Proximal Femur Fractures Management and an insight about Proximal Femoral Nail System

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Article History: Received 15th August, Accepted 25th August, published online 20th August 2023

Abstract

Background: Hip fractures are anatomically categorised in relation to the hip capsule as either: Intracapsular fractures (i.e., at the femoral neck), or Extracapsular fractures (i.e., intertrochanteric or subtrochanteric fractures). Cortical and compact cancellous bone are present in the intertrochanteric region. As a result, these fractures happen along the path of least resistance. It is likely that a combination of compression, bending, torsion, and shear loads causes fractures. Compression and bending forces make up most of the forces contributing to all loads. Stronger in compression than tension is the long bone. Fatigue fracture is brought on by repeated loads that are less than the tensile strength of bone. Each load causes minute fractures in the osseous structure, which eventually combine to form fracture. Either simple or comminute depending on the amount of energy absorbed. Early anatomical reduction and surgical fixation remains the best option to reduce the risk of complications like non-union and avascular necrosis in treating fracture neck femurs. Cancellous screws continue to be the preferred treatment for fixation of neck femur fractures in younger population until the benefit of using sliding hip screws is validated by large multicentric studies. In the geriatric age group, early prosthetic replacement brings down the mortality and morbidity associated with neck femur fractures. Sliding hip screw (DHS) is the best available option for stable inter trochanteric fractures. The use of intramedullary nails e.g. PFN is beneficial in treating inter trochanteric fractures with comminution and loss of lateral buttress. Intramedullary implants have been proven to have increased success rates in subtrochanteric fractures and should be preferred over extramedullary plate fixation systems.

Keywords: proximal femur fractures

Introduction

Proximal femoral Fractures account for a large proportion of hospitalization among trauma cases. An overwhelming majority of these patients (>90%) are aged above 50 years. The incidence of these fractures is 2–3 times more in females as compared to male population. They are classified on basis of anatomical location of fracture into: neck of femur fracture, inter trochanteric fracture and subtrochanteric fracture. Each of these fracture types require special methods of treatment and have their own set of complications and controversies regarding the optimal method of management. We undertook a literature review to try and understand the various issues involved in management of proximal femoral fractures and search for answers to the existing contentions in the numerous treatment options available. **(1)**

Classification: (1)
Hip fractures are anatomically categorised in relation to the hip capsule as either:
- Intracapsular fractures (i.e., at the femoral neck).
- Extracapsular fractures (i.e., intertrochanteric or subtrochanteric fractures).

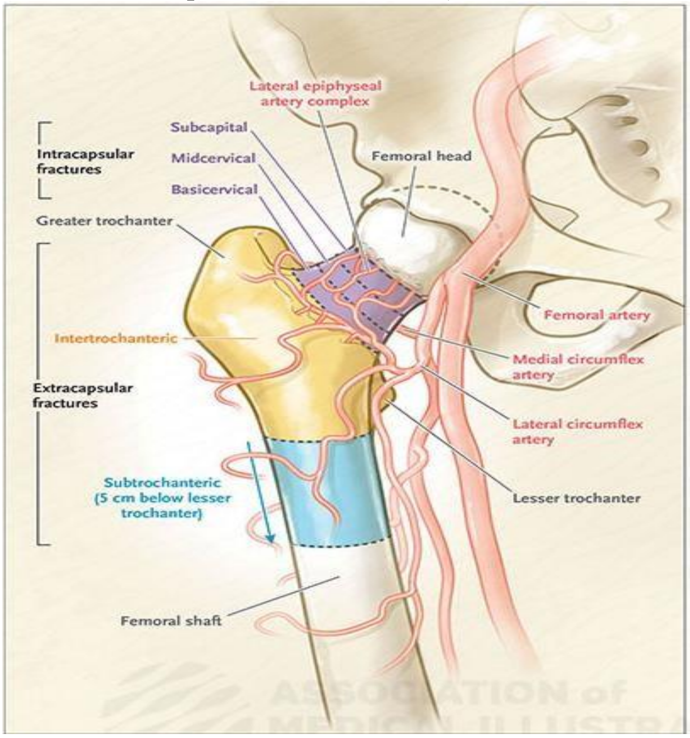


Fig. (1): Classification of hip fracture according to anatomical fracture site. **(1)**

AO/OTA classification (2)
One of the most common systems for categorising proximal femoral fractures or proximal femoral end segment fractures is the AO/OTA classification. They are divided into three categories based on the complexity and severity of the particular injury.

Table (1): AO/OTA classification of proximal femoral fracture: **(2)**

type A: trochanteric fracture (below the intertrochanteric line and above the inferior border of the lesser trochanter)
A1: simple pertrochanteric fracture
A1.1 isolated trochanter fracture: greater or lesser trochanter
A1.2 two-part fracture
A1.3 lateral wall intact (lateral wall thickness ≥20.5 mm*)
A2: multifragmentary pertrochanteric fracture/incompetence of the lateral wall (thickness≤20.5 mm*)
A2.2 one intermediate fragment
A2.3 two or more intermediate fragments
A3: intertrochanteric or reverse oblique fracture
A3.1 simple oblique fracture
A3.2 simple transverse fracture
A3.3 wedge fracture or multifragmentary fracture
type B: femoral neck or subcapital femoral fracture (below the articular cartilage of the femoral head and above the intertrochanteric line)
B1: subcapital fracture
B1.1 valgus impacted

B1.2 nondisplaced
B1.3 displaced
B2: transcervical fracture (Pauwels 1-3: <30°, 30-70°, >70°)
B2.1 simple
B2.2 multifragmentary
B2.3 shear fracture
B3: basicervical fracture
type C: femoral head fracture (articular fracture)
C1: split fracture
C1.1 ligamentum teres avulsion
C1.2 infrafoveal split fracture
C1.3 suprafoveal split fracture
C2: depression fracture
C2.1 depression with chondral lesion
C2.2 depression impaction fracture
C2.3 split depression fracture
*The lateral wall thickness is measured as the distance between fracture and a reference point on an anteroposterior x-ray 3 cm below the innominate tubercle of the greater trochanter angled 135° upwards.

Femoral neck Fractures

Femoral neck fractures are intracapsular hip fracture. The femoral head's blood supply is a crucial factor to consider in displaced fractures. **(3)**

Etiology

Femoral neck fractures in the elderly are linked to low-energy falls especially in women or high velocity trauma in younger patients **(4,5, 6,7)**

Pathophysiology

The MFCA is the main vascular supply to the femoral head. Displaced femoral neck fractures may result in tearing of the ascending cervical branches that originate from the arterial ring supply created by the circumflex arteries ultimately leading to osteonecrosis or non-union. **(8)** The younger population that sustains this fracture makes this especially significant. **(9)** Avascular necrosis is the most frequent side effect in patients who receive treatment with open reduction internal fixation. **(10)**

History and Physical Examination:

Trauma is the main cause, but elder patients may be negligent so getting a report from the nursing home or the medical staff is essential in this situation. There may be no deformity in non-displaced fractures. A shortened and externally rotated lower limb; however, may be present with displaced fractures. **(3)**
. During the history and physical exam, the following information should be gathered: **(3)**

- Low energy trauma: the mechanism is extremely important.
- High-energy trauma: When necessary, adhere to the ATLS (Adult Trauma Life Support) protocol.
- Important medical information to consider includes the patient's baseline function, use of ambulatory aids, blood thinners, pulmonary embolism, and deep vein thrombosis.

Evaluation (3)

When indicated, imaging the following in the order listed:

- Plain films: radiographs-anterior-posterior (AP) pelvis, AP and lateral hip, AP and lateral femur, AP and lateral knee.
- Computed tomography (CT) scan - helps better classify the fracture pattern or delineate a subtle fracture line.
- Magnetic resonance imaging (MRI) - not generally used.

Basic lab tests such as complete blood count, basal metabolic panel, and prothrombin/international normalised ratio may be included in medical evaluation. Chest imaging and an electrocardiogram may be performed. Cardiology evaluations performed prior to surgery may be beneficial for elderly patients with known or suspected cardiac disease.
The most prevalent clinical classification by Garden and Pauwel are just a few of the many classifications for femoral neck fractures. **(11,12)**

Table (2): Garden Classification **(12)**

Type I: Incomplete fracture - valgus impacted-non displaced
Type II: Complete fracture - nondisplaced
Type III: Complete fracture - partial displaced
Type IV: Complete fracture - fully displaced

The most common system for describing the type of fracture is the Garden classification. In terms of therapy, it is frequently divided into nondisplaced (Type 1 and Type 2) versus displaced (Type 3 and Type 4).

Table (3): Pauwel Classification. **(3)**

Type I	less than 30 degrees
Type II	30 to 50 degrees
Type III	greater than 50 degrees

The angle of inclination between the fracture line and the horizontal is also included in the Pauwel classification. Additionally, the risk of osteonecrosis following surgery is higher with these fractures. **(3)**

Fig. (2): Femoral Neck fracture. Contributed by Jillian Kazley, MD. **(3)**

Treatment / Management

Non-operative

Rarely, non-operative management is the chosen course in patients who require non-ambulatory care, comfort care, or are at high risk.

Operative

Young patient:

Emergent open reduction internal fixation will be necessary for the treatment of young patients with femoral neck fractures. **(4,13)**

Elderly patient: Nondisplaced:

Treatment for non-displaced fractures typically involves a sliding hip screw or percutaneous cannulated screws. However, compared to cannulated screws (4%), the use of sliding hip screws results in a higher rate of avascular necrosis (AVN), at 9%. **(14)**

Displaced:

The course of treatment for elderly patients with displaced femoral neck fractures is determined by the patient's age and baseline level of activity. Hemiarthroplasty may be performed on people who are less active. **(15)** Total hip replacements are used to treat people who are more active; however, compared to a hemiarthroplasty, total hip arthroplasty carries a higher risk of dislocation. **(13,16,17)**

Prognosis

A 6% internal mortality rate follows a femoral neck fracture. The risk is greatest in the first six months, with a mortality rate of 20–30% after one year. **(18)** In general, 22% of people with hip fractures will remain nonambulatory while 51% will resume independent ambulation. **(3)**

Complications (3)

- Avascular necrosis **(10)**
- Nonunion
- Dislocation increased with total hip arthroplasty surgery

Postoperative and Rehabilitation Care

Weight-bearing should begin as soon as tolerated for patients who have undergone a total hip arthroplasty or hemiarthroplasty. Deep venous thrombosis prophylaxis should begin during the perioperative period and be continued for 4 to 6 weeks postoperatively. Immediately following surgery, physical therapy should be started. **(3)**

Intertrochanteric Femur Fracture

Extracapsular fractures of the proximal femur occuring between the greater and lesser trochanters. **(19)**

Etiology

These fractures can happen to both young and old people but commonly to elder females due to osteoporosis. Additionally, these patients tend to be older than those who experience femoral neck fractures. **(20)**

Pathophysiology

These fractures typically result from a ground-level fall in the elderly population. Determining stability is crucial because it aids in identifying the kind of fixation needed for stability. Once reduced, compressive loads will not be applied to stable fractures because they still have their posteromedial cortex. A thin lateral wall, a displaced lesser trochanter fracture, subtrochanteric extension, and reverse obliquity fractures are examples of unstable fractures. Based on displacement, the number of fragments, and the type of fragments that are displaced, the intertrochanteric femur fractures are classified according to Evans. **(19)**

Table (4): Evans classification. **(21)**

Type I: Fracture line extends upwards and outwards from the lesser trochanter (stable). Type I fractures can be further subdivided as: - Type IA: un-displaced two-fragment fracture. - Type IB: Displaced two-fragment fracture. - Type IC: Three-fragment fracture without posterolateral support, owing to displacement of greater trochanter fragment -Type ID: Three-fragment fracture without medial support, owing to displaced lesser trochanter or femoral arch fragment. - Type IE: Four-fragment fracture without postero-lateral and medial Support Type II: Fracture line extends downwards and outwards from the lesser trochanter. These fractures are unstable and have a

tendency to drift medially.

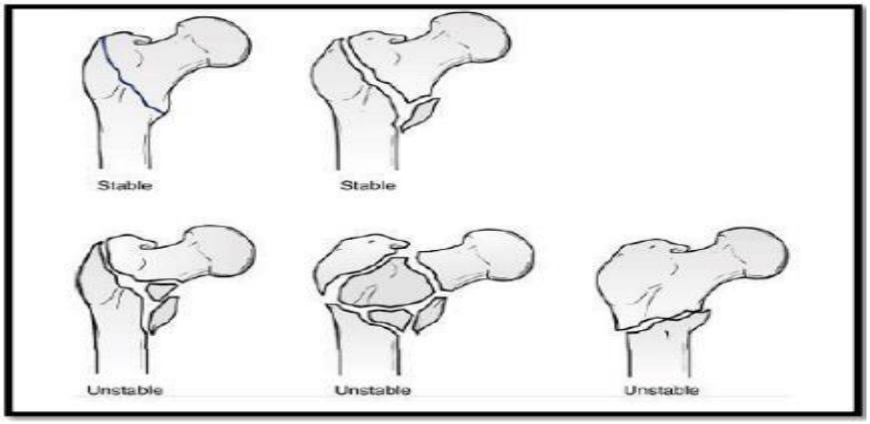


Fig. (3): The Evans classification of intertrochanteric fractures. **(21)**

History and physical Exam:

Usually, the lower extremity of these patients is short and rotated externally. Evaluation of the skin (open versus closed fracture) and neurovascular status are crucial. Usually, pain makes it impossible to evaluate a range of motion. To identify abnormalities that might need time to correct before surgical stabilisation, basic lab studies like complete blood count, comprehensive metabolic panel, and coagulation studies should be obtained. To medically optimise surgical candidates for operative repair, early involvement of an interprofessional team including anaesthesia and internal medicine or geriatrics is ideal. **(19)**

Evaluation

Anteroposterior (AP) pelvis, the AP and cross-table lateral of the affected hip, and full-length radiographs of the affected femur are among the advised views of the plain radiographs. To check for femur shaft deformities that might affect the placement of an intramedullary nail and to assess any prior implants in the distal femur, full-length radiographs of the femur are helpful. If there is a single greater trochanteric femur fracture and intertrochanteric extension is a concern, an MRI is advised. Additionally, a doctor-assisted AP traction view of the injured hip can be useful in determining the fracture morphology and whether closed reduction techniques are possible or necessary. **(22,23)**

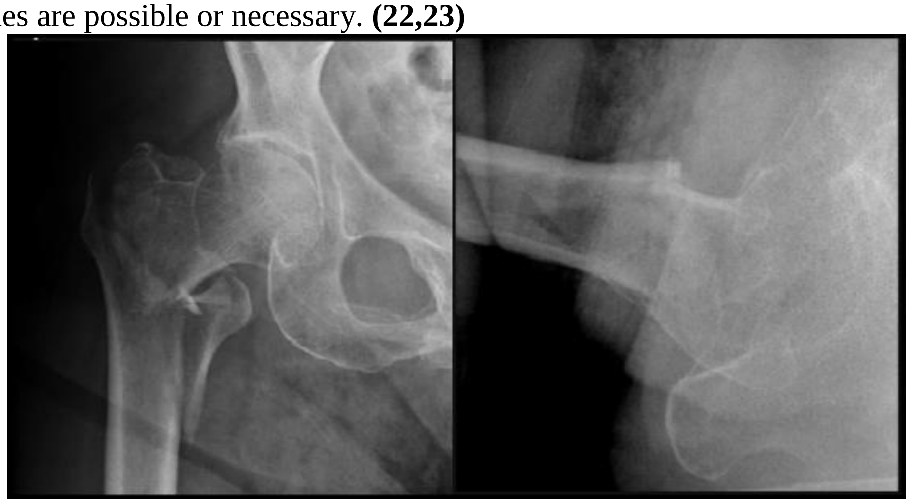


Fig. (4): x-ray of intertrochanteric fracture AP and lateral. **(24)**

Fig. (5): CT of intertrochanteric fracture. **(24)**

Fig. (6): MRI of intertrochanteric fracture was transverse linear hypointensity with adjacent bone marrow edema of the inferomedial femoral neck (black arrow), consistent with a compression fracture. Tension fractures are high-risk fractures and typically require fixation to heal. Compression fractures are low-risk fractures that generally heal well with rest. **(24)**

Treatment / Management

Nonoperative treatment is infrequently indicated and should only be indicated in patients with high risk of morbidity and mortality if surgical intervention was to be applied. Its complications range from non-union to death by pneumonia or thromboembolism. **(25)**

According to the pattern of fracture, the implant will be chosen. Unstable fracture patterns that call for intramedullary nailing include fractures with comminution of the posteromedial cortex, a thin lateral wall, displaced lesser trochanter fractures, subtrochanteric extension of the fracture, and reverse obliquity fractures. **(19)**

The use of the sliding hip screw is indicated in fracture patterns that are stable and have an intact lateral wall. When applied to the proper fracture pattern, this treatment provides results that are comparable to intramedullary nailing. The dynamic hip screw has two benefits over intramedullary devices: it allows for dynamic interfragmentary compression and is less expensive. The open technique and increased blood loss are the main drawbacks. The lateral wall's lack of integrity or the screw's placement—which should be done at a tip apex distance of less than 25 millimeters—can both contribute to implant failure. **(19)**

Although there is no evidence that an intramedullary hip screw is superior to a sliding hip screw for treating stable fracture patterns, young surgeons are using it more and more frequently. In these fractures, there is some debate over whether to use short or long intramedullary implants. **(19)**

In most cases, arthroplasty is not recommended as the first line of treatment and is only used in cases of severely comminute fractures, patients with a history of degenerative arthritis, internal fixation salvage, and osteoporotic bone that is unlikely to support internal fixation. **(19)**

Complications

Males tend to have a higher mortality rate than females in the first year following fracture ranging from 20% to 30%. Cardiopulmonary, thromboembolic events, and sepsis are the most frequent complications seen in patients receiving nonoperative treatment. **(26)**

Operative complications include blood loss, anaemia, infection, non-union, and collapse. In most cases, the cephalomedullary screw was placed at a tip apex distance greater than 25 millimetres, which resulted in screw cutout, one of the more well-known complications of implant-related failure. In the young patient, a corrective osteotomy with open revision reduction and internal fixation is typically required, whereas in the elderly patient, this complication is typically treated by conversion to hip arthroplasty. The anterior perforation of the distal femur cortex is another well-known risk associated with the implantation of a long intramedullary device in the elderly population. The radius of curvature of the femur and the implant are not compatible, which is the cause of this. Less than 2% of unions do not operate as intended. **(19)**

Postoperative and Rehabilitation Care

Weight-bearing as tolerated, chemical venous thromboembolism prophylaxis for up to 6 weeks, and progressive physical therapy beginning right away after surgery make up the postoperative protocol. **(19)**

Dynamic hip screw (DHS)

Due to controlled impaction and stable contact between the fragments, dynamic screw fixation has consistently produced positive results. The sliding devices have become widely used as the fixation method for everyone. Although DHS has a long clinical history of successful outcomes and the benefits of a straightforward, predictable surgical technique, it is associated with a high rate of complications in osteoporotic trochanteric fractures, including varus collapse and cutting out of the lag screw through the superior aspect of the femoral neck. **(27)**

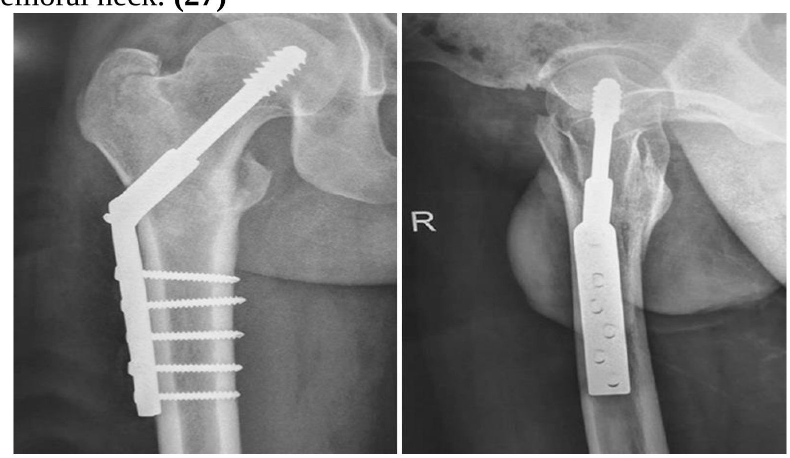


Fig. (7): Plain radiograph showing anterior and posterior lateral views of right hip showing the trochanteric fracture after 3 months postoperatively of fixation by DHS. DHS, dynamic hip screw. **(28)**

Surgical technique:

Surgical safety measures that must be followed in DHS: (29,30)

1. Surgery was done on traction table.
2. Verify that the fracture table post is not pressing against the labia or scrotum. Obtain near anatomic reduction in both lateral and anteroposterior views.
3. For fracture union, satisfactory reduction is essential.
4. To insert the guide pin, use 135° angle guides.
5. Insert the femoral head screw in the dead centre.
6. Check the tip-to-apex distance.
7. Make use of a standard (long-barrel) plate and a 32mm screw.

8. During surgery, apply static pressure to the fracture.

Advantages: (81)

1. Stable intertrochanteric fracture fixation.
2. Cheaper implant in relation to advanced implants like Gamma nail.
3. Requires less experience from the surgeon to apply.
4. Better hip activity and function
5. Early patient mobility and weight bearing were improved at 1 and 3 months after surgery.

Disadvantages: (31,32)

Although sliding hip screw constructs have theoretical and biomechanical benefits, they are not without drawbacks. Failure occurs when there is a lot of collapse.

1. Fixation failure is more common when there is sliding of more than 15 mm. The main cause of fixation failure was excessive sliding.
2. Fixation failure is seven times more likely when the femoral shaft is medialized by more than one-third of the femur's diameter.
3. Incorrect implant placement and severely osteoporotic bone may result in implant cutout.
4. The D.H.S. failure rate is around 5%.

Pitfalls in using DHS (29)

1. There is an excessive or insufficient amount of sliding length between the screw and barrel.
2. The screw being forced into the low angle barrel plate and becoming stuck. (Angle 120 or 125).
3. The majority of failures are caused by incorrect screw placement.

TAD > 25 mm, and the screw is not centred in the head.

4. D.H.S. results in reverse oblique fracture are poor.

Advantages of central placement of the implant (33,34)

1. By positioning the lag screw in the middle, you can avoid the potential complications that could arise from a peripherally placed screw, which could appear to be partially outside the femoral head in tangential view even though it would appear to be inside the femoral head on AP and lateral views during surgery.
2. Central placement hinders joint penetration.
3. The strongest part of the bone, the trabeculae, are crossed by a centrally located screw. Consequently, the purchase is better.
4. More threads can be engaged in the strongest part of bone in the femoral head if the centrally located screw's length can be increased.

Complications of DHS

Numerous DHS complications can occur during or after surgery. 1. Intraoperative complications: inadequate fracture reduction, K-wire breakage, improper technique, and fracture of the distal fragment of the fracture are among the intraoperative complications.

2. Postoperative complications: haemorrhage, infection, screw cut-out, avascular necrosis, screw breakage, pseudoarthrosis, and incorrect placement of the side plate. When inserting DHS, proper training and close attention to detail will assist in reducing or even eliminate some of these complications. **(35)**

According to studies on intertrochanteric fractures treated with DHS,

68% of patients experienced only minor fracture collapse, 24% experienced moderate collapse, and 8% experienced severe collapse. They also noticed that osteoporosis and fracture instability were linked to 80% of the moderate and severe collapse categories. **(36)**

Proximal Femoral Nail System

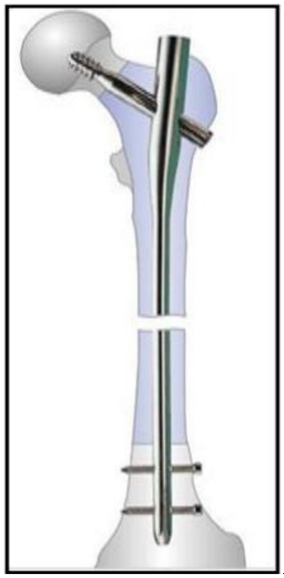
Based on more than 20 years of Gamma Nail experience, the Gamma III Locking Intramedullary Nail System was developed**.** The larger-diameter lag screw has been replaced with a 6.5 mm superior and an 11 mm inferior screw in the proximal femoral nail (PFN) (Synthes, Paoli, PA)**.** When positioned close to the femoral head's subchondral bone, the superior screws with a smaller diameter have been known to fracture. It experiences significant varus stresses in this position that are not experienced by the larger inferior screw. It is debatable whether two smaller screws perform better than one larger lag screw in a cephalomedullary construct. A large-diameter lag screw (IMHS) and two small-diameter lag screws were compared in a recent biomechanical cadaver study using an unstable intertrochanteric fracture model. Regarding femoral head displacement or screw sliding under cyclical loading, there was no difference found between the two constructs. The two-screw device was however, better in load to failure testing. The two-lag screw construct has been demonstrated to exhibit a specific failure pattern in vivo known as the "Z effect" despite positive biomechanical testing results. Short nails used in fracture patterns that are unstable frequently lead to this failure. The Z-effect happens when one screw enters the joint and the other backs out of the nail. This phenomenon is thought to be secondary to the two lag screws' different tension and compression forces. **(37)**

Fig. (8): short trochanteric nail. **(37)**

The trochanteric fixation nail (TFN) is a cephalomedullary nail in which the lag screw has been swapped out for a helical blade (Synthes, Paoli, PA). This blade is designed to slide inside the proximal portion of the femoral nail. The improved rotational control of the head and neck fragment and improved resistance to varus collapse are the theoretical benefits of this blade. It has been demonstrated that the 11.0 mm-diameter helical blade removes less bone from the femoral head than a traditional lag screw. There are long and short versions of this nail with 125-, 130-, and 135-degree femoral neck angles. The nail has a 6-degree valgus inclination to make it easier to insert through the greater trochanter, and it is 17 mm long at its proximal end to accommodate the helical blade. **(39)**

Fig. (9): Photograph of the short trochanteric fixation nail (TFN). **(39)**

Following a step-by-step improvement process based on clinical experience and results, the successful Trochanteric and Long Gamma intramedullary Nails as well as the small stature versions were developed.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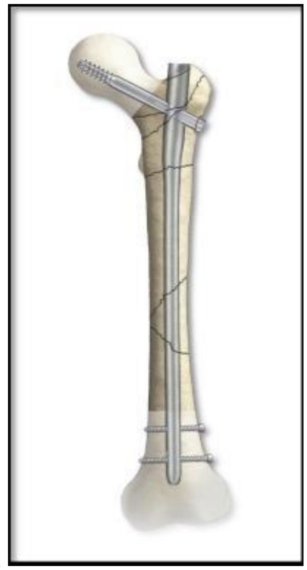
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Fig. (10): Showing A; Gamma nail, B; gamma nail III design. **(40)**

Components Of Proximal Femoral Nail (GAMMA NAIL III) **(41)**

- Gamma III Locking Nails are available with neck-shaft angles of 120, 125, and 130 degrees.
- In the following, these Gamma III Nails are called: Long Nail.
- Every nail uses the same Lag Screws, Set Screws, distal Locking Screws, and End Caps.

Gamma III Nail Long

This nail includes a number of crucial mechanical design elements. Unslotted and cannulated, the nail is ready for Guide Wire-controlled insertion. The Long Nail is available in both a left and right version to make it easier to conform to human anatomy. **(40)**

Variations in femoral neck anatomy are accommodated by the three neck-shaft angles. The Long Nail provides the option to control rotation and telescoping with two distal Locking Screws that are inserted through the distal nail end. According to the fracture pattern, the nail can result in either static, dynamic, or secondary dynamic distal locking. **(40)**

Technical Specifications: (40)

Material: Titanium alloy with type II anodized surface finishing.

Nail length: 20mm increments from 260mm to 480mm; shorter or longer nails are available upon request.

Nail diameter:

Proximal: 15.5mm,

Distal: R1.5: 10mm, 11mm, 13mm, 15mm R2.0: 11mm, 13mm,
15mm

Proximal Nail angle range: 120°, 125°, 130°

M-L bend for valgus curvature: 4 degrees

Proximal anterversion of 10°

End Caps: 0mm, +5mm and +10mm

Antecurvature radius R1.5m and R2.0m of the shaft Distal locking holes (round and oblong) for 5mm screws; up to 5mm dynamization is possible.

Long Nail Distal Locking Options (40)

- One screw is all that is needed to lock in the distal portion of the oblong hole, creating a dynamic locking mechanism.
- Place one screw in the round hole and the other in the distal portion of the oblong hole. The screw that was inserted into the round hole must be removed if dynamization is needed later and two screws are needed.

- Two screws are needed, one in the round hole and the other in the proximal part of the oblong hole.

Design of GAMMA NAIL III

Lag Screw and Set Screw Function

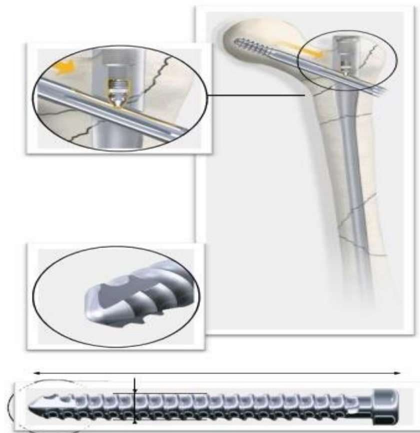


Fig. (11): Technical Specifications of Gamma nail III. **(40)**

Diameter of Lag Screw: 10.5mm

Lengths of lag screws: 70-130mm in increments of 5mm

Design of the lag screw for highload absorption and simple insertion

Asymmetrical depth profile to only permit lateral movement of the lag screw.

Retaining itself Set Screw to prevent rotation of the lag screw while simultaneously allowing lateral movement of the lag screw. **(40)**

Distal Locking Screws

Length Definition of the Distal Locking Screw the Distal Locking Screw is measured from head to tip. Dimensions are nominal.

Technical Specifications

Diameter of Distal Locking Screw: 5mm.

Length of Distal Locking Screw ranging from 25−50mm, in 2.5 and 5mm increments. Longer screws up to 120mm are available on request.

Fully threaded screw design. Partially treaded screws are available on request. **(40)**

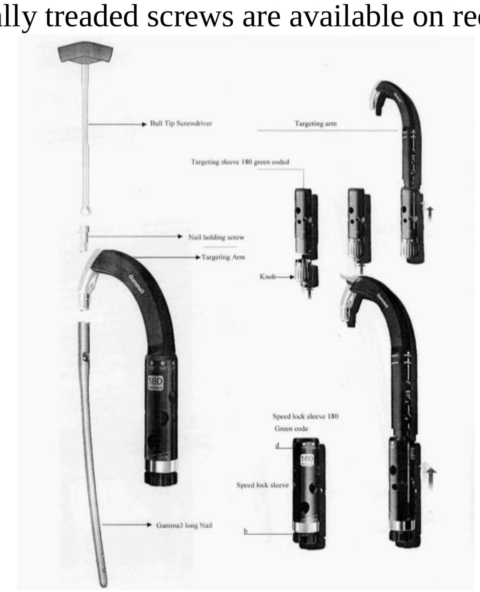
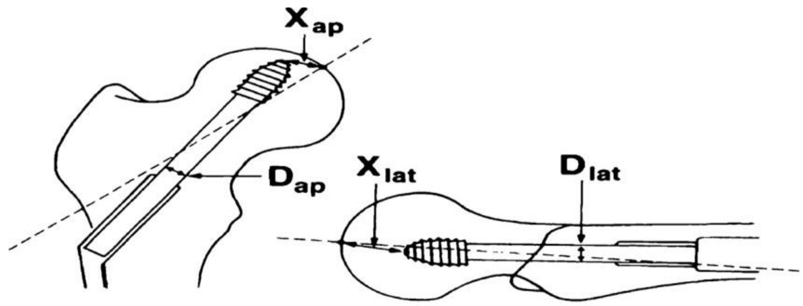


Fig. (12): Gamma III nail design &components with insertion device. **(40)**

Tip apex distance



$$TAD = \left(X_{ap} \times \frac{D_{true}}{D_{ap}}\right) + \left(X_{lat} \times \frac{D_{true}}{D_{lat}}\right)$$

Fig. (13): Illustration of tip-apex distance (TAD) with its corresponding equation for correcting radiographic magnification. X ap and X lat refer to the measured distance as illustrated on the anteroposterior and lateral X-rays, respectively. D true refers to the actual diameter of the lag screw; whereas, D ap and D lat refer to the measured diameter of the lag screw as illustrated on the anteroposterior and lateral X-rays. Hip fractures come with a high risk of morbidity, mortality, and extra cost. Lag screw cut-out is one of many potential causes for implant-based hip fracture fixation system failure. It has been demonstrated that the tip apex distance (TAD), which reveals the location and depth of a screw in the femoral head, is related to cut-out failure. **(41)**

The most common explanation for mechanical failure following screw implantation is the lag screw's femoral head being cut out. The screw can be positioned precisely in the femoral head to prevent cut-out failures. Calculating the tip-apex distance (TAD) on anteroposterior and lateral radiographs is one technique used to aid in accurate measurement of screw
position. **(42)**

The tip to apex distance, which should be less than 25 mm, has been described as a guide for precise screw placement. Cutout risk can be quickly and easily assessed during surgery. If TAD 25mm, the risk of fixation failure almost disappears. As the screw is positioned shallower and more peripherally, risk rises quickly. **(43,44)**

After magnification has been corrected, the distance in millimetres between the lag screw's tip and the apex of the femoral head as measured on anteroposterior and lateral radiographs is added together to determine the tip apex distance. **(43)**

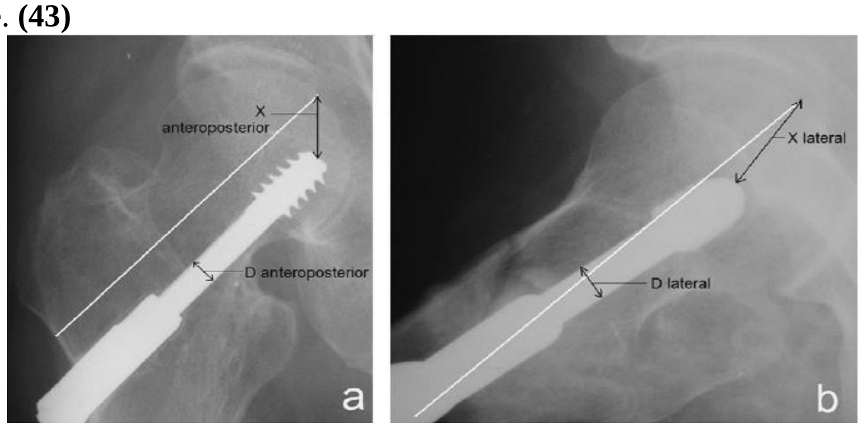


Fig. (14): Measurement of the distance between the tip of the lag screw to the apex of the femoral head (X) and the diameter of the lag screw (D) on the (a) anteroposterior and (b) lateral radiographs. (Tip-apex index = X anteroposterior x [True diameter / D anteroposterior] + X lateral x [True diameter / D lateral]). **(45)**

The radiographic magnification is calculated by dividing the known diameter of the screw's projected shaft by a diameter on the radiograph, and the correction is calculated by multiplying the distance measurement by this factor. As end points, the radiographs will evaluate screw cut out, nonunion, and union. **(43)**

The barrel plate angle is determined from the normal side. The most frequently used ideal angle is 135 degrees. There doesn't seem to be any proof that another angle is better. A higher angled blade plate (140 degree) may be necessary if the screw is accidently placed in the upper half of the head. The barrel and plate are less than 135 degrees, typically 130 degrees, if the screw is positioned in the lower half of the head. (97)

Anatomical reduction and locating the implant centrally within the femoral head both help to reduce the mechanical failure rate of the fixation. More on the surgeon's technical skill than the patient's bone quality determines whether fixation will be successful. **(46)**

An excellent blood supply is provided by the cancellous bone, which experiences intertrochanteric fractures. Even if the varus deformity is not treated, the fracture quickly unites. This causes a limp, short leg gait, pain, and potential osteoarthrosis. **(47)**

Most often, severely osteoporotic bones have poor implant holding capacity, which can lead to implant failure from bending, breaking, pulling out of screws, and breaking of screw heads. **(35)**

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