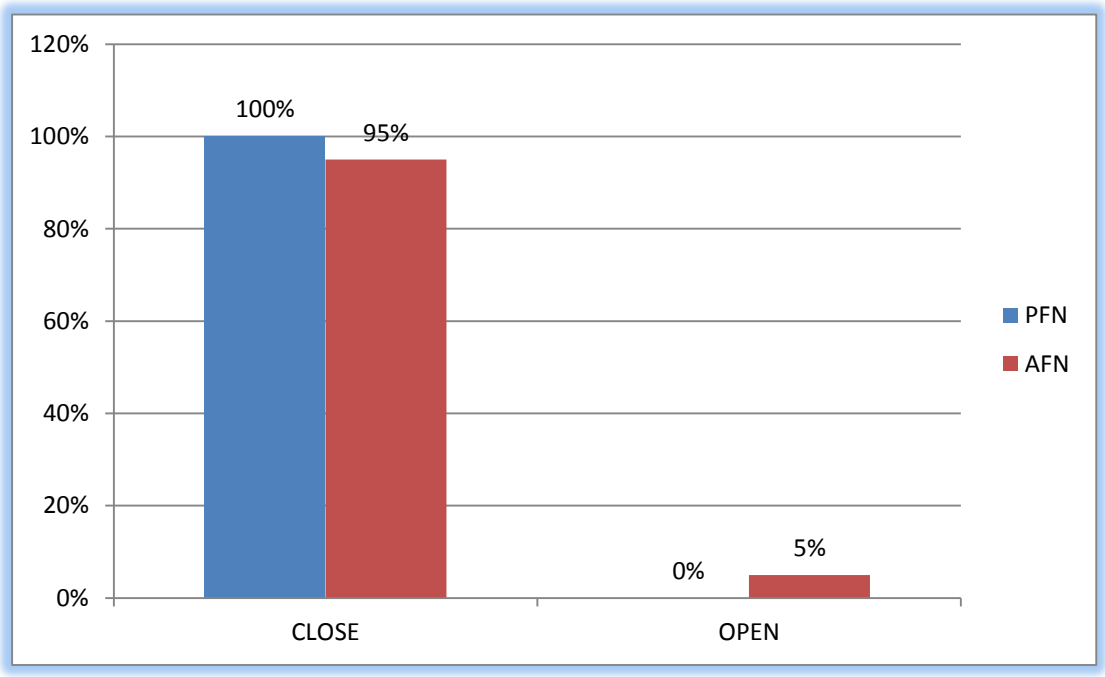


**TABLE-11 REDUCTION OF FRACTURES TREATED WITH PFN &AFN**

| REDUCTION | NO OF PATIENTS (PFN) | NO OF PATIENTS(AFN) |
|---|---|---|
| **CLOSE** | 20(100%) | 19(95%) |
| **OPEN** | 0(0%) | 1(5%) |
| **TOTAL** | 20(100%) | 100% |

All the fractures were reduced by taking the patient on fracture table by close method.

All the fractures were redused by taking the patient on fracture table by close method except one case that required open reduction. There was a markedly comminuted fracture which required open reduction.



## TABLE-12: BLOOD LOSS

| BLOOD LOSS(ml) | NO OF PATIENTS(PFN) | NO OF PATIENTS(AFN) |
|---|---|---|
| **61-80 ml** | 11(55%) | 13(65%) |
| **81-100 ml** | 8(40%) | 4(20%) |
| **101-120 ml** | 1(5%) | 3(15%) |
| **TOTAL** | 20(100%) | 20(100%) |

In our study, blood loss equal in both procedure(PFN & AFN).

| Chi-square value | df | Exact p-value |
|---|---|---|
| **2.5** | 2 | 0.286 |

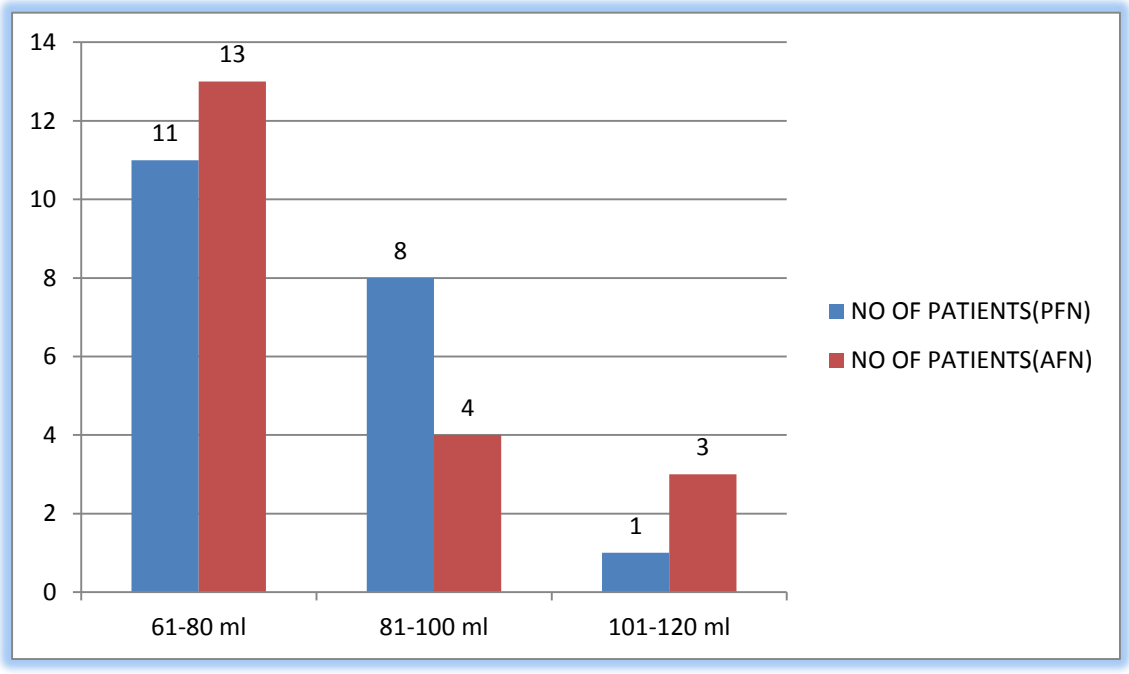


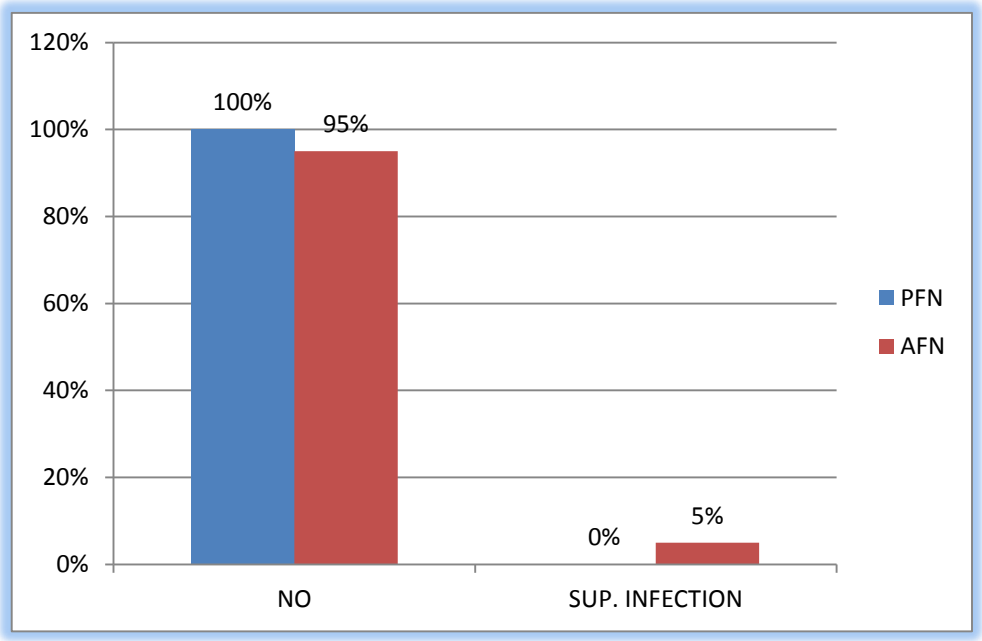
**TABLE 13A IMMEDIATE POST OPERATIVE COMPLICATION(PFN)**

| COMPLICATION | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **NO** | 20 | 100% |
| **SUP. INFECTION** | 0 | 0% |
| **TOTAL** | 20 | 100% |

**TABLE 13B IMMEDIATE POST OPERATIVE COMPLICATION(AFN)**

| COMPLICATION | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **NO** | 19 | 95% |
| **SUP. INFECTION** | 1 | 5% |
| **TOTAL** | 20 | 100% |

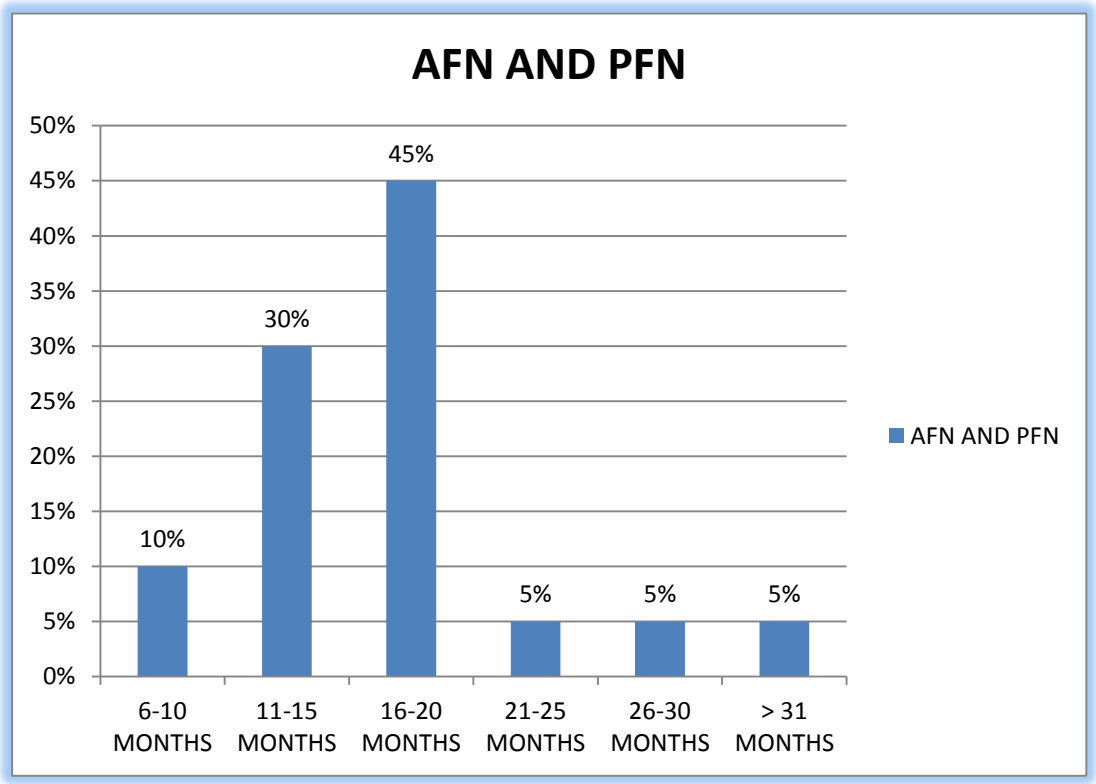
| Chi-square value | df | Exact p-value |
|---|---|---|
| **0** | 1 | 0.999 |




In unstable intertrochanter fracture treated with pfn cases no any immediate post op complication but in treated with afn cases 2 superficial infection occurred.

**TABLE 14: F0LLOWUP(PFN AND AFN)**

| FOLLOWUP (IN MONTHS) | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **6-10 months** | 4 | 10% |
| **11-15months** | 12 | 30% |
| **16-20 months** | 18 | 45% |
| **21-25 months** | 2 | 5% |
| **26-30 months** | 2 | 5% |
| **Above 31 months** | 2 | 5% |
| **Total** | 40 | 100% |




Majority of patients 75% able to followup11 to 20 months.

In our study, unstable intertrochanter fracture average followup treated with pfn 16.95 months and afn 15.85 months.

**TABLE15 A PAIN AND LIMP(PFN)**

| | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **PAIN** | 2 | 5% |
| **LIMP** | 2 | 10% |

In our study(PFN) we had 2 patients experienced occasional pain and 2 patients had limp while walking.

**TABLE15 B PAIN AND LIMP(AFN)**

| | NO OF PATIENTS | PERCENTAGE |
|---|---|---|
| **PAIN** | 5 | 25% |
| **LIMP** | 3 | 15% |

| | Chi-square value | df | Exact p-value |
|---|---|---|---|
| **Pain** | 1.558 | 1 | 0.212 |
| **Limp** | 0.229 | 1 | 0.999 |

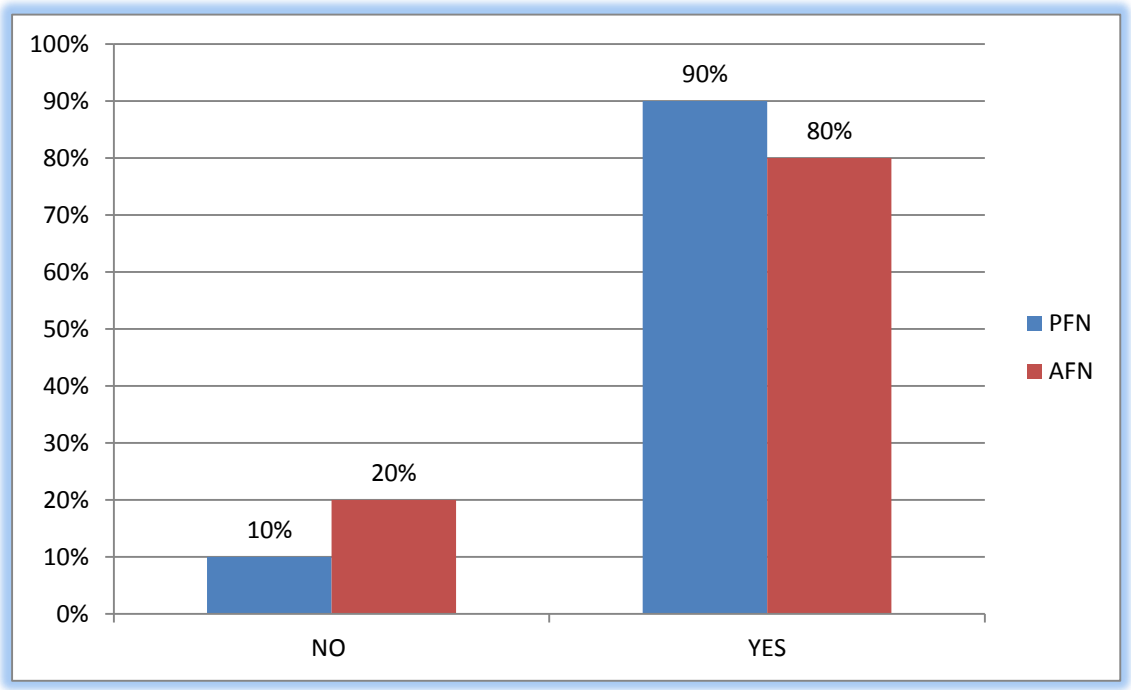
In our study(AFN) we had 5 patients experienced occasional pain and 3 patients had limp while walking.

**TABLE 16 SQUATING (PFN & AFN)**

| SQUATING | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **NO** | 2(10%) | 4(20%) |
| **YES** | 18(90%) | 16(80%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| 0.784 | 1 | 0.661 |

Majority of patients 90% able to do squatting in PFN and 80%AFN.



## TABLE 17 CROSS LEG SITTING

| CROSS LEG SITTING | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **NO** | 3(15%) | 4(20%) |
| **YES** | 17(85%) | 16(80%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| 0.173 | 1 | 0.999 |

In our study, 85% able to do cross leg sitting in treated with PFN and 80% able to do cross leg sitting in treated with AFN.

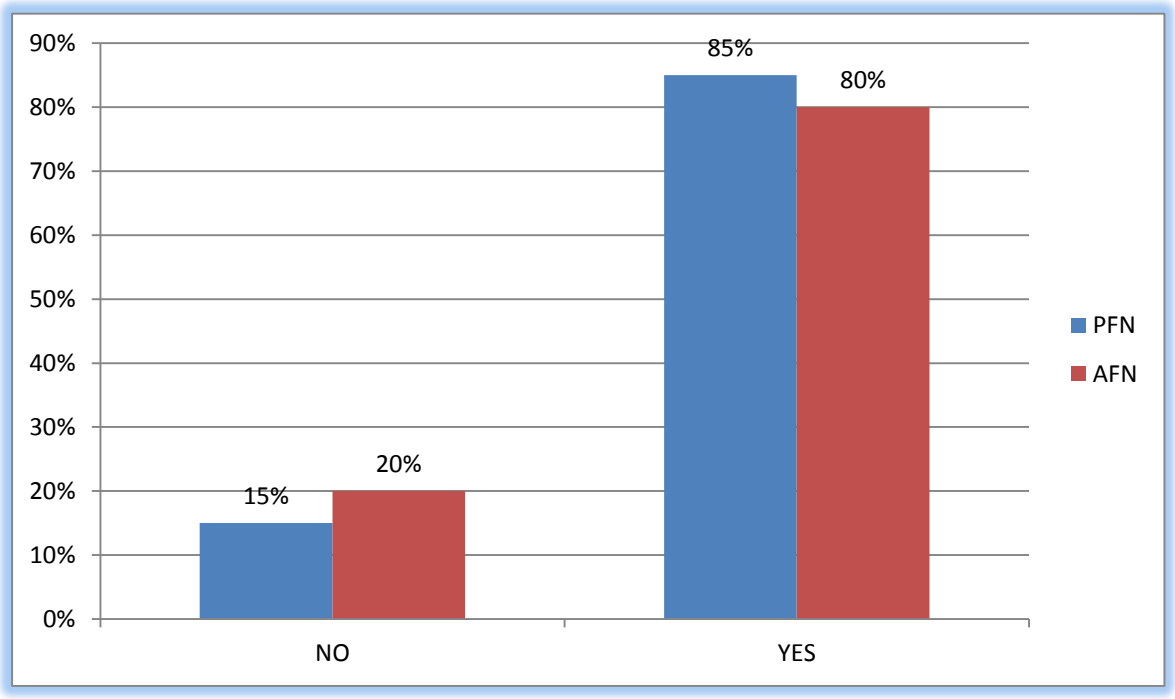
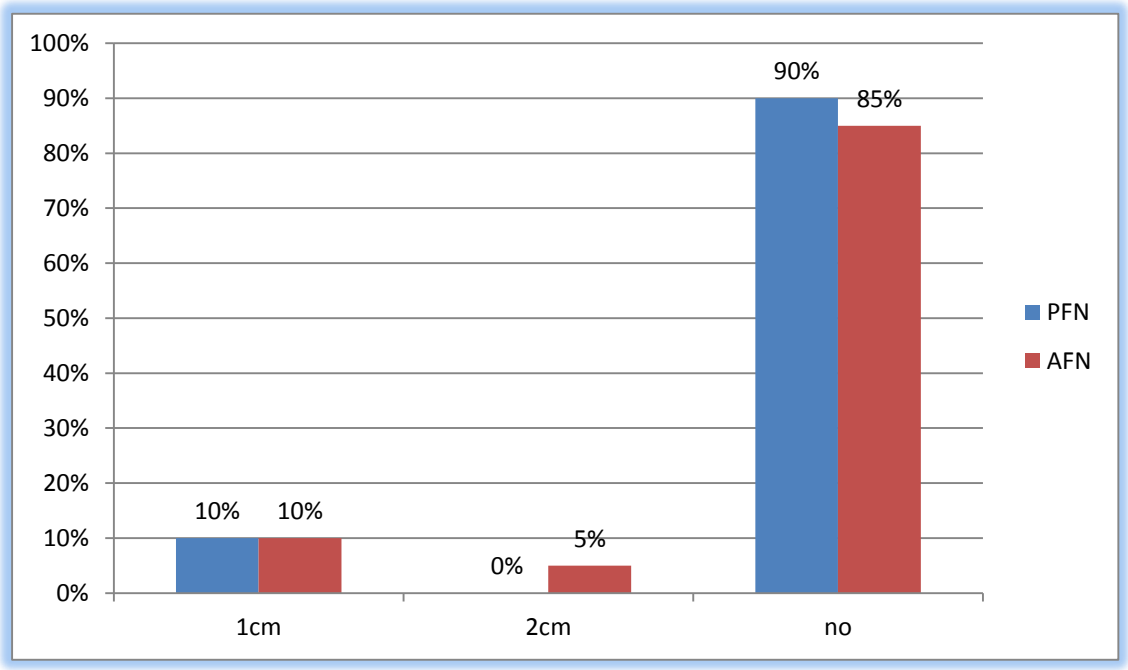


**TABLE 18 LIMB SHORTENING**

| LIMB SHORTENING | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **1 cm** | 2(10%) | 2(10%) |
| **2cm** | 0(0%) | 1(5%) |
| **NO** | 18(90%) | 17(85%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| 2.362 | 2 | 0.605 |

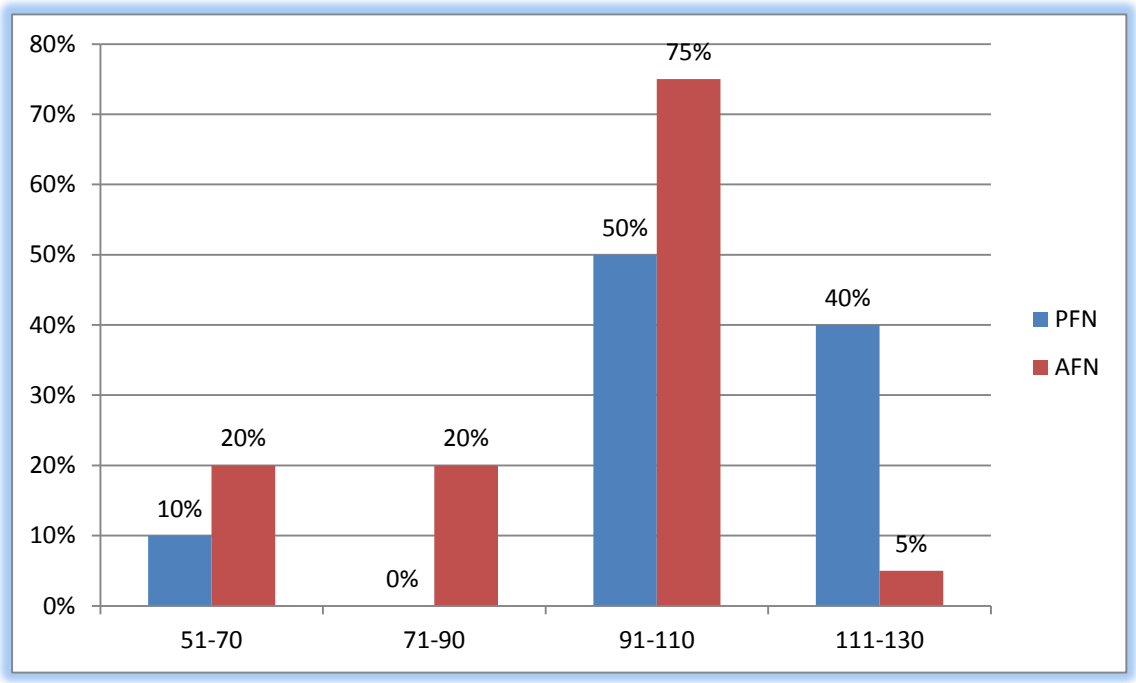



Majority of patients 90% (PFN) and 85%(AFN) had no limb lenth discrepancy at the time final follow up.

**TABLE 19 FLEXION(PFN & AFN)**

| FLEXION | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **51-70 degree** | 2 (10%) | 2 (10%) |
| **71-90 degree** | - | 2 (10%) |
| **91-110degree** | 10(50%) | 15(75%) |
| **111-130degree** | 8 (40%) | 1 (5%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **2.362** | 2 | 0.605 |

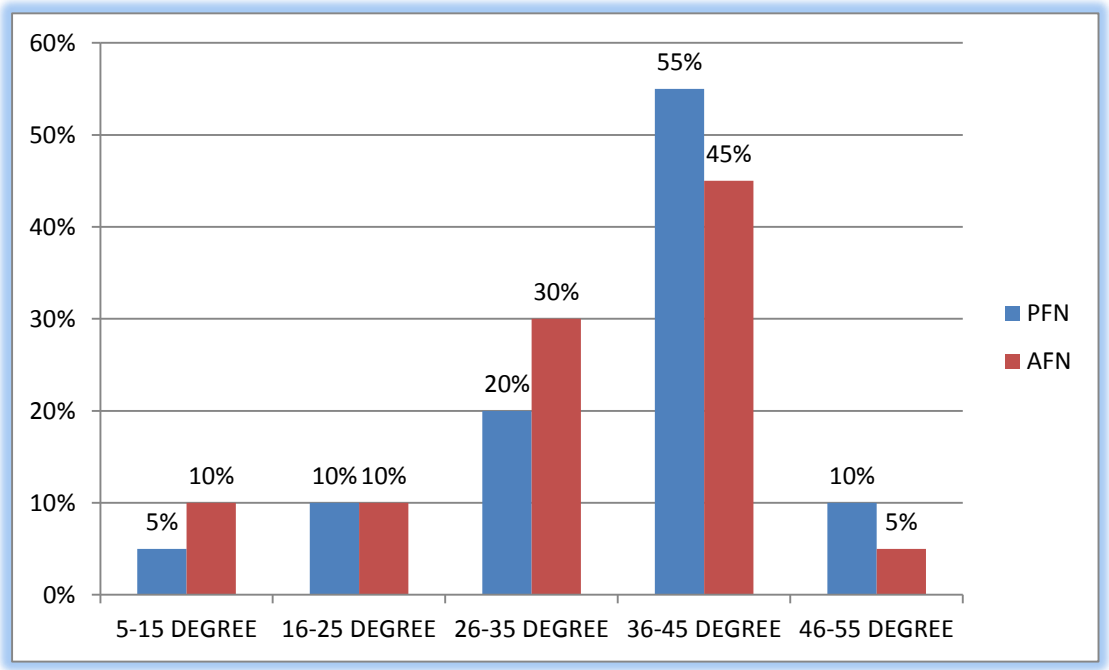



These show that incidence of patients having more than $110^0$ flexion higher (40%) cases of patients with PFN and (5%) cases of patients with AFN.

## TABLE 20 ABDUCTION

| ABDUCTION (DEGREE) | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **5-15 degree** | 1(10%) | 2(10%) |
| **16-25degree** | 2(10%) | 2(10%) |
| **26-35degree** | 4(20%) | 6(30%) |
| **36-45degree** | 11(50%) | 9(45%) |
| **46-55degree** | 2(10%) | 1(5%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **1.267** | 4 | 0.900 |

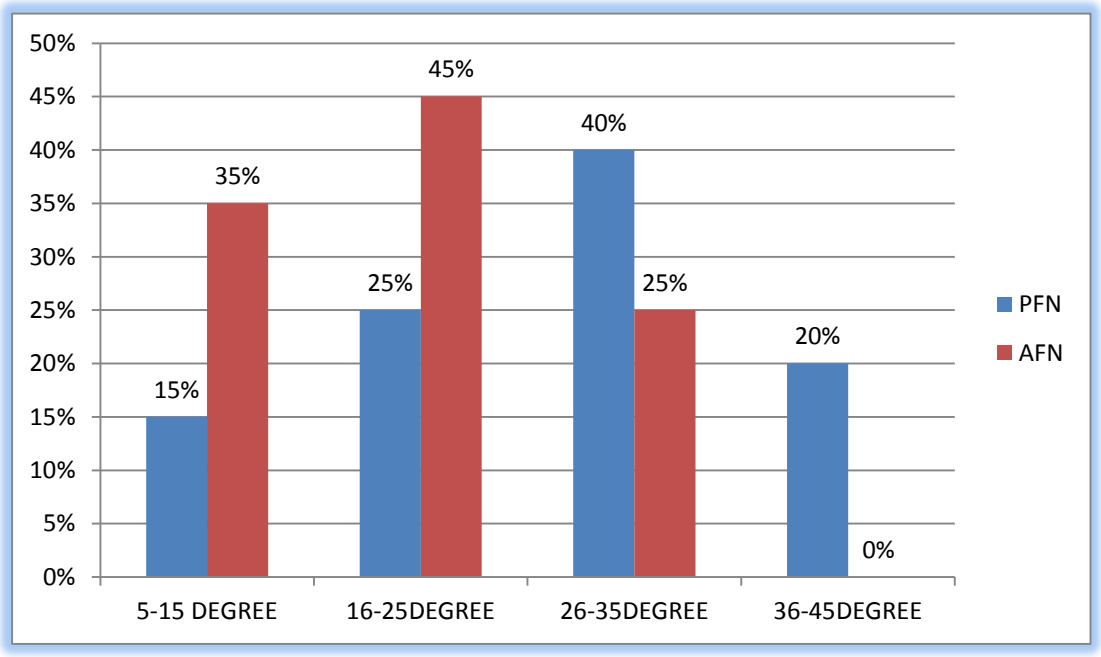



Incidence of patients having abduction more than $30^0$ higher in 85% of PFN then 80% AFN.

**TABLE 21 ADDUCTION**

| ADDUCTION (DEGREE) | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **5-15degree** | 3(15%) | 6(30%) |
| **16-25degree** | 5(25%) | 9(45%) |
| **26-35degree** | 8(40%) | 5(25%) |
| **36-45degree** | 4(20%) | 0(0%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **1.267** | 4 | 0.900 |

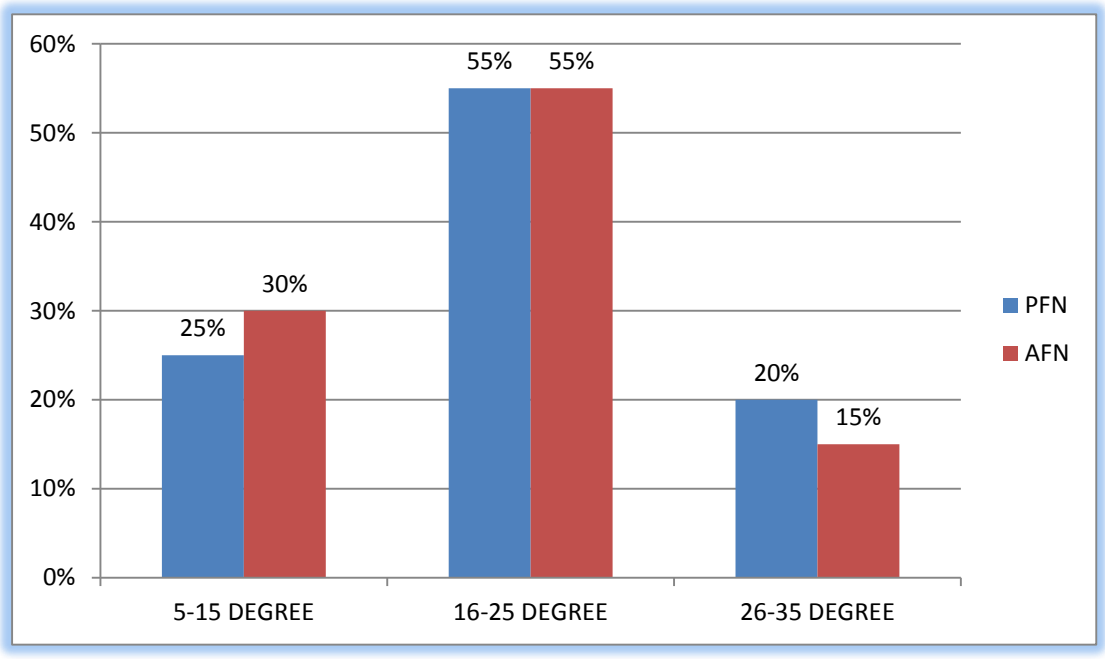



Incidence of patients having adduction more than $26^0$ higher in 60% of PFN then 25% AFN.

**TABLE: 22 INTERNAL ROTATION**

| INTERNAL ROTATION (DEGREE) | NO OF PATIENT(PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **5-15** | 5(25%) | 6(30%) |
| **16-25** | 11(55%) | 11(55%) |
| **26-35** | 4(20%) | 3(15%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **0.234** | 2 | 0.999 |

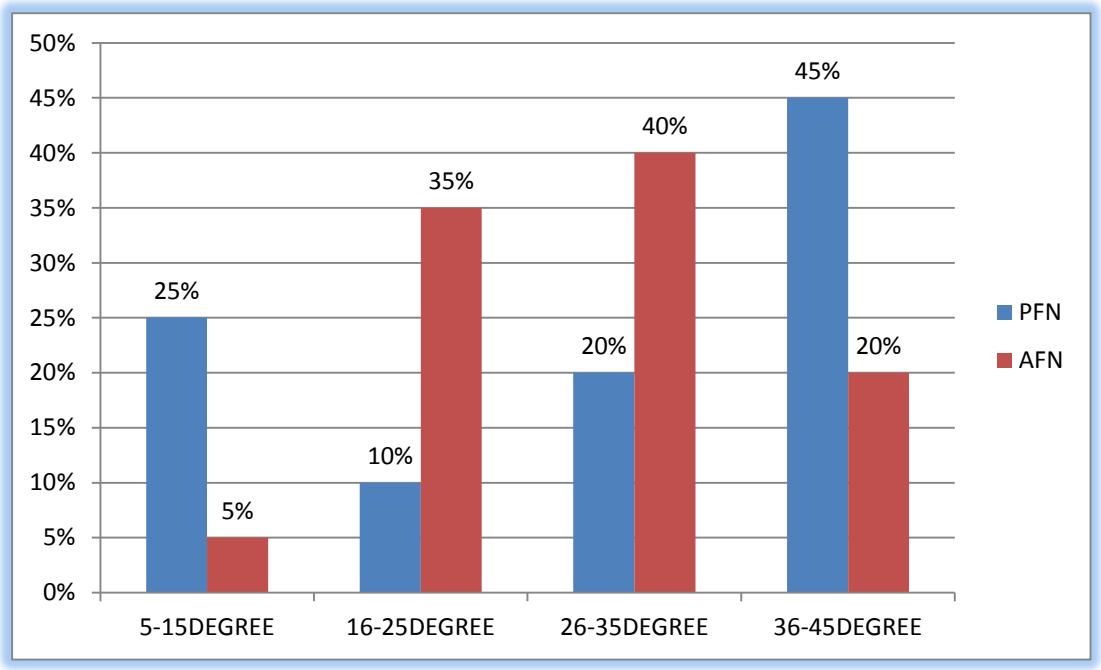



Incidence of patients having internal rotation more than $26^0$ higher in 20% of PFN then 15% AFN.

## TABLE 23 EXTENAL ROTATION

| DEGREE | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **5-15** | 5(25%) | 1(5%) |
| **16-25** | 2(10%) | 7(35%) |
| **26-35** | 4(20%) | 8(40%) |
| **36-45** | 9(45%) | 4(20%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **8.701** | 3 | 0.041 |

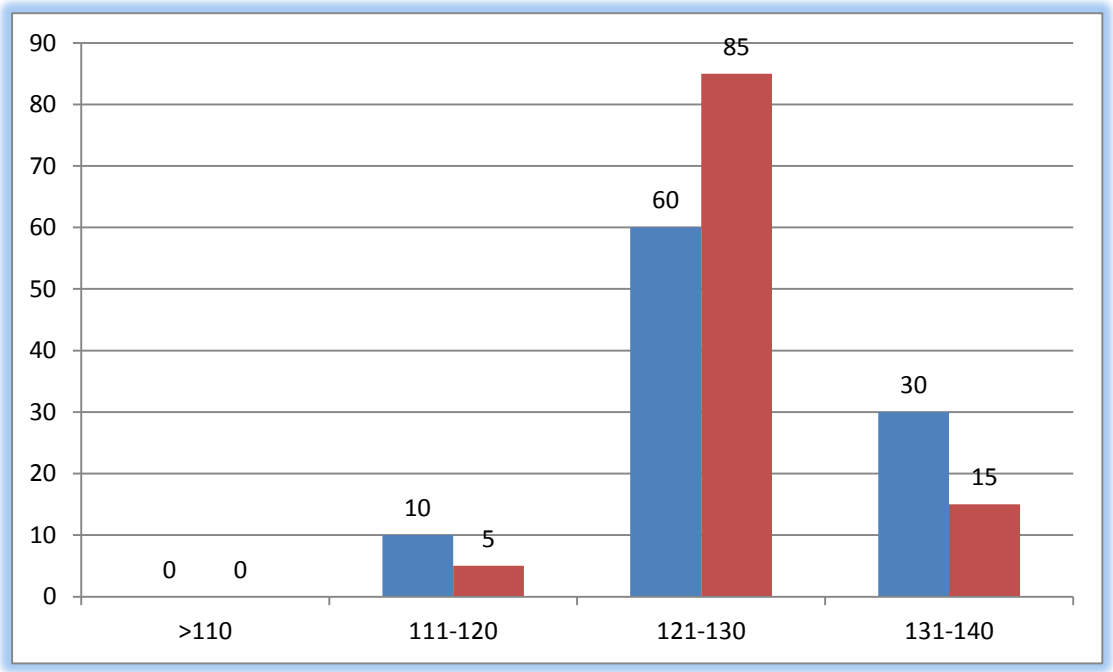



Incidence of patients having external rotation more than $26^0$ higher in 20% of PFN then 15% AFN.

## TABLE 24 NECK SHAFT ANGLE

| NECK SHAFT ANGLE ( DEGREE) | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **>110** | 0(0%) | 0(0%) |
| **111-120** | 2(10%) | 1(5%) |
| **121-130** | 12(60%) | 16(80%) |
| **131-140** | 6(30%) | 3(15%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **8.701** | 3 | 0.041 |




In followup, unstable fractureintertrochanter fracture treated with afn and pfn neck shaft angle is equal both.

**TABLE 25 IMPLANT STATUS**

| IMPLANT STATUS | PFN | AFN |
|---|---|---|
| **SAME AGE AS INTRA OP.** | 19 | 19 |
| **Z-EFFECT** | 1 | 0 |
| **IMPLANT FAILURE** | 0 | 1 |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **0** | 2 | 0.999 |

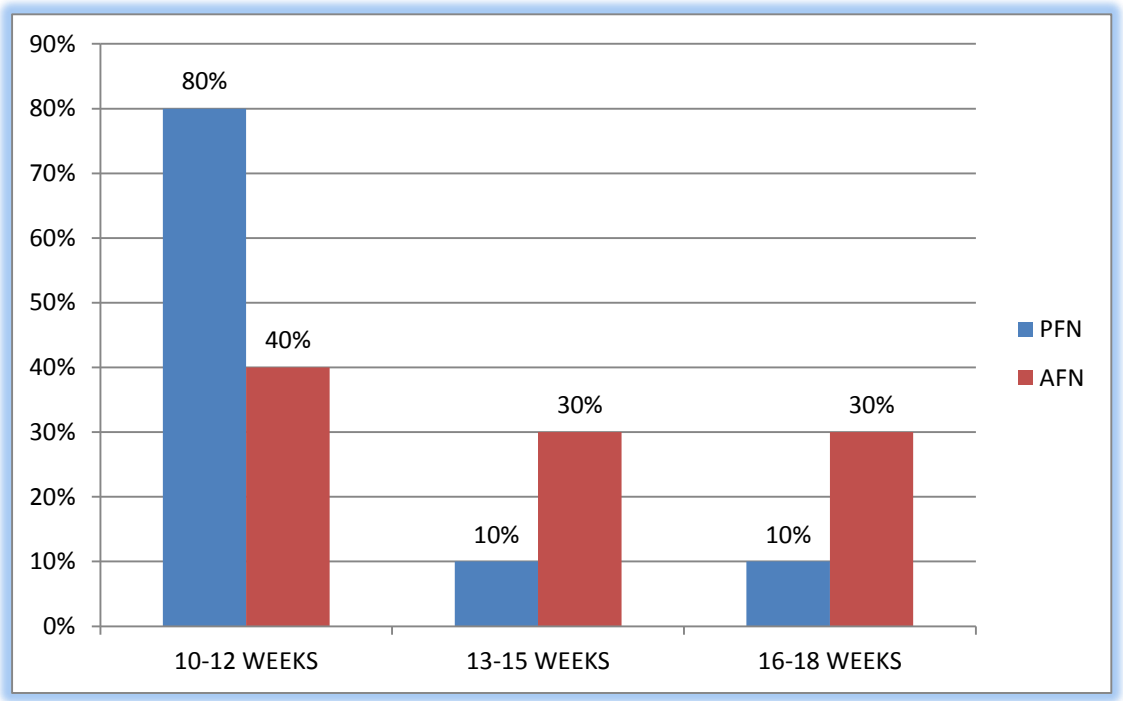
In our study z effect occured one case of unstable intertrochanter fracture treated with PFN. In these cases, screws were changed later on.

And implant failure occurred one case of unstable intertrochanter fracture treated with AFN. In these cases, implant were changed later on.

**TABLE:26 TIME OF UNION**

| TIME OF UNION(WEEKS) | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **10-12** | 16(80%) | 8(40%) |
| **13-15** | 2(10%) | 6(30%) |
| **16-18** | 2(10%) | 6(30%) |
| **TOTAL** | 20(100%) | 20(100%) |

| Chi-square value | df | Exact p-value |
|---|---|---|
| **6.667** | 2 | 0.456 |

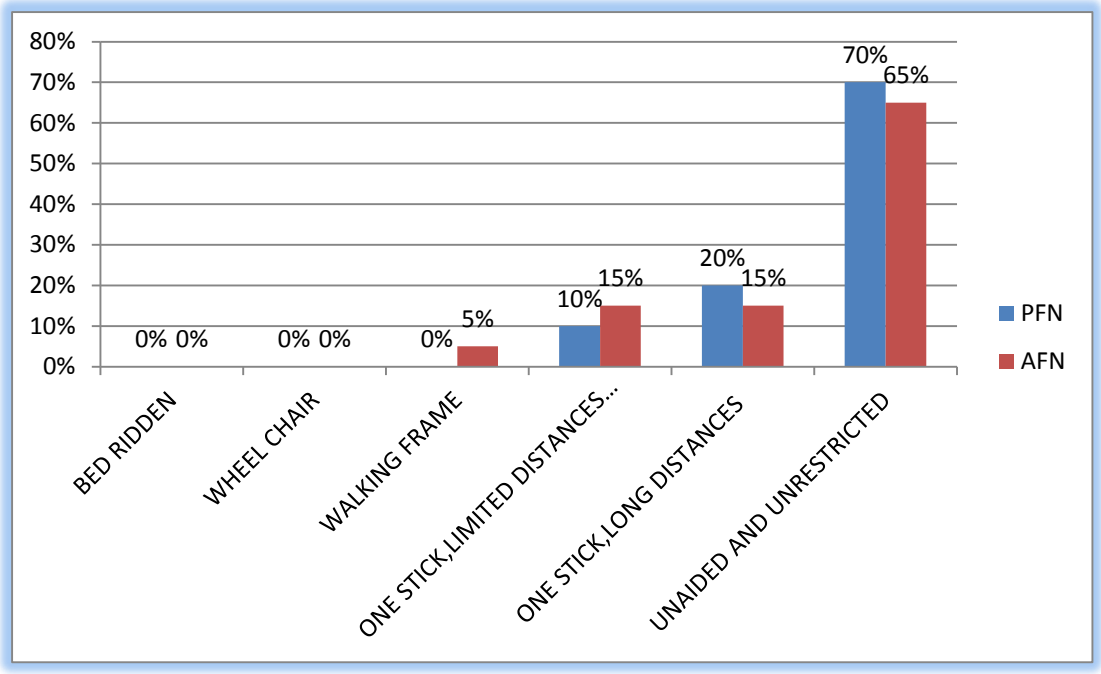



In our study , unstable intertrochanter fracture mean time of union was treated with PFN(11.9 weeks) and treated with AFN(13.5 weeks) .

**TABLE:27 WALKING**

| WALKING | NO OF PATIENTS(PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **BEDRIDDEN** | 0(0%) | 0(0%) |
| **WHEELCHAIR** | 0(0%) | 0(0%) |
| **WALKING FRAME** | 0(0%) | 1(5%) |
| **ONE STICK, LIMITED DISTANCES UP TO 400 YARDS** | 2(10%) | 3(15%) |
| **ONE STICK, LONG DISTANCE** | 4(20%) | 3(15%) |
| **UNAIDED AND UNRESTRICTED** | 14(70%) | 13(65%) |
| **TOTAL** | 20(100%) | 20(100%) |

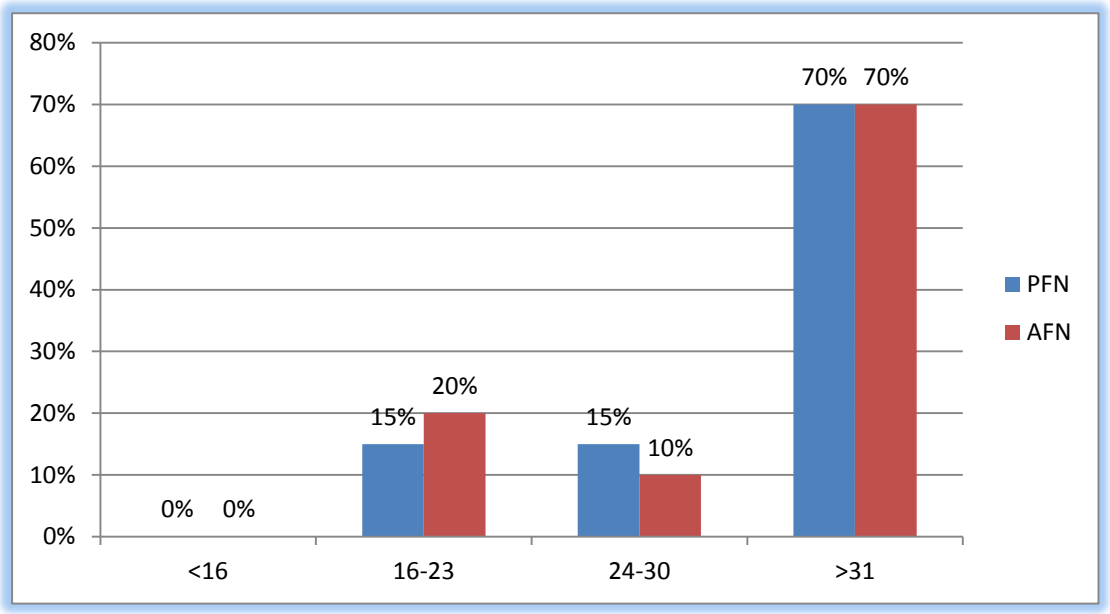
| | Chi-square value | df | Exact p-value |
|---|---|---|---|
| **BEDRIDDEN** | NA | NA | NA |
| **WHEELCHAIR** | NA | NA | NA |
| **WALKING FRAME** | - | 2 | 1.000 |
| **ONE STICK, LIMITED DISTANCES UP TO 400 YARDS** | 0.229 | 1 | 1.000 |
| **ONE STICK, LONG DISTANCE** | 0.173 | 1 | 1.000 |
| **UNAIDED AND UNRESTRICTED** | 0.114 | 1 | 0.736 |




In our study operated with PFN(70%) and AFN(65%) patients walking to long distance both are same.

**TABLE : 28 SALVATI WILSON SCORE**

| SCORE | NO OF PATIENTS (PFN) | NO OF PATIENTS (AFN) |
|---|---|---|
| **<16(POOR)** | 0(0%) | 0(0%) |
| **16-23(FAIR)** | 3(15%) | 4(20%) |
| **24-30(GOOD)** | 3(15%) | 2(10%) |
| **>31(EXCELLENT)** | 14(70%) | 14(70%) |
| **TOTAL** | 20(100%) | 20(100%) |




| Chi-square value | df | Exact p-value |
|---|---|---|
| **NA** | 3 | 1.000 |

In present series of operated by PFN, depending on Salvati Wilson, the result shows excellent results in the 14 patients (70%), good results in 3 patients (15%), fair results in 3 patients (15%). In operated by AFN study, excellent result in14 patients(70%), good results in 2 patients (10%), fair result in 4 patients(20%) (p>0.05%, not significant).

# DISCUSSION

Extracapsular proximal femur fractures especially unstable variety have been recognized as a major challenge by the Orthopaedic community. This is not solely to achieve fracture union, but for restoration of optimal function in the shortest possible time, that too with minimal complications. The aim of management accordingly has drifted to achieving early mobilization, rapid rehabilitation and quick return of individuals to prefracture stage as a functionally and psychologically independent unit.

Operative treatment in the form of internal fixation permits early mobilization and offer the best chance of functional recovery, hence it has become the treatment of choice for majority of fractures in the trochanteric region. Amongst the various types of implants available i.e. fixed nail plate devices, sliding nail/screw plate and intramedullary devices, the compression hip screw is most commonly used. However recently, techniques of closed intramedullary nailing have gained popularity with good outcome.

There are stable and unstable types of proximal femur fractures, but in case of unstable variety with loss of posteromedial cortex, there is fracture impaction with shortening of the neck of femur, thereby it leads to reduction of the lever arm of the hip abductors.

Theoretical biomechanical advantage of these intramedullary nails , over screw and plate fixation are attributed to the reduced distance between the hip joint and implant which diminishes the bending movement force across the implant – fracture construct.

Most of the body weight is transferred by the calcar and a plate supporting a nail or screw which would be at a distance lateral to this weight bearing line produces considerable tension on the implant. Proximal femoral nail is closer to the calcar, subjected to less tension and is more stable and better fixation.[88]

Proximal femoral nail insertion is accomplished by closed method with smaller skin incision preserving the fracture hematoma, which is an essential element in fracture healing. The decrease in surgical trauma certainly reduces intra-operative blood loss, infection and wound complications, allowing significantly earlier rehabilitation and a shorter hospital stay.[89]

In this study an attempt was made to survey, evaluate, document and quantify our result in the management of such patients by using proximal femoral nail (PFN) and anti grade femoral nail(AFN). We had used SALVATI WILSON hip score for the assessment of the results.

We had studied 40 cases of extracapsular proximal femur fractures during the period from December 2015 to September 2017 at Dhiraj General Hospital, Piparia, Vadodara. The minimum follow up period was six months. I evaluated results and compared them with those obtained from Minos et al (2004)[111] unstable inter trochanter fracture treated with proximal femoral nailing.

In our study, proximal femur fractures were more common after 5th decade with a mean age group of 55.17years in proximal femur nailing and antegrade femur nailing. It was different to the study of Minos et al(2004) who had a mean age of 72 years respectively..

The sex ratio as per this study was male 25(62.5%) patients and female 15(37.5%) patients out of 40 patients in proximal and antegrade femoral nailing. While in Minos et al (2004)[111] more patients were female 28(62.23) than male patients 17(37.77) out of 45 patients. Increased incidence in male as compared to female is due to their involvement in riding vehicles, heavy agriculture, labour and more outdoor activities.

Most common mode of injury in my study was high energy trauma in 65% patients which include road traffic accidents(50%) and fall from height(15%).While 35%patients had low energy trauma due to fall while walking(20%) which was most commonly seen in elderly patients. These were also attributed to the high incidence of osteoporosis specially in elderly patients.

In study of Minos et al (2004) [111] 67% patients had high velocity injury. In present series, 30% patients had associated medical co-morbidities like hypertension and diabetes mellitus were most frequently found which were 15% and 5% respectively.

In present series (PFN), 30% patients had associated medical co-morbidities like hypertension (15%) and diabetes mellitus (5%) comparable to the study of Minos et al (2004)111. In AFN, 20% patients had associated medical co-morbidities like hypertension and diabetes mellitus.

In our study, we had used Tronzo's classification for intertrochanteric fractures. All cases were operated on fracture table.

In 20 patients (100%) treated by PFN closed reduction possible in all cases but in 20 patients treated by AFN one patient required open reduction.

In this study, We observed mean incision size was 5.16 cms, while in study of Minos et al (2004)[111] incision length was 7.6cm. In this study (PFN), the average amount of blood loss was 82.2ml which were due to closed operative technique. In AFN, the average amount of blood loss was 82ml which were due to closed operative technique.

In one case(NO: 37) operated with AFN 110ml was the blood loss due to open reduction and required blood transfusion. Both AFN and PFN had same amount of blood loss in operative technique. ( p >0.05, not significant) In the study by Minos et al(2004)[111], the mean blood loss was 225 ml.

The average operative time of surgery was 90 min. For both AFN and PFN operative time of surgery was same (p>0.05, not significant). Where as in Minos et al (2004)[111] it was 68min which was mainly attributed to better equipment and trained technical staffs. We encountered little longer operative time of our study because of

- Most of the cases were done by training doctors.
- Inefficient nursing staff.
- Inadequte instrument available when required.
- More than necessary time taken to show the images using image intensifier.
- Thus, for the above reasons, intra operative time is prolonged leading to infection.

In our study, we had not used any prophylactic antithrombotic agents and there were no cases of deep vein thrombosis, pulmonary embolism. While in study of minos et al (2004)[111] there were 2 cases of deep vein thrombosis.

On discharge, 40 patients walked Non weight bearing treated with PFN and AFN.

In our study, one case which was operated by AFN had superficial infection post operatively. This case was satisfactorily managed by parenteral antibiotic and regular dressings. There were no cases of deep infection in our study.

While in Minos et al (2004)[111] the superficial infection has occurred in 2 patients.

In our study, unstable intertrochanter fracture average follow up treated with PFN 16.95 months and AFN 15.85 months.

In study of PFN, 2 patients had occasional pain on final follow up and because of that they had limp while walking. Pain was relieved on taking analgesics. Out of 20 patients, 3 patients (15%) had difficulty on cross leg sitting and squatting.

But in AFN, 5 patients had occasional pain on final follow up and because of that they had limp while walking.

In this study, 2 patients had occasional pain on final follow up in PFN and because of that they had limp while walking. Pain was relieved on taking analgesics. Out of 20 patients of PFN, 3 patients (15%) had difficulty on cross leg sitting and squatting. Out of 20 patients of AFN, 5 (25%)patients had difficulty on cross leg sitting and squatting .

At final evaluation, implant status was evaluated radio logically once the fracture was united and checked for any kind of implant related complication or failure. We found 1 case (5%) with 'Z' effect where there was intrusion of the proximal hip screw into the joint and back out of the lag screw in PFN. The Z-effect involves the lateral migration of the inferior screw, varus collapse of the fracture and perforation of the femoral head by the superior screw. The first account of the Z-effect has been attributed to Minos et al (2004)[111], who reported a series of 45 cases of

fractures treated using PFN. These authors also advised that fixation of the fracture at neck shaft angle of <125° is a predisposing factor for the Z-effect. Although the cause of this complication has been explained by varus collapse of the fracture and the lack of medial cortical support. Here in this series, there was varus seen in case of Z-effect. In these cases, screws were changed later on.

Failure of screw can be seen in form of z- effect. Z-effect is secondary to differing tension and compression forces on the two lag screws.

Reproduction of this complication was attempted experimentally using simulated bones of varying densities to determine a biomechanical explanation[112].Backing out of the inferior screw occurred when there was a mismatch in compressive bone strength of the femoral head and neck, whereas medial penetration of superior screw only occurred in the specimens with low density in the femoral head.

It has been suggested,

Both superior and inferior screw should be placed horizontally in the same plan in femoral head as show in figure. Superior screw should be smaller (5mm to 10mm) in length than inferior screw.

It has also been mentioned in literature that fracture of the smaller diameter superior screws has been seen especially when it is placed hear the subchondral bone of the femoral head. In this position, it encounters large varus stresses that are not shared by the large inferior screw. Though we had fracture of screws in none of the cases.

In our study, one case (no = 30)of intertrochanter with sub trochanter fracture treated with AFN and encirclage. nonunion had occured at the sub trochanter fracture side at the end of 6 months follow up. After 6 months, nonunion side was treated with bone grafting.

In our study, we have taken 40 patients having 41 fractures treated with PFN and AFN. One case (case 40) of bilateral unstable inter-trochanteric fracture with shaft femur fracture was treated with AFN on both the sides. In this case nonunion at the bilateral femur shaft fracture side treated with bone grafting. Patient did not turn up for follow up subsequently.

In our study, limb length was measured regularly and final limb length was measured when the fracture has radiologically united. The limb length was measured and compared to the normal limb. Out of 20 patients, 18 patients (90%) had no limb length discrepancy and 2 patients (10%) had limb shortening which are 1 cm and 1cm respectively in PFN. Out of 20 patients, 17 patients (85%) had no limb length discrepancy and 3 patients (15%) had limb shortening which are 2cm ,1cm and 1cm respectively in AFN ($p>0.05$, not significant).

I have used criteria for union as absence of pain at fracture site clinically and presence of bridging callus at fracture site radiologically.

In our study, unstable intertrochanter fracture mean time of union was treated with PFN(11.9 weeks) and treated with AFN(13.5 weeks) .

In present series of operated by PFN, depending on Salvati Wilson, the result shows excellent results in the 14 patients (70%), good results in 3 patients (15%), fair results in 3 patients (15%). In operated by AFN study, excellent result in14

patients(70%), good results in 2 patients (10%), fair result in 4 patients(20%) (p>0.05%, not significant) . Minos (2004) et al[111] excellent result in 66.2%, good results in 28.2% and fair result in 5.6%

Proximal Femoral Nailing in intertrochanteric fracture helps in least blood loss, early mobilization and weight bearing even in unstable fractures, thus providing good functional recovery and early fracture union with excellent results. We think this is the best treatment available for proximal femur fracture in present scenario.

# SUMMARY

The present study is retrospective analysis of 40 operated cases of intertrochanter fractures. This is a randomized study of fracture fixation technique by proximal femur nail and anti grade femoral nail.

- In our study, 50% patients were belonging to more than 60 years of age .
- Out of all the patients, 62.5 % were males and 37.5%were females in our study.
- In present study, 47.5% cases had fractures in Left lower limb, 50% cases in Right lower limb and 2.5% case in both sides.
- Road traffic accidents was a major cause of trauma producing these fractures which was 47.5% and while 15% patients had history of simple fall. while walking at home or outside. Younger patients sustain fractures due to high velocity trauma (70%) like road traffic accidents and fall from height.
- Associated co-morbidities were present in 25% cases and most common was hypertension (12.5%) second most common co-morbidities was diabities.
- We have used tronzo's classification for study . At final follow up did clinical and functional assessment of patients employing salvati wilson Score..
- More than 90% fractures united within 10-15 weeks in pfn and 70% fractures united within 10-15 weeks in afn.
- It was observed that 85% of patients at final follow up(38 week) had no pain and were able to resume their pre-injury life style works. More than 90% of the

patients had full range of flexion, abduction and external rotation movements at the hip joint.

- It was observed that 90 % of the patients did not have any limb length discrepancy in pfn.

- Out of 20 patients, 18 patients (90%) had no limb length discrepancy and 2 patients (10%) had limb shortening which are 1 cm and 1cm respectively in PFN. Out of 20 patients, 17 patients (85%) had no limb length discrepancy and 3 patients (15%) had limb shortening which are 2cm ,1cm and 1cm respectively in AFN ($p>0.05$, not significant).

- Hence in an era of minimally invasive surgeries, proximal femoral nail is the superior alternative as it requires shorter incisions, with minimal blood loss, less operative time and less chances of infection.

- The advantage of lesser operation time and blood loss, decreased the morbidity in pfn than afn.

- The unstable varieties of fractures have good to excellent results with proximal femoral nail. This is because the shaft fixation is nearer to the centre of rotation of the hip, giving a shorter lever arm and a lower bending movement on the device. It gives a biomechanically sound fixation. Therefore considering the fact that PFN being a closed procedure with technical ease of instrumentation, giving better functional outcome with lesser complications at final follow up, I can recommend that PFN is a better choice of implant for the management of extracapsular proximal femur fractures.

# CONCLUSION

With strict adherence to anatomical reduction, proper fixation and proper in time regular physiotherapy protocol, We get satisfactory results in all cases treated by cephalocondylar nail.

Normally antegrade femoral nail (AFN) is entered just lateral and distal to tip of greater trochanter which makes it vulnerable to pass through the fracture site, thus creating a gap between proximal and distal fragment.

Thus, we suggest that though antigrade femoral nail is good implant for subtrochanteric fracture element.

It's use in intertrochanteric fracture has got inferior outcome compared to proximal femoral nail thus making proximal femoral nail more preperable implant for treatment of intertrochanteric fracture.

# CASES TREATED WITH AFN

## CASE 1:

42 YR OLD NARVAT SINGH H/O FALL FROM HIGHT.

TRONZO TYPE 5 REVERSE OBLIGUE FRACTURE TREATED WITH ANTI-GRADE FEMORAL NAILING.


Pre op

Immediate post op

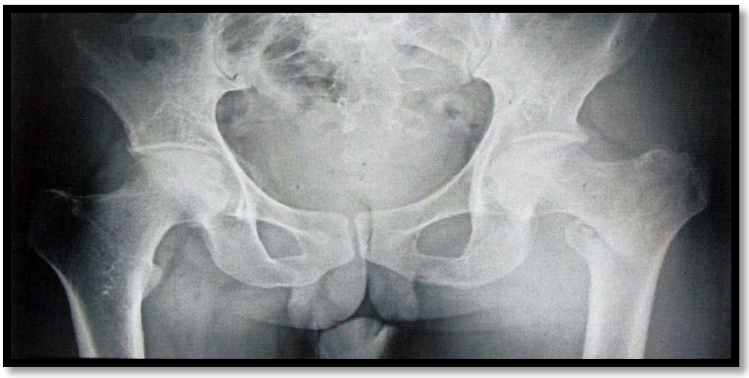
## 6 month follow up

## CASE 2

**70 years Old man Ramanbhai history of Road Trafic Accident.**

**Right side intertrochanter Fracture Suggest in X-ray.**

**Treated with close reduction internal fixation Proximal Femoral nailing**



Pre Operative

**Immediate Post op.** **Follow up 6 months**

**HIP ROM at 7 months**

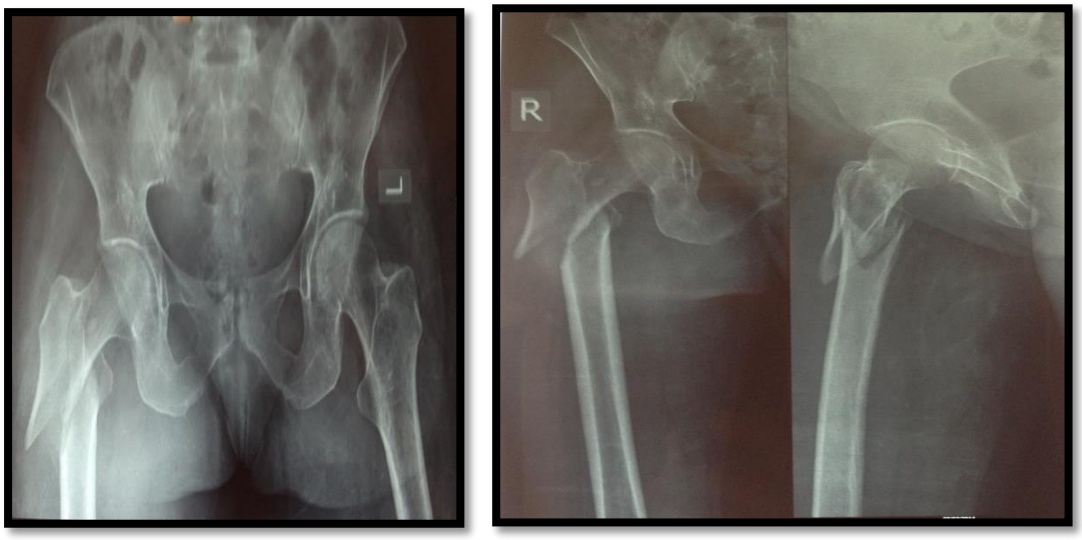
## CASES TREATED WITH PFN

### CASE 1

A 50 YEARS OLD FEMALE H/O FALL WHILE WALKING.

RIGHT SIDE INTERTROCHANTER FRACTURE TREATED WITH CLOSE REDUCTION INTERNAL FIXATION WITH PROXIMAL FEMORAL NAILING.

### PRE OP XRAY



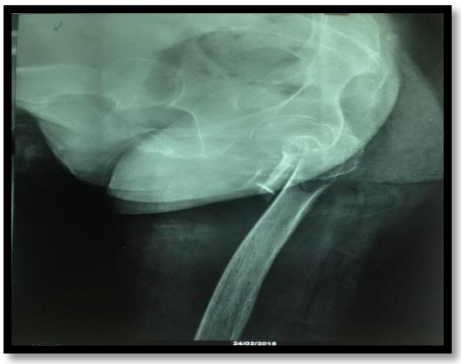

### POST OP X-RAY

## FOLLOWUP (6 MONTHS)

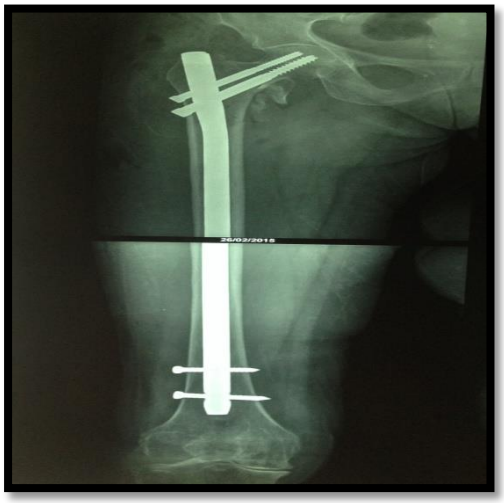

## CASE :2

A 55 years old female history of fall at home 3 day back and come with chif complain of right side hip joint pain.in x-ray suggest of right side inter trochanter fracture. It was treated with close reduction internal fixation with proximal femoral nailing.

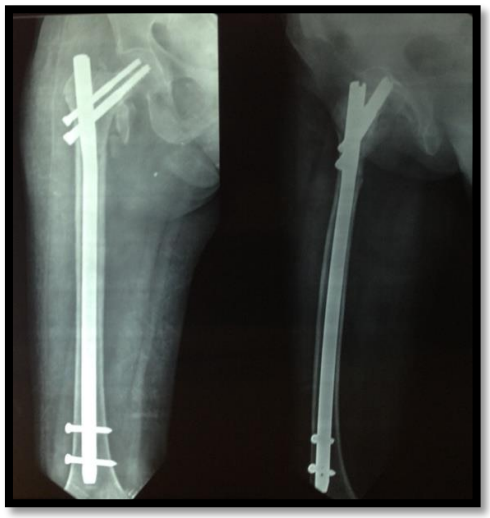
## Pre- op x-ray



## Post op x-ray



# 6 month followup



# CASE 3

A 80 years old male history of fall from hight. In x-ray suggest inter trochanter fracture treated with close reduction internal fixation with proximal femoral nailing.

## PRE OP X-RAY

## POST OP X-RAY

## 6 MONTHS FOLLOW UP X-RAY

# BIBLIOGRAPHY

1. Lorich, Dean G.M.D. et.al. Osteoporotic Pertrochanteric hip fractures management and current controversies JBJS Am. Feb 2004; 86:398- 410

2. Guyton JL. Fractures of hip, acetabulum, and pelvis. In: Canale ST, editor. Campbell's operative orthopaedics. 9th ed. St. Louis: Mosby; 1998:2181–27

3. Hernandez-Avila M, Colditz GA, Stampfer MJ, et al. Caffeine, moderate alcohol intake, and risk of fractures of the hip and forearm in middle-aged women.Am J Clin Nutr 1991;54:157– 63.

4. Paganini-Hill A, Chao A, Ross RK, Henderson BE. Exercise and other factors in the prevention of hip fracture: the Leisure World study. Epidemiology 1991;2:16–25.

5. Farmer ME, Harris T, Madans JH, et al. Anthropometricindicators and hip fracture. The NHANES I epidemiologic follow-up study. J Am Geriatr Soc 1989;37:9–16.

6. Farmer ME, Harris T, Madans JH, et al. Anthropometric indicators and hip fracture. The NHANES I epidemiologic follow -up study. J Am Geriatr Soc1989;37:9–16.

7. http://li593-83.members.linode.com/node/1220623

8. McGrory BJ. Stinchfield resisted hip flexion test. Hosp Physician 1999;35(9):41–2.

9. Parker MH. Conservative versus operative treatment for extracasular hip fracture. Cocharane Database sys rev 2000(2).

10. Bedi A, Tonale T. Subtrochanteric femur fracture. Orthop Clin N Am 2004;35(4)

11. Dobbs R.E., Parvizi J., Lewallen D.G. Perioperative morbidity and 30- day mortality after intertrochanteric hip fractures treated by internalfixation or arthroplasty. J Arthroplasty. 2005;20(8):963–966.

12. Jenó Manninger, Ulrich Bosch, Peter Cserháti, Károly Fekete, György Kazár, internal fixation of femoral neck fractures, chapter 4.14;89.

13. Cooper AP.A Treatise on dislocations and fractures of the joints. London, England: Longman, Hurst, Rees, Orme and Brown; 1822

14. Sudan M, Sadowski C etal. : Peritrochanteric fractures. Is there an advantage of intramedullary nail? ; J Orthop Trauma 2002; 16 : 386 –393

15. David J. Magee, James E. Zachazewski, William S. Quillen, Scientific Foundations and Principles of Practice in Musculoskeletal rehabilitation ;28:615.

16. Thornton L: Tlt of trochanteric fractures of femur. Two methods: Piedmont Hospt. Bull,10-21-37, 1937

17. Christian Boldin, Franz J Seibert, Florian Fankhauser.: etal.: "The proximal femoral nail (PFN)—-a minimal invasive treatment of unstable proximal femoral fractures . Acta Orthop Scand 2003; 74(1): 53 -58.

18. Boyd HB, Griffin LL. Classifications and treatment of Trochanteric fractures. Arch Surg1949; 58:853 -866.

19. Koval KJ, Zuckerman JD. Hip fractures: II. Evaluation and treatment of intertrochanteric fractures. J Am Acad Orthop Surg 1994;2:150–6.

20. Fielding JW, Magliato HJ. Subtrochanteric fracture. Surg Gynecol Obstet 1966;122.

21. Kinast C, Bolhofner BR,Mast JW, et al. Subtrochanteric femur fracture, results of treatment with the 95 condylar blade plate. Clin orthop 1989;28.

22. Ricci, William M.M.D. New implants for the treatment of intertrochantric femur fractures. Techniques in orthopedics. Sept 2004; Vol 19 (3); 143-152.

23. Doppelt SH: The sliding compression screw. Today's best answer for stabilization of intertrochanteric hip fractures. Orthopclin North A.II. 507-523, 1980.

24. Simpson AHRW, Varty K, Dodd CAF: Sliding hip screws: Modes of failure. Injury20:227-231, 1989.

25. WolfganGl, Blyart MH, O'Neil JP: Treatment of intertrochanteric fracture of the femur using sliding screw plate fixation. ClinOrthop 163: 148-158, 1982.

26. Davis TRC, sher JL Horsman S, et.al. Intertrochanteric femoral fractures: Mechanical failure after internal fixation. JBJS Br. 1990;72:26-31.

27. Kaufer H. Mechanics of the treatment of hip injuries. Clin. Orthop. 1980; 146: 53-61.

28 Rosenblum Sf, Zuckerman JD, Kummer FJ et.al. A biochemical evaluation of the Gamma nail. JBJS Br. 1992; 74: 353-357.

29. KemmethJ.Koval and Joseph D. Zuckerman: Rockwood and Green's fracture in Adults, chapter 39, 5thedition, 2001-edited by Robert W.Buchlog and James D.Heckman, J.B.Lipincott Company, Vol-2,1635-1663.

30. Ehmke L.W., Fitzpatrick D.C., Krieg J.C. Lag screws for hip fracture fixation: evaluation of migration resistance under simulated walking. J Orthop Res. 2005;23:1329–1335.

31. Singh M, Nagrath A.R, Maini P.S., changes in trabecular pattern of upper end of femur as index of osteoporosis ;J.B.J.S am 1970;52:457-467.

32. Jesse C Delee. Rockwood and Green's fractures in Adults. Chapter 18 3rd edition 1991, Charles S. Rockwood, David P. Green Robert. W. Bucholz JB, Lippincott Company, Vol.2, 1481-1651.

33. Harrington K.D and Johnson J.O., the management of communited unstable intertrochanteric fractures J.B.J.S 55A:1367:1973.

34. Green S, Moore T, Proano F. Bipolar prosthetic replacement of unstable intertrochanteric hip fractions in the elderly. Clin Orthop 1986;224:169–177.

35. Stern MB, Angerman A. Comminuted intertrochanteric fractures treated with a Leinback prosthesis. Clin Orthop 1987;218:75–80.

36. Medoff RJ and Kirk Maes : A new device for fixation of unstable peritrochanteric hip fractures, JBJS 73 A. No 8, 119 2, Sept 1991.

37. A Bodoky, U Neff, M. Herberz and F Harder: Antibiotic prophylaxis with two doses of cephalosporin in patients managed with internal fixation for a fracture of hip JBJS Vol. 75, issue-1,61-65, 1993.

38. Halder SC: The Gamma nail for peritrochanteric fractures JBJS, 74B. No.3, 340, May 1990.

39. Gargan M, Gundle R, Simpson AH: How effective are osteotomies for unstable intertrochanteric fractures JBJS, (Br.) 1994, Sept, 76(5) 789-92.

40. Butt MS, Krikler SJ, Nafie S , Ali MS : Comparison of DHS and Gamma Nail : A prospective randomized, controlled trail. Injury 1995, Nov;25(9): 615-8.

41. Kasser JR, editor. Orthopaedic knowledge update 5– homestudy syllabus. Rosemont (IL): AmericanAcademy of Orthopaedic Surgeons; 1996.

42. Bentley G. Treatment of Non-displaced Fractures of the Femoral Neck. ClinOrthop 1980;153:93.

43. Zuckerman JD, Skovron ML, Koval KJ, et al. Postoperative Complications and Mortality Associated with Operative Delay in Older Patients Who Have a Fracture of the Hip. J Bone Joint Surg Am 1995;77:1551.

44. Evans E. The treatment of trochanteric fractures of the femur. JBJS 1949;31B 190-203

45. Tronzo R.G surgery of hip joint Volume II of Surgery of the Hip Joint

46. Jewett EL: One piece angle nail for trochanteric fractures JBJS 23: 803-810, 1941

47. Clawson D.K. trochanteric fractures treated by sliding plate fixation device J.Trauma 4:737:1964.

48. Sarmiento A avoidance of complications of internal fixation of intertrochanteric fractures, experience of 250 casers CORR 53;47,1967.

49. Dimon J.H and Hughston J.C unstable intertrochanteric fractures of hip; J.B.J.S 49A,440:1967.

50. Fielding JW, Magliato HJ. Subtrochanteric fractures; Surg Gynecol . Obstet. 1966; 122:555.

51. Baumgartner MR, Curtin SL, Keggi JM: The value of tip apex distance in predicting failure of fixation of trochanteric fractures of hip. JBJS 77-A, 1058,1995.

52. Bartl R, Hofer F: Placement of anti-rotation screw using a fixed parallel bore guide device in DHS management of hip para-articular femoral fractures. Unfallchirurgie 1996, April; 22(2): 85-7.

53. Loch Da, Kyle RF, Bechtold JE, Kane M, Anderson K, Sherman RE. Forces required to initiate sliding in second-generation intramedullary nails. J Bone surg Am.1998;80:1626-31.

54. Hoffmann R, Schmidmaer G. Schulz R, Schutz M: Classic nail v/s DHS: A prospective randomized study of fixation of trochanteric femur fractures. Unfallchirugie 1999 Mar: 102(3):182-90.

55. Herrera A, Domingo LJ, Calvo A, Martinez A, Cuence J. A comparative study of trochanteric fractures treated with the gamma nail or the proximal femoral nail.IntOrthop TraumatoCech 2002;69(1):22-30

56. Sudan M, Sadowski C etal. : Peritrochanteric fractures. Is there an advantage of intramedullary nail? ; J Orthop Trauma 2002; 16 : 386 –393

57. Christian Boldin, Franz J Seibert, Florian Fankhauser.: etal.: "The proximal femoral nail (PFN)—-a minimal invasive treatment of unstable proximal femoral fractures . Acta Orthop Scand 2003; 74(1): 53 -58.

58. Daniel F.A. Menezes, Axel Gamulin etal. : Is the Proximal femoral nail a suitable implant of all the trochanteric fractures? CORR; 2005; 439 : 221 –227

59. MSG Ballal, N Emms, G Thomas. : Proximal femoral nail failures in extra capsular fractures of the hip. : J of Orthopaedic Surgery 2008; 16(2) : 146 -9

60. Gray's textbook of anatomy 39th edtn:1440-1444.

61. Harty M: The Calcar femorale and femoral neck: JBJS 39 a, 625-630-1957.

62. Griffin JB: The Calcar Femorale Redefined. Clin. Orthop 164, 221-214, 1982.

63. Wu CC, Shih CH. LeeMy, Tai CL-Biomechanical analysis of locationof lag screw of dynamic hip screw in treatment of unstable intertrochanteric fractures. J. Trauma 1996, Oct. 41 (4): 699-702.

64. Horn and Wang: Mechanics of trochanteric anatomy of trochanteric fractures; Br.Jr.of Surgery, 51, 574, 1964.

65. Ward FO : Human Anatomy, London, Renshaw, 1838. 8:1 Wamik Williams : Grays anatomy, 35 Ed., 357, 1975.

66. Singh M, Nagrath A.R, Maini P.S., changes in trabecular pattern of upper end of femur as index of osteoporosis ;JBJS am 1970;52:457-467 .

67. T Morihara, Y Arai, S Tokugawa, S Fujita, K Chatani, T Kubo. Proximal femoral nail for treatment of trochanteric femoral fractures. Journal of Orthopaedic Surgery 2007;15(3): 273-7 .

68. Dora c, Leunig M, Beck M et. Al. Entry point soft tissue damage in antergrade femoral nailing; a cadaver study. J orthop Trauma 2001; 15(7).

69. Boyd HB, Griffin LL. Classifications and treatment of trochanteric fractures. Arch Surg1949; 58:853–866.

70. Evans E. The treatment of trochanteric fractures of the femur. JBJS 1949;31B 190-203 .

71. Simmermacher RKJ, Bosch A M,Van der Werken C. The AO ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. Injury 1999; 30: 327-32.

72. Roger W .Soames. Skeletal system.chapter 6 in GRAY'S ANATOMY.684 697.

73. JDavid G. Lavelle. Fractures and dislocations chapter-52 in CAMPBELL'S OPERATIVE ORTHOPEDICS, eleventh edition. Vol-3 pages;3237-3308.

74. Singh M, Nagrath A.R, Maini P.S., changes in trabecular pattern of upper end of femur as index of osteoporosis ;J.B.J.S am 1970;52:457-467.

75. MICHAEL R. Baumgaertner and Thamos F. Higgins.chapter 38 in ROCKWOOD AND GREEN'S FRACTURE IN ADULTS 5thedition;vol-2 :1579-94,1665-1681.76. Garden RS. The structure and function of the proximal end of femur. JBJS 1961, 43-B(3).

77. Singh M, Nagrath A.R, Maini P.S., changes in trabecular pattern of upper end of femur as index of osteoporosis ;JBJS am 1970;52:457-467

78. Blount WP; presidential address American academy of orthopedic surgeons, jan 30,1956, JBJS 38A: 695; 1956 .

79. Inman VT: functional aspect of abductor muscles of hIp joint, JBJS 29:607, 1947 .

80. Pawels F; Ein mechanisches problem. Stuttgart, Enke 1935.

81. Muller ME,Nazarian S, Koch P, Schanzker J. The Comprehensive Classification of fractures of long bones. Berlin:Springer-Verlag,1990.

82. Russell-taylor classification of Subtrochanteric femur fracture. Skeletal trauma 1998;2.

83. Franco Lavini. L. Renzi-Brivio. R. Aulisa. F. Cherubino. P. L. Di Seglio. N. Galante. W. Leonardi. M. Manca. The treatment of stable and unstable proximal femoral fractures with a new trochanteric nail: results of a multicentre study with the VeronailStrat Traum Limb Recon (2008) 3:15–22.

84. Ujjal Bhakat#, Ranadeb Bandyopadhayay Comparitive Study between Proximal Femoral Nailing and Dynamic Hip Screw in Intertrochanteric Fracture of Femur : Open Journal of Orthopedics, 2013, 3, 291-295.

85. Fu-Ting Huang, Md; Kai-Cheng Lin, Md; Shan-Wei Yang, Md; Jenn-Huei Renn, Md Comparative Study of the Proximal Femoral Nail Antirotation Versus the Reconstruction Nail in the Treatment of Comminuted Proximal Femoral Fracture: doi: 10.3928/01477447-20111122-02.

86. S.K. Venkatesh Gupta, Veera Shekar Valisetti Comparative study between dynamic hip screw vs proximal femoral nailing in inter-trochanteric fractures of the femur in adults: IJOS 2015; 1(1): 07-11.

87. Kim KC, Shin HK, Son KM, Ko CS. The Treatment of Unstable Intertrochanter Fracutures of Femur: Comparison between Proximal Femoral Nail andDynamic Hip Screw.J Korean FractSoc 2005 Oct 18(4):369-374. Korean.99.

88. Halder Sc. The gamma nail for peritrochanteric fractures. JBJS(Br) 1992; 74:340-4.

89. Christian Boldin, Franz J Seibert, Florian et al. The proximal femoral nail (PFN) –a minimal invasive treatment of unstable proximal femoral fractures. A prospective study of 55 patients with a follow up of 15 months. Acta Orthop Scand 2003; 74 (1): 53-58.

90. W. M. Gadegone and Y. S. Salphale. Proximal femoral nail –an analysis of 100 cases of proximal femoral fractures with an average follow up of 1 year.IntOrthop. 2007 June; 31(3): 403–408.

91. Strauss EJ, Kummer FJ, Koval KJ, Egol KA: The "Z-effect" phenomenon defined: a laboratory study. J Orthop Res 2007, 25:1568-1573.

92. Werner-Tutschku W, Lajtai G, Schmiedhuber G, Lang G, Pirkl C, Orthner E: Intra-und perioperative Komplikationen bei der Stabilisierung von perund subtrochantären Femurfrakturen mittels PFN. Unfallchirurg 2002, 105:881-885.

93. Ehmke L.W., Fitzpatrick D.C., Krieg J.C. Lag screws for hip fracture fixation: evaluation of migration resistance under simulated walking. J Orthop Res. 2005;23:1329–1335.

94. Dobbs R.E., Parvizi J., Lewallen D.G. Perioperative morbidity and 30-day mortality after intertrochanteric hip fractures treated by internal fixation or arthroplasty. J Arthroplasty. 2005;20(8):963–966.

95. Jenó Manninger, Ulrich Bosch, Peter Cserháti, Károly Fekete, György Kazár, internal fixation of femoral neck fractures, chapter 4.14;89

96. Cooper AP.A Treatise on dislocations and fractures of the joints. London, England: Longman, Hurst, Rees, Orme and Brown; 1822

97. Sudan M, Sadowski C etal. : Peritrochanteric fractures. Is there an advantage of intramedullary nail? ; J Orthop Trauma 2002; 16 : 386 –393

98. David J. Magee, James E. Zachazewski, William S. Quillen, Scientific Foundations and Principles of Practice in Musculoskeletal rehabilitation ;28:615.

99. Christian Boldin, Franz J Seibert, Florian Fankhauser.: etal.: "The proximal femoral nail (PFN)—-a minimal invasive treatment of unstable proximal femoral fractures . Acta Orthop Scand 2003; 74(1): 53 -58.

100. Koval KJ, Zuckerman JD. Hip fractures: II. Evaluation and treatment of intertrochanteric fractures. J Am Acad Orthop Surg 1994;2:150–6.

101. Fielding JW, Magliato HJ. Subtrochanteric fractures; Surg Gynecol . Obstet. 1966; 122:555

102. Jesse C Delee. Rockwood and Green's fractures in Adults. Chapter 18 3rd edition 1991, Charles S. Rockwood, David P. Green Robert. W. Bucholz JB, Lippincott Company, Vol.2, 1481-1651.

103. Harrington K.D and Johnson J.O., the management of communited unstable intertrochanteric fractures J.B.J.S 55A:1367:1973.

104. Green S, Moore T, Proano F. Bipolar prosthetic replacement of unstable intertrochanteric hip fractions in the elderly. Clin Orthop 1986;224:169–177.

105. Stern MB, Angerman A. Comminuted intertrochanteric fractures treated with a Leinback prosthesis. Clin Orthop 1987;218:75–80.

106. Gargan M, Gundle R, Simpson AH: How effective are osteotomies for unstable intertrochanteric fractures JBJS, (Br.) 1994, Sept, 76(5) 789-92.

107. Butt MS, Krikler SJ, Nafie S , Ali MS : Comparison of DHS and Gamma Nail : A prospective randomized, controlled trail. Injury 1995, Nov;25(9): 615-8

108. Baumgartner MR, Curtin SL, Keggi JM: The value of tip apex distance in predicting failure of fixation of trochanteric fractures of hip. JBJS 77 A,1058,1995.

109. Bartl R, Hofer F: Placement of anti-rotation screw using a fixed parallel bore guide device in DHS management of hip para-articular femoral fractures. Unfallchirurgie 1996, April; 22(2): 85-7.

110. Thornton L: Tlt of trochanteric fractures of femur. Two methods: Piedmont Hospt. Bull,10-21-37, 1937.

111. Minos Tyllianakis, andreas Panagopoulos, Andreas Papadopoulos,Socratis papasimos, Konstantinos Mousafiris :treatment of extracapsular hip fractureswith the proximal nail(PFN) :long term results in 45 patients. Acta orthop. Belg., 2004,70,444-454.

# ANNEXURE-1

## PROFORMA

**GENERAL DATA**

NAME

AGE

SEX

ADDRESS

CONTACT NO

INDOOR NO

OUT DOOR NO

OCCUPATION PRE OP

**SPECIAL DATA**

DATE OF ADMISSION

DATE OF SURGERY

DATE OF DISCHARGE

**PAST HISTORY**

MEDICAL ILLNESS

MAJOR

SURGERY

**INJURY DATA**

SIDE AFFECTED

MODE OF TRAUMA

VEHICLE INJURY

FALL FROM HEIGHT

ASSAULT

ASSOCIATED IPSILATERAL INJURY

ASSOCIATED LIMB INJURY

NEURO VASCULAR STATUS OF LIMB

TRIVAL TARUMA

TYPE OF FRACTUE

**GENERAL EXAMINATION**

- TEMPERATUE
- PULSE
- RESPIRATION
- BLOOD PRESSURE
- HEAD AND ABDOMINAL INJURY
- PELVIC COMPRESSION TEST
- CHEST COMPRESSION TEST

**LOCAL EXAMINATION**

- OVERLYING SKIN NORMAL/CONTUSED
- TEMPERATURE
- TENDERNESS
- ATTITUDE
- DEFORMITY
- MOVEMENTS ACTIVE/PASSIVE
- SHORTENING
- DISTAL NEURO VASCULAR STATUS
- PRE OPERATIVE TRACTION GIVEN (Y/N NO. OF DAYS)
- SKIN TRACTION
- SKELETAL TRACTION

**INVESTIGATIONS**

- HB,CBC
- URINE ALBUMIN SUGAR
- RBS
- B.UREA
- S.CREATEANINE
- S.ELECROLYTE
- HIV & HB.A
- ECG
- ROENTGENTOGRAMS CHEST PA VIEW
  PELVIS WITH BOTH HIPS
  HIP WITH FEMUR AP
  CROSSTABLE LATERAL VIEW

**OPERATIVE DETAILS**

- TYPE OF ANAESTHESIA GIVEN
- OPERATING SURGEON
- FRACTURE TABLE POSITION
- REAMING DONE
- SIZE OF NAIL
- DIAMETER OF NAIL
- DISTAL LOCKING : DYNAMIC OR BOTH

**COMPLICATIONS**

INTRAOPERATIVE: NEUROVASCULAR INJURY

GREATER TROCHANTER FRACTURE

POSTOPERATIVE : INFECTION

DELAYED UNION

DEEP VEIN THROMBOSIS AND THROMBOEMBOLISM

MAL -UNION

LIMB LENTH DISCREPRANCY

**POST OPERATIVE DETAILS**

- ANTIBIOTICS
- INFECTION
- SUTURE REMOVAL AT
- WOUND GAPING
- STICH LINE NECROSIS

**POST OPERATIVE LIMB LENTH DISCREPRANCY**

**POST OPERATIVE RADIOLOGICAL EXAMINATION**

(X-RAY OF PELVIS WITH BOTH HIP AND UPPER FEMUR ANTEROPOSTERIOR VIEW AND CROSS TABLE LATERAL VIEW)

- FRACTURE REDUCTION IN NEUTRAL/ VARUS/VALGUS

**MORTALITY IN EARLY POST OPERATIVE PERIOD**

**REHABLITATION AND DISCHARGE**

- STATIC QUADRICEPS EXERCISE
- GLUTEAL STRENTHENING EXERCISES STARTED
- HIGH SITTING
- WEIGHT BEARING STARTED AT- WITH WALKER
  WITH CRUTCHES
- FULL WEIGHT BEARING STARTED AT

- POST OPERATIVE COMPLICATIONS OF SPECIAL FEATURES
- CONDITION OF WOUND ON DISCHARGE - STICHES REMOVED NOT REMOVED
- INFECTION - PRESENT
  ABSENT
- IF PRESENT- SUPERFICIAL
  DEEP
- DRAINING SINUS - PRESENT
  -ABSENT

**FOLLOW UP**

FIRST (1 MONTH)

- COMPLAIN OF- PAIN
  LIMP
  DEFORMITY
  HIP/KNEE/ANKLE
  TEMPERATURE
  SWELLING
  WASTING
  STIFFNESS OF JOINTS
  SHORTENING
- GAIT
- WALKING AID USED STICK/WALKER/NONE
  LIMB LENTH DISCREPRANCY
  MOVEMENTS AT HIP FLEXION/EXTENSION/ ABDUCTION/ EXT.
  ROTATION
  MOVEMENTS AT KNEE JOINT FLEXION/ EXTENSION
  F0LLOW UP

SECOND (3 MONTH)

- COMPLAIN OF -PAIN

  LIMP

  DEFORMITY HIP/KNEE/ANKLE

  TEMPERATURE

  SWELLING

  WASTING

  STIFFNESS OF JOINTS

  SHORTENING

- GAIT
- WALKING AID USED STICK/WALKER/NONE

  LIMB LENTH DISCREPRANCY

  MOVEMENTS AT HIP FLEXION/EXTENSION/ ABDUCTION/ EXT.

  ROTATION

  MOVEMENTS AT KNEE JOINT FLEXION/ EXTENSION

**ASSESSMENT**

- PATIENTS (OWN) ASSESSMENT EXCELLENT/ GOOD/ FAIR/ POOR/FAILURE
- DOCTORS ASSESSMENT EXCELLENT/ GOOD/ FAIR/ POOR/ FAILURE.

## ANNEXURE- 2

## SALVATI AND WILSON SCORE

### PAIN

0=Constant and unbearable. Frequent strong analgesia.

2= Constant but bearable. occasional strong analgesia.

4= Nil or little at rest. with activity.

6= Little pain at rest. Pain on activity.

8= occasional slight pain.

10=no pain

### WALKING

0=Bedridden

2=Wheelchair

4=walking frame

6=one stick, limited distance up to 400 yards

8=one stick , long distances

10=unaided and unrestricted

### MUSCLE POWER AND MOTION

0=Ankylosis with deformity

2=Ankylosis with good functional position

4=poor muscle power. Flexion< $60^0$abduction <100

6 =fair muscle power. Flexion 60-900 abduction10-200

8=Good muscle power. Flexion>900 abduction>200

10=normal muscle power. Full range of movement

**FUNCTION**

0= Bedridden

2= housebond

4=limited housework

6= most housework, can shop freely

8=very little restriction

10=normal activity

**Grading of result** >31 = excellent

24-31 = good

16-23 = fair

<16 = poor

# ANNEXURE-III

# PARTICIPANT INFORMATION SHEET

Study Title: -"COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES"

DATE:

You are being cordially invited to participate in the above titled study.The proposed study is a scientific endeavor to generate data of treatment of closed extra capsular proximal femur fractures with proximal femur nail in our hospital.

1. Purpose & nature of the study : To study the results "COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES"
2. Voluntary nature of participation: -

   Your participation in this study is voluntary and at your freewill. You can refuse to participate in the study. More over youare also free to withdraw at any time without having to give areason. Despite this, you will continue to receive your standardmedical care and treatment.
3. Study methods: -

   The study is interventional and the investigator will not intervene in any part of the treatment. The treatment will be decided by the treating doctor, and only the treatment and the investigations will be observed and noted by the investigator. The investigator may ask questions relevant to your history, your disease, drug treatment and may enter it in the case record form prepared for the purpose.
4. Participant's responsibility: -

   You will share information regarding the health problem with the investigator as required.You will co-operate with the investigator with regard to follow upvisits .

5. Expected adverse events, risks and solution: -

   This is an interventional study only. Treatment of your disease will be decided by senior consultant only and not by theinvestigator. There is no question of adverse effects or risk to you on account of the study.

6. Benefits of participation: -

   Your disease will be diagnosed easily and fast, there will bebetter chances of accurate diagnosis and treatment.So the treatment will be started as early as possible.Your treatment will become more appropriate and effective.

7. Confidentiality: -

   Your information will remain strictly confidential and will not berevealed to any third party and will not be published anywherewithout your prior permission.

8. Investigator's Contact Information: -

   This interventional study, no additional problem will expect toarise. However if you need to share any information or seekadvice with regard to the study, you can contact –

   Dr. DHRUVEN KOSADA
   RESIDENT ORTHOPAEDICS,
   DEPARTMENT
   OF ORTHOPAEDICS,
   SBKS MI&RC, PIPARIYA
   Tal. Waghodia, Dist. Vadodara
   Mob: -9429831627.

9. Financial consideration: -

   You will not have to bear any extra cost purely for the purpose of the study. However, if the investigator desires to carry out any additional investigation, other than the ones suggested by yourtreating doctor or the ones which are a part of treating protocolsfor your disease condition, the cost of the same will be borne bythe investigator. You will not get any financial incentives for participating.

10. Protection and security: -

    It is an interventional study and no newdrugs/procedure/technique is being tested, so this does notapply.

11. Obtaining additional information: -

If you need any additional information with regard to the study,or if you require any clarification, or in case of any doubt, youare free to ask questions to the Investigator. You will be given acopy of this participant information sheet for your informationand record if you need more information at a later date, you may call the investigator or meet him.

## ઇન્ફોર્મડકન્સેન્ટફોર્મ

## પરિશિષ્ટ-3

અભ્યાસનુંશીર્ષક: -

તારીખ:

1. **અભ્યાસનોમુખ્યહેતુ:-**

તમારાજેવાદર્દીઓમાંતપાસકરવાનોછેકેજેઓર્થોપેડીકવિભાગમાંદાખલથયેલા છે. આઅભ્યાસમાંતેપણતપાસકેજેનિયમિતસંચાલનમાટેજરૂરીછેતેનો સમાવેશથશે.

2. **ભાગીદારીની** સ્વૈચ્છિક **પ્રકૃતિ:** -

આઅભ્યાસમાંતમારીભાગીદારીસ્વૈચ્છિકછે.

તમેઆઅભ્યાસમાંભાગલેવાનોઇન્કારકરીશકોછો.

વધુમાં,તમેકોઈકારણઆપ્યાવગરગમે ત્યારેસંમતિપાછીખેચીશકોછો.

આમછતાંતમારીપ્રમાણભૂતતબીબીસારવારચાલુરહેશે .

**3.** અભ્યાસનીપદ્ધતિઓ : -

- આઅભ્યાસમુખ્યરીતે ઇન્ટરવેનશનલછે.

અભ્યાસકર્તાતમારીસારવારમાંકોઈરીતેદરમ્યાનગીરીનહિકરે.

તમનેતમારીસારવાર,સારવારઆપતાડોક્ટરદ્વારાઆપવામાંઆવશે.

તેમનીમુખ્યઅસરોનુંનિરીક્ષણઅભ્યાસકર્તાદ્વારાનોંધવામાંઆવશે.

- અભ્યાસકર્તાતમારારોગસંબંધિતપ્રશ્નો, રોગનોઇતિહાસ,સારવાર અંગેનીમાહિતીકેસરેકોર્ડ(CRF) ફોર્મદાખલકરીશકેછે.

**4. સહભાગીનીજવાબદારી:** -

- તમેજરૂરપડેતમેતપાસસાથેઆરોગ્યસમસ્યાતરીકેજરૂરીસંબંધિતજાણકા રીઅભ્યાસકર્તાનેઆપશો.

- તમેઅભ્યાસકર્તાનેદરેકમુલાકાતમાંસહકારઆપશો.
- લોહી,પેશાબનુંપરીક્ષણકરવુંજરૂરીથઇશકેછે.તેમાંએવીતપાસકરવા માંઆવશેકેજેનિયમિતરીએજરૂરીહશેઅનેજેમફતથશે.

**5. અપેક્ષિત આડઅસરો,તેનાથી રહેલા જોખમો અને તેના ઉપાયો:-**

- આ એક ઇન્ટરવેનશનલ આધારિત અભ્યાસ છેતમારા રોગની . સારવારવરિષ્ઠસલાહકારદ્વારાનક્કીકરવામાંઆવશે.આ અભ્યાસના કારણે તમને કોઈ આડઅસરોનું જોખમ રેહવાનું નથી.

**6. સહભાગી થવાના ફાયદાઓ:-**

- તમારા રોગની ઉંડાણપૂર્વક તપાસ કરવામાં આવશેજેનાથી . જેનાથી તમને યોગ્ય .તમારા રોગનું સચોટ નિદાન અને સારવાર મળશે અને ગુણકારક સારવાર .મળશેતેમજરોગસરળતાથીઅનેઝડપથીનિદાનકરવામાંઆવશે, ત્યાંચોક્કસનિદાનઅનેસારવારવધુસારીતકરહેશે.
- તેથીસારવારશક્યપ્રારંભતરીકેશરૂકરવામાંઆવશે.

**7. ગુપ્તતા:-**

- તમારી માહિતી ચોક્કસ રીતે ગુપ્ત રાખવામાં આવશેતમારી . માહિતીની જાણ, કોઈ ત્રીજી વ્યક્તિને કે જાહેરમાં પ્રસિદ્ધ કરવામાં નહિ આવે.

**8. અભ્યાસકર્તાનો સંપર્ક- :**

આ એક નિરીક્ષણ પર આધારિત અભ્યાસ છે તમને સારવાર આપતા . ડોક્ટરે આપેલી દવાઓથી થતી આડઅસરો સિવાય બીજી કોઈ સમસ્યા થવાનીશક્યતા નથીજો તમને બીજી કોઈ પણ માહિતી જોઈતી હોય કે . તમને કોઈ સલાહની જરૂર હોય તો તમે નીચેની વ્યક્તિનો સંપર્ક કરી શકો .છો

ડો.

રેસીડેન્ટ ડોક્ટર

ઓર્થોપેડીક વિભાગ ,

એસસી .એન્ડઆર .આઈ .એમ .એસ .કે .બી .. ,પીપરીયા

તાલુકોવડોદરા .વાઘોડિયા જીલ્લો .

મોબાઈલ - :9429831627

**9. નાણાકીય ખુલાસો- :**

તમારે આ અભ્યાસ માટે કોઈ વધારાનો ખર્ચો ઉપાડવાનો નથીજો તમારી . સારવાર આપતા ડોકટરે કરાવેલાપરીક્ષણો સિવાય અભ્યાસકર્તા કોઈ અન્ય પરીક્ષણો કરાવવા માંગે તો તેનો સંપૂર્ણ ખર્ચો અભ્યાસકર્તા ઉપાડશે . અભ્યાસમાં સામેલ થવાના લીધે તમને કોઈ વળતર અપાશે નહી કે નાણાકીય ફાયદો મળશે નહી.

**10. રક્ષણઅનેસલામતી:-**

આએકઅભ્યાસછે.

તેમાંકોઈનવીદવાઓકેપ્રક્રિયાનુંપરીક્ષણકરવામાંઆવવાનુંનથી. જેથી આ પ્રશ્ન ઉપસ્થિત થતો નથી.

**11. વધારાનીજાણકારીમેળવવી:-**

જો તમનેઅભ્યાસસંદર્ભેકોઈપણ પણ વધારાની જાણકારીજોઈતી હોય અથવાતમને કોઇસ્પષ્ટતાની જરૂરહોય તો, અથવાકોઇ શંકા હોય તો, તમેઅભ્યાસકર્તાને પ્રશ્નોપૂછીશકો છો. તમનેતમારી માહિતી માટે આ પત્રકની નકલઆપવામાં આવશે જો.ભવિષ્યમાં તમનેવધારે માહિતી જોઇતી હોય, તો તમે અભ્યાસકર્તાને ફોન કરી શકો છો અથવાતેમને રૂબરૂ મળવાઆવી શકો છો.

# ANNEXURE-4

Informed Consent Form (ICF) for Participants in Research Programmesinvolving studies on human beings

**Study Title**: -**"COMPARATIVE STUDY OF ANTEGRADE FEMORAL NAILING VS PROXIMAL FEMORAL NAILING FOR THE TREATMENT OF PROXIMAL FEMORAL FRACTURES"**

Please initial box (Subject)

I confirm that I have read and understood the information sheet dated ……...….for the above study and have had the opportunity to ask questions. ☐

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

(iii) I understand that the Sponsor of the clinical trial, others working on the Sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may beconducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published. ☐

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s) ☐

(v) I agree to take part in the above study. ☐

Signature (or Thumb impression) of the Subject/LAR: _____

Date : ____/____/____

Signatory's Name: _____

Signature of the Investigator: _____

Date: _/___ __/ _____

Study Investigator's Name: _____

Signature of the Witness _____

Date:____/___/_____

Name of the Witness:

## સંમતિ જાણ

**અભ્યાસ શીર્ષક: શાફ્ટ ટીબીઆઈ ફ્લકમાં ઈન્ટરલૉકિંગ નખનો અભ્યાસ**

અભ્યાસ નંબર:

વિષયનો પ્રારંભ: વિષયનું નામ:

જન્મ તારીખ / ઉંમર:

વિષયનું સરનામું:

લાયકાત:

વ્યવસાય: વિદ્યાર્થી / સ્વ રોજગારી / સેવા / ઘરની પત્ની / અન્ય :( કૃપા કરીને યોગ્ય તરીકે નિશાની કરો)

આ વિષયની વાર્ષિક આવક:

નોમિની (ઓ) ની વિગતો:

નોમિની નામ:

નોમીનીનું સરનામું:

વિષય સાથે સંબંધ:

કૃપા કરી પ્રારંભિક બોક્સ (વિષય)

(i) હું પુષ્ટિ કરું છું કે મેં માહિતીપત્રની તારીખ વાંચી અને સમજી લીધી ..... .. ઉપરના અભ્યાસ માટે અને પ્રશ્નો પૂછવાની તક મળી છે.

(ii) હું સમજી શકું છું કે અભ્યાસમાં મારો સહભાગિહ સ્વૈચ્છિક છે અને તે કોઈપણ તબીબી કાળજી અથવા કાયદાકીય અધિકારોને પ્રભાવિત કર્યા વિના, કોઈપણ કારણ વગર, કોઈપણ સમયે હું પાછી ખેંચી શકું છું.

(iii) હું સમજું છું કે ક્લિનિકલ ટ્રાયલના પ્રાયોજક, અન્યો

પ્રાયોજકની વતી કાર્યરત, એથિક્સ કમિટી અને નિયમનકારી સત્તાવાળાઓએ વર્તમાન અભ્યાસના સંદર્ભમાં અને અન્ય કોઈ સંશોધનમાં તેનો સંદર્ભ આપવા માટે મારી સ્વાસ્થ્યના વિકમોને જોવાની મારી પરવાનગીની જરૂર નથી,

જો હું ટ્રાયલમાંથી પાછો ખેંચી લો તો પણ હું આ ઍક્સેસ માટે સંમત છું, પણ હું સમજું છું કે તૃતીય પક્ષો દ્વારા પ્રકાશિત અથવા પ્રકાશિત થયેલા કોઈપણ માહિતીમાં મારી ઓળખ જાહેર કરવામાં આવશે નહીં.

(iv) હું કોઈપણ અન્ય માહિતી અથવા પરિણામોના ઉપયોગને પ્રતિબંધિત કરવા માટે સંમત થતો નથી.

(v) હું ઉપરના અભ્યાસમાં ભાગ લેવા માટે સંમત છું.

વિષય / LAR ની હસ્તાક્ષર (અથવા અંગૂઠા છાપ):

તારીખ: / /

હસ્તાક્ષરનું નામ:

તપાસકર્તાના હસ્તાક્ષર:

તારીખ: / /

અભ્યાસ તપાસ કરનારનું નામ:

સાક્ષીની હસ્તાક્ષર

તારીખ: / _ /

સાક્ષીનું નામ:

પેશન્ટ ઈન્ફર્મેશન શીટની નકલ અને ભરવામાં આવશે ઈન્ફોર્મ્ડ કોન્સન્ટ ફોર્મ વિષય અથવા તેના / તેણીના પરિચરને આપવામાં આવશે.