ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 9| Issue: 3| March 2023|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2023: 8.224 || ISI Value: 1.188

# INTERTROCHANTERIC FEMUR FRACTURE

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**Article DOI: https://doi.org/10.36713/epra12573**
**DOI No: 10.36713/epra12573**

## SUMMARY

***Introduction:*** *Intertrochanteric fractures are a type of extracapsular fractures of the proximal femur occurring between the greater and lesser trochanter. They are frequently seen in the elderly because their incidence is higher as life expectancy increases.*
***Objective****: to describe the current information related to epidemiology, anatomy, presentation, classification, evaluation and management of intertrochanteric fractures.*
***Methodology:*** *a total of 35 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 27 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: transtrochanteric, intertrochanteric, femur, fracture, fratura.*
***Results:*** *Intertrochanteric fractures have a bimodal presentation. They have a female to male ratio ranging from 2:1 to 8:1, possibly due to changes in bone metabolism after menopause. They are frequently seen in the elderly because their incidence is higher as life expectancy increases. Plain radiographs are still the initial choice to complement the diagnosis in this type of fractures. It is preferable to take anteroposterior (AP), AP and lateral cross pelvis projections of the affected hip and full body radiographs of the affected femur. Surgical treatment is preferred over conservative treatment except in cases that contraindicate surgery or anesthesia.*
*Conclusions: Intertrochanteric fractures are a type of extracapsular fractures of the proximal femur occurring between the greater and lesser trochanter. Femur fractures have several classifications, recently the classification of intertrochanteric fractures is based on the stability of this area. It is of vital importance to evaluate whether it is an open or closed fracture, in addition to assessing the neurovascular status. The surgical treatment has the mission of providing a stable internal fixation that allows early mobilization and full weight bearing. There are several tools and techniques to provide surgical treatment, however, in our current reality, intramedullary nails are the most used devices in the treatment of intertrochanteric fractures. Regardless of the therapeutic alternative chosen, the mortality risk is 20% to 30% in the first year after the fracture, with males being more affected than females.*

**KEY WORDS:** *transtrochanteric, intertrochanteric, femur, fracture.*

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## INTRODUCTION

Intertrochanteric fractures are a type of extracapsular fractures of the proximal femur occurring between the greater and lesser trochanter. They are frequently seen in the elderly because their incidence is higher as life expectancy increases. They are also called transtrochanteric fractures and represent 50% of all fractures in the proximal femur(1,2).

The intertrochanteric aspect of the femur lies between the greater and lesser trochanters and consists of dense trabecular bone. The lesser trochanter functions as an insertion site for the iliacus and psoas major. The greater trochanter functions as the site of origin of the vastus lateralis and insertion site for the obturator internus, piriformis, gluteus medius, gluteus minimus muscles. The vertical wall of dense bone extending from the posteromedial aspect of the femoral diaphysis to the posterior portion of the femoral neck is known as the femoral calcar, which is crucial in determining the stability of a fracture. Reduction and fixation with a proximal femoral nail is the treatment of choice; however, the osteosynthesis defect produces an increase in mortality and morbidity, mainly in the elderly(1-3).

**Figure 1. Simple anteroposterior radiograph showing the presence of an intertrochanteric fracture classified by Tronzo type III in the proximal portion of the right femur.**

**Source:** The Authors.

## METHODOLOGY

A total of 35 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 27 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: transtrochanteric, intertrochanteric, femur, fracture, fratura.

The choice of bibliography exposes elements related to femur fractures; in addition to this factor, epidemiology, anatomy, presentation, classification, evaluation and management of intertrochanteric fractures are presented.

## DEVELOPMENT

Some bibliographies report that intertrochanteric fractures, also known as transtrochanteric fractures, represent almost 50% of all fractures in the proximal femur. The average age of affected individuals is 66 to 76 years, being a relatively younger age than those who suffer fractures of the femoral neck. The ratio between women and men ranges from 2:1 to 8:1, possibly due to changes in bone metabolism after menopause(4,5).

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Among the elements mostly related to intertrochanteric fractures compared to femoral neck fractures are:
Greater number of associated diseases.
Advanced age.
History of other fractures related to osteoporosis.
Greater dependence on activities of daily living and frailty(2,4).

**Figure 2. Fractures in the proximal femoral region. Right with the presence of a gamma intramedullary nail.**


**Source:** The Authors.

Intertrochanteric fractures are generated between the greater and lesser trochanters in the proximal section of the femur, although sometimes they tend to be directed towards the subtrochanteric part. They are extracapsular fractures, have a rich vascular supply in addition to having cancellous bone, so they have less risk of osteonecrosis or pseudarthrosis, compared to femoral neck fractures. The contiguous musculature generally generates external rotation, shortening and varus at the fracture site. The abductor muscles tend to translate the greater trochanter laterally and proximally. The iliopsoas moves the lesser trochanter medially and proximally. The hip flexors, adductors and extensors direct the distal fragment in a proximal direction. One of the determining factors for fracture stability is the presence of bone contact in the posteromedial region, which acts as a buttress, making fracture collapse impossible(2,4).

Intertrochanteric fractures have a bimodal form of presentation, within which it is observed that in young individuals they are frequently caused by high energy blows, traffic accidents, bicycle falls at high speeds or falls from a height. In the antipodal age group of young people, 90% of intertrochanteric fractures are caused by a simple fall. Most of these fractures are produced by a direct impact on the greater trochanter region (2-4,6).

It is very common for patients to leave a considerable time after the fracture to go to the health personnel, so the conditions they present are not the best; they usually spend time lying on the floor and without eating, so whoever attends the person should be aware of this circumstance, because they may find malnutrition, dehydration, venous thromboembolic disease, pressure ulcers and in some cases hemodynamic instability due to hemorrhage, since intertrochanteric fractures are caused by intertrochanteric fractures. It is of vital importance to evaluate whether it is an open or closed fracture, in addition to evaluating the neurovascular status. Another very important point is to have the necessary laboratory studies, such as complete blood count, comprehensive metabolic panel and coagulation studies to distinguish alterations and fix them before surgery(2-4).

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Simple radiographs are still the first choice to complement the diagnosis in this type of fractures, it is preferable to take anteroposterior (AP), AP and lateral cross pelvis projections of the affected hip and full body radiographs of the affected femur. In addition, sometimes an assisted internal rotation projection of the injured hip may be useful to clarify the fracture pattern. Magnetic resonance imaging (MRI) is the imaging test of choice to determine occult or undisplaced fractures that are not easily visualized on plain radiographs. Scintigraphy or computed tomography are saved for those who have a contraindication to MRI(3,4,7,8).

**Figure 3. Different views of plain radiographs. Patient with intertrochanteric fracture treated surgically.**

**Source:** The Authors.

Femur fractures present several classifications, recently, the classification of intertrochanteric fractures is based on the stability of this area(9).

The Evans classification presents the following division:

Type I: the fracture line is directed upward and outward from the lesser trochanter. Presenting a two-part fracture.

Type II: fracture with inverted oblique line: the main line is directed downward and outward, from the lesser trochanter, with medial displacement of the distal fragment by the action of the adductors. Presenting 3-part fracture.

Type III: presenting 4-part fractures(3,10).

Tronzo classification for intertrochanteric fractures

Type I: Incomplete fracture, without displacement.

Type II: Complete fracture without displacement.

Type III: IIIA: Comminution of the greater trochanter. IIIB: Comminution of the lesser trochanter with telescoped proximal fragment. The shaft is displaced medially.

Type IV: Fracture with comminution of the posterior wall. The shaft is displaced laterally.

Type V: Fracture with inverted trace(10,11).

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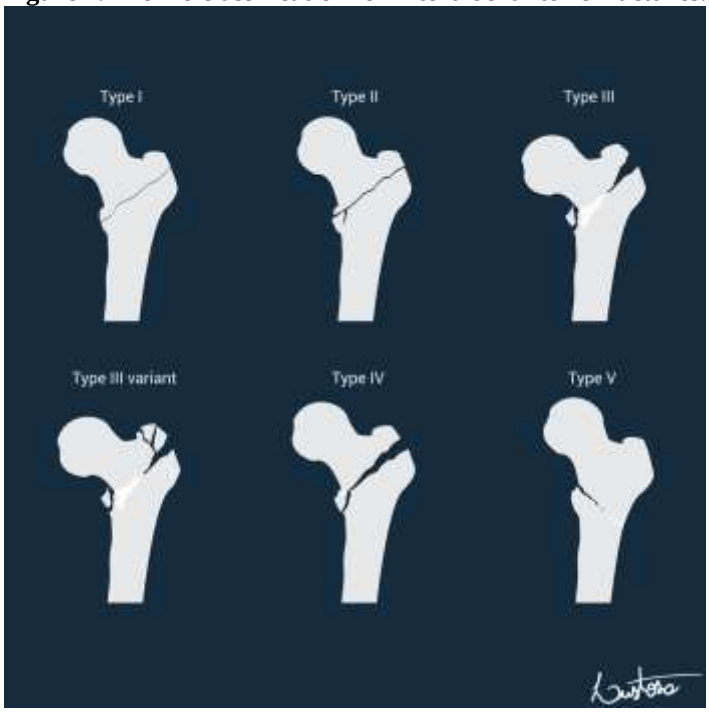
**Figure 4. Tronzo classification for intertrochanteric fractures.**




**Source:** Lustosa L. Tronzo classification of trochanteric fractures(11).

Classification of Boyd and Griffin this includes all fractures from the extracapsular part of the neck to a point 5 cm distal to the lesser trochanter, it is based on the involvement of the subtrochanteric region.
Type I: fracture along the intertrochanteric line from the greater to the lesser trochanter.
Type II: comminuted fracture, the main trace runs along the intertrochanteric line, but with several traces in the medial cortex.
Type III: subtrochanteric fracture, with at least one fracture going to the proximal femoral diaphysis, immediately distal or at the level of the lesser trochanter.
Type IV: fracture of the trochanteric region with irradiation to the femoral diaphysis(10,12,13).

There are unusual patterns within fractures of the proximal femur, such as basicervical fractures and inverted obliquity fractures. The former are located just below the intertrochanteric line or along it, being anatomically fractures of the femoral neck, considered extracapsular, act and are treated as intertrochanteric fractures. Basicervical fractures have a higher risk of osteonecrosis compared to intertrochanteric fractures. They also have a greater tendency to rotate at the time of insertion of the implants in the femoral head. On the other hand, fractures with inverted obliquity are unstable fractures that present an oblique fracture line extending from the medial cortex, proximally, to the lateral cortex, distally. The direction and location of the fracture trace gives a tendency to medial translation due to the traction of the adductor muscles, so these fractures should also be treated as subtrochanteric fractures(2,4).

In those patients with a risk factor that contraindicates surgery, conservative treatment is recommended. Conservative treatment can also be proposed for dementia patients without ambulation capacity and without or slight pain in the hip or in those who contraindicate the anesthesia used. Early mobilization from bed to chair is substantial to escape the high risk and complications of bed rest. In addition, conservative treatment can be considered for non-displaced fractures, with the justification that, unlike femoral neck fractures, secondary displacement does not modify the type of intervention or the results. In case of displacement, the consequent hip deformity is to be expected and understandable. Some authors show that conservative treatment in both intertrochanteric fractures and femoral head and neck fractures is associated with high morbidity and mortality rates, which is why it is currently out of use(4,14-17).
Surgical treatment is intended to provide stable internal fixation for early mobilization and full weight bearing. Bone quality, fracture reduction, fracture pattern, implant design, timing of surgery and implant placement are crucial factors for fracture fixation stability. It is recommended that surgery be performed in a timely manner as soon as the patient's clinical condition is stabilized. Surgical management of these fractures is considered urgent, not emergent(2-4).

Next we will describe some of the implants used for surgical treatment. The first one we will describe is the sliding screw hip

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plate implant, which over time has been widely used in both stable and unstable fractures. These plates can generally present different angles from 130° to 150°. Technically the sliding screw hip plates should be placed 1 cm from the subchondral bone to provide an accurate fixation, it should be centered on the femoral head with a reference called tip-apex distance which is the addition of the distance in millimeters between the tip of the cephalic screw and the apex of the femoral head in the anteroposterior and lateral projections; this allows to determine the position of the cephalic screw. The addition should be 25 mm to decrease the danger of proximal screw migration. Some biomechanical and clinical articles have shown no superiority between placing four or two screws to stabilize the lateral plate. From 4% to 12% of patients present loss of fixation, especially in unstable fractures. Posterior displacement, rotation defect and residual varus angulation should be corrected in the operative act. Technical mishaps in screw placement and/or incorrect impaction of the bone fragments at the moment of screw insertion are the main causes of fixation failure. At the moment of inspection, a greater shortening and more deformity can be noted when using this variety of implants in unstable fracture patterns(2,4,9).

The indications for the sliding hip screw include stable fracture patterns with an intact lateral wall since some studies show that when using them for the appropriate fracture pattern, they present results similar to those of the intramedullary nailing, however it presents some disadvantages such as increased blood loss and being an open technique, on the contrary it presents superiority in dynamic interfragmentary compression and presents relatively lower cost compared to intramedullary devices(3).

In our current reality, intramedullary nails are the most widely used devices in the treatment of intertrochanteric fractures. The endomedullary nail with sliding hip screw, also called cephalomedullary nail or gamma nail, combines the particularities of intramedullary nails and the hip plate with sliding screw, presenting some technical and mechanical superiorities. An example of this is that they can be inserted in a closed manner with less exposure of the fracture, reducing bleeding, tissue injury and fracture collapse compared to the screw-plate. Due to their intramedullary position, they also present a lower moment of forces. Some studies have shown that intramedullary nails do not offer advantages over the screw-plate in stable fracture patterns; however, cephalomedullary nails have been more effective in intertrochanteric fractures with subtrochanteric extension and in inverted oblique fractures. Early designs of these implants were associated with a risk of femoral fracture at the level of the nail tip or below the proximal locking screw insertion(2,18,18,19).

One study shows that when surgically reconstructing unstable intertrochanteric fractures with comminution of the lesser trochanter using the proximal intramedullary nailing method, the modified Candy packing wiring technique increases fixation strength at the fracture site(20).
A meta-analysis published in 2019 identified that the risk of secondary fracture, pseudarthrosis, infection and osteosynthesis failure was similar for long and short intramedullary nails. In addition, that study showed that the surgical time was longer for long nails due to the need for reaming and distal, hands-free nailing(1,21)

**Figure 5. Short gamma intramedullary nail as surgical treatment in left femur fracture.**

**Source:** The Authors.

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As for the use of prosthesis, it has been successfully used in those patients with failure of open reduction with internal fixation and undergoing a new attempt of reduction and internal fixation is not a good option. Depending on the fracture site, hemiarthroplasty with calcar replacement may be required. Primary prosthetic replacement in comminuted and unstable intertrochanteric fractures provides optimal results in up to 94% of cases. Among its disadvantages are the inconvenience of internal fixation when reinserting the trochanter, the morbidity related to major surgery and the risk of postoperative dislocation. Arthroplasty is not indicated as first line treatment and is intended for patients with severe comminuted fractures, patients with a history of degenerative arthritis, recovery of internal fixation and osteoporotic bone that is unlikely to maintain internal fixation(3,4).

External fixation is not frequently used in intertrochanteric fractures; however, there were experiences in these fractures where it was found to be related to postoperative complications, such as infection, loosening of the pins and collapse of the fracture in varus(4).

When using a screw-plate, the stabilization of the large displaced fragments of the trochanter by means of an obenchus or screws and a trochanteric plate should be taken into account. Basicervical fractures treated with a cephalomedullary nail or a screw-plate sometimes require additional anti-rotational screws or nails. Inverted oblique fractures do better when treated as subtrochanteric fractures with a 95° fixed angle nail-plate or an intramedullary device. In high-impact trauma, the possibility of an ipsilateral fracture of the femoral diaphysis should be ruled out(2,4).

**Figure 6. Short gamma intramedullary nail in the introducer guide.**

**Source:** The Authors.

Regardless of the therapeutic alternative chosen, the risk of mortality is 20% to 30% in the first year after the fracture, with males being more affected than females. In those patients managed conservatively, cardiopulmonary and thromboembolic situations and sepsis are the most frequent complications(3,22).

Loss of fixation is usually the consequence of varus collapse of the proximal fragment with pullout of the cephalic screw from the femoral head; it occurs in up to 20% in unstable fracture

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patterns. Avulsion of the cephalic screw occurs mainly within 3 months after surgery, being its main causes:
Eccentric placement of the screw within the femoral head.
Inability to obtain a stable reduction.
Inadequate drilling that forms a second tunnel in the femoral neck.
Inadequate fit between the screw and its base, which does not allow sliding.
Excessive collapse of the fracture, so that the limit of sliding of the implant is exceeded.
Significant osteopenia that does not allow adequate fixation.

Faced with this circumstance, one can choose to accept the deformity, revise the internal fixation as it may require methylmethacrylate or convert the synthesis into a prosthetic replacement.

Pseudarthrosis is infrequent, around 2%, especially in those who present unstable fractures. It usually presents with persistent hip pain and radiographs with a persistent radiolucent line at the fracture site 4 to 7 months after fixation. When good bone stock is present, it is likely to use a new internal fixation with a valgus osteotomy and bone graft. In older patients, conversion to a prosthesis with calcar replacement is preferred.
The rotational deformity usually occurs thanks to an internal rotation of the distal fragment in the act of internal fixation. If it is severe and modifies ambulation, revision surgery is considered to remove the plate and perform a de-rotatory osteotomy of the femoral diaphysis. When using a long intramedullary nail, the distal end of the nail may penetrate the anterior cortex of the femur because of a mismatch between the curvature of the nail and that of the femur. The Z-effect is most often seen when using cephalomedullary nails with two screws, usually appearing when the more proximal screw is driven into the joint and the distal screw is driven distally.

Other more infrequent complications are osteonecrosis of the femoral head, dissociation of the implant and traumatic laceration of the superficial femoral artery by a displaced fragment of the lesser trochanter(2,4).

The occurrence of intraoperative complications is directly related to the proper surgical technique, so standardized protocols should be followed correctly to reduce their presence(23).

Timely surgical intervention is recommended to reduce the probability of hypostatic pneumonia, pressure ulcers or other complications due to long-term prostration(24-26).

In rehabilitation, early mobilization of the patient with weight bearing is pertinent according to their tolerance to ambulation. The postoperative protocol is based on weight bearing according to tolerance, chemical deep vein thrombosis prophylaxis for up to 6 weeks and gradual physiotherapy(3,27).

Isolated fractures of the greater trochanter are usually the result of eccentric muscle contraction or direct trauma. Conservative treatment may be used in older patients or surgical treatment in young, active patients who demonstrate extensive displacement of the trochanter, with preference given to open reduction with internal fixation of the displaced fragment by means of an obenchus and reinsertion of the abductor musculature, as well as plate and screw fixation with a "hooked plate". Isolated fractures of the lesser trochanter occur more in adolescents, due to a sudden contraction of the iliopsoas, on the other hand, in older people these are pathognomonic of pathological lesions of the proximal femur(2,4).

## CONCLUSIONS

Intertrochanteric fractures are a type of extracapsular fractures of the proximal femur occurring between the greater and lesser trochanter. They are frequently seen in the elderly because their incidence is higher as life expectancy increases. Intertrochanteric fractures have a bimodal presentation. They have a female to male ratio ranging from 2:1 to 8:1, possibly due to changes in bone metabolism after menopause. Femur fractures have several classifications, recently the classification of intertrochanteric fractures is based on the stability of this area. It is of vital importance to evaluate whether it is an open or closed fracture, in addition to assessing the neurovascular status. Plain radiographs continue to be the initial choice to complement the diagnosis in this type of fracture, it is preferable to take anteroposterior (AP), AP and lateral cross pelvis projections of the affected hip and full body radiographs of the affected femur. Surgical treatment is preferred over conservative treatment except in cases that contraindicate surgery or anesthesia. Surgical treatment is intended to provide a stable internal fixation that allows early mobilization and full weight bearing. There are several tools and techniques to provide surgical treatment, however, in our current reality, intramedullary nails are the most used devices in the treatment of intertrochanteric fractures. Regardless of the therapeutic alternative chosen, the mortality risk is 20% to 30% in the first year after the fracture, with males being more affected than females.

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**Conflict of interest statement**
The authors report no conflicts of interest.

**Funding**
The authors report no funding by any organization or company.