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Review article

Ipsilateral femoral neck and shaft fractures: review of the literature.

Ortega-Yago, A 1*, Balfagon-Ferrer, A 2 , Alonso-Caravaca, A3 , Castillo-Soriano, MA4,, De Pedro-Abascal, M5

1 * Correspondence: ortegayago94@gmail.com
1,2,3 Department of Orthopedic Surgery and Traumatology, The University and Polytechnic la Fe Hospital of Valencia.

Abstract: Fractures of the neck and ipsilateral femoral shaft are rare fractures, which are associated with young patients after a high-energy mechanism. These types of fractures pose a challenge when it comes to diagnosis, since up to 20% of femoral neck fractures can go unnoticed. Correct surgical planning after an accurate diagnosis allows optimal treatment of fractures, as well as a decrease in the rate of complications arising from them. Currently, with the advancement of implants, there are multiple surgical options to treat these fractures, and that allows individualizing the treatment depending on the patient and the type of fracture they have. This review aims to synthesize the concepts about the diagnosis and surgical management of ipsilateral femoral neck and shaft fractures.

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1.Introduction

Ipsilateral femoral neck and shaft fractures are rare fractures (2-6%). The average age is approximately 35 years, and more than half of the cases occur in men. These fractures are produced by a high energy mechanism, in which there is a high energy impact on the knee. Subsequently, the energy enters through the knee creating an axial force through the shaft until it reaches the femoral neck. [1,2]. Many times it occurs because the lower limb is abducted, unlike when it is adducted, which tends to produce posterior hip dislocation [3].

The femoral neck fractures most frequently associated with ipsilateral shaft fractures are subcapital (Figure 1) or non-displaced basicervical fractures.
and vertical neck fractures (Pauwels type 3).

On many occasions there is contamination in the femoral diaphysis. Furthermore, these fractures They are associated with ipsilateral knee injuries (20-40%), including tibial plateau fractures, ligament complex injuries, patella fracture, or knee dislocation. [4,5]

Figure 1: subcapital and diaphyseal fracture of the left femur

2. Diagnosis

Diagnosis is usually late and is a challenge for the traumatologist, since it can go unnoticed on many occasions. Among these reasons, there is the femur, which tends to external rotation. Other added factors are the lack of radiographs, their poor quality, little femoral displacement of the neck, and difficult exploration in unstable patients. Up to 20% of these fractures may go completely undetected [3].

To prevent this from happening, we must obtain an anteroposterior X-ray of the pelvis, as well as an axial X-ray of the hip and a lateral X-ray of the femoral diaphysis. Regarding the use of CT, a test that is increasingly used in our environment for surgical planning and fracture diagnosis, it has been observed to be very useful for refining the diagnosis and discovering hidden fractures.

Yang et al observed that 76% of the fractures that were not detected by radiographs were diagnosed thanks to CT. [6]. As the use of CT became more widespread and the slices decreased in millimeter thickness, the diagnosis has become more precise, reaching up to 82% of diagnostic accuracy [7].

There are currently some imaging diagnostic protocols, among which are internally rotated X-rays, CT, pre-surgical fluoroscopic controls, prior to diaphysis fixation and after its fixation, as well as post-intervention X-rays. . With this protocol, the probability of a hidden fracture going unnoticed is reduced by 90%

3. When to intervene on the patient?

There are recommendations to decide when is the ideal time to intervene on the patient. Normally it is recommended that it be urgent, as soon as the patient is stable, since it allows femoral vascularization to be recovered as soon as possible. Even so, there is no consensus on when to perform surgery, since these fractures are rare, fracture patterns are different depending on the patients, there is great variability of treatments, and the cohorts are small [3].

4. Surgical treatment In

surgical treatment there are two main objectives of performing surgery: anatomical reduction of the femoral head, and reduction of the diaphysis to correct length, alignment and rotation.

Many authors agree that the femoral head has preference over the treatment of the diaphysis. First, because the complications of the femoral head are greater than those of the shaft (avascular necrosis, non-union), and second, because if the femoral shaft is reduced first, femoral head reduction is more complicated than if it is performed secondarily. inverse [4,5]. If a closed reduction of the femoral head cannot be performed, open reduction is indicated to achieve the most anatomical reduction possible.

Regarding the osteosynthesis options available for these fractures, we have the single implant and the combination of two implants.

With respect to an implant, the reduction tends to be more complex. The use of a single implant is preferable if the neck is minimally displaced (Figure 2).

As for the combination of two implants, neck reduction tends to be somewhat easier, and is preferred when the femoral neck is displaced.

Single implant options include the cephalomedullary nail (reconstruction nail) and the long DHS. The LCP is not prepared to fix the femoral neck due to its inability to perform compression. In some studies it has been observed that medullary nailing has a higher rate of non-union with respect to the combination of two implants [9].

Figure 2: Reconstruction nail, one implant.

Regarding the use of two implants, there are three options:

- Antegrade nail + cannulated: there is less space to work on head reduction (Figures 3 and 4).

- Retrograde nail + DHS/ cannulated: more work to reduce the femoral neck (Figure 5)

- Compression plate / MIPO + DHS/ cannulated

Figure 3 and 4: Antegrade nail together with cannulated screws.

Figure 5: Retrograde nail together with DHS

For the femoral neck combined with antegrade or retrograde nailing, different options can be used: [9, 10, 11]

- Femoral Nail system: it is an option when there are subcapital fractures. Contraindicated its use in intertrochanteric or pertrochanteric.

- Cannulated screws: for subcapital fractures

- DHS: for pertrochanteric, intertrochanteric or basicervical fractures.

- DHS + cannulated: In the case of type 3 Pauwels, both the DHS and the cannulated can be used in combination due to the vertical pattern they present, and because the DHS in isolation has difficulty withstanding the rotational forces in this pattern of fractures . [12]

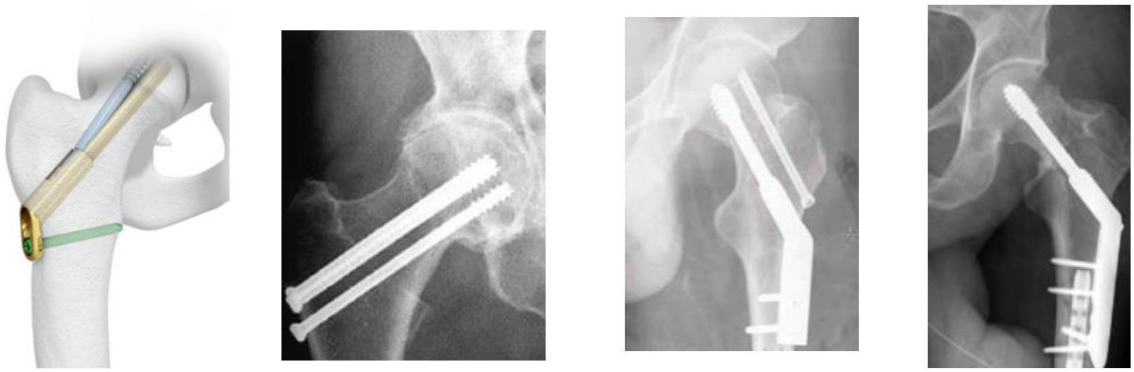

Figure 4: Different options for fixing the femoral neck: femoral nail system (A), cannulated screws (B), DHS (C) and DHS together with cannulation (D).

There are no significant differences between the DHS and cannulated screws in terms of increased probability of non-union, nor in the subsequent functionality of the patient. [10]

Current recommendations recommend drilling before inserting the nail, since drilling has been shown to reduce the probability of non-union, especially in the diaphysis. [5,10]. This occurs because the nail has not been reamed and does not adapt since the component of the nail shaft is usually smaller in size compared to the diameters of the medullary canal.

The definitive treatment of these fractures will depend on whether the diagnosis is made before, during or after fixation, or if the femoral neck fracture is displaced.
If the head is minimally displaced or not displaced, an implant tends to be tried. To do this, the head is first temporarily fixed, the nail is subsequently placed in the shaft, and finally the head is permanently fixed.

If the head is displaced, two implants tend to be used. First, the femoral head is fixed with either closed or open reduction, and then the shaft is reduced. In this way you manage to manipulate the diaphysis with the femoral neck fixed.

Among the techniques that can be used to fix the femoral neck is the “miss a nail”.
This technique makes it possible to reduce the femoral neck fracture before fixing the femoral shaft. It allows temporary stabilization, either with needles (anteriorly) or open reduction, if necessary, of the femoral neck under spinal control. Subsequently it is introduced

a manipulation nail, an adapter (miss a nail) is placed, and then a guide is inserted. A needle is then placed to hold the position and stabilize the fracture.

The guide wires are placed under scope to later insert the screws perpendicular to the fracture. Subsequently, the manipulation nail is removed and the length of the screws is determined, to then introduce them.

If the finding of the fracture is intraoperative after the insertion of the intramedullary nail, anterior cannulated screws can be added to the nail (2 implants), or the nail being used can be changed to a reconstruction nail. In the event that the finding is postoperative, depending on the type of fracture and the previous implant, we will have to use another implant or modify the previous implant (Figure 5).

Figure 5: Gross Kempf nail. The appearance of a left subcapital fracture not diagnosed at the time prior to fixation is observed as a postoperative finding. In this case, we opted for cannulated screws in a second intervention.

In some cases, closed reduction fails, so open reduction must be used to stabilize the head prior to definitive fixation. When open reduction is performed, then the femoral head is used as a joystick after opening the capsule, thus allowing proper reduction [3]. In general terms, the direct anterior approach (Smith Peterson) or the lateral approach (Hardinge) tends to be used, although this is less
used.

5. Prognostic factors and complications

The factors associated with a good prognosis for fixation are early surgery, the quality of the reduction, and stable fixation. Factors associated with a poor prognosis are displacement and subsequent comminution [13].

Regarding complications, non-union is more frequent in the femoral diaphysis than in the neck. The risk of nonunion and osteonecrosis of the femoral neck depends on:

- *Delayed diagnosis*
- *Initial displacement*
- *Malreduction [13].*

The incidence of VAP and non-union is unknown, but it is postulated that approximately 5% of fractures will end with avascular necrosis, and 20% with non-union, with this risk being greater if it is an open fracture.
It has been seen that the incidence of VAP is lower than in the case of femoral neck fractures since it is suspected that the high energy may be dissipated through the femoral diaphysis, in addition to the fact that many of the fractures are non-displaced, unlike the fractures isolated from femoral neck [3, 14].

Malunion rates were especially associated with delayed fixation and poor reduction, as well as heavy comminution. Postponing more than 48 hours before surgery did not influence the probability of VAP when compared to > 48 hours after surgery. [15,16,17]

However, the diaphysis has a higher rate of complications than if it is isolated, since it is usually more comminuted. The reason why the lack of consolidation may be greater than in isolated fractures can be explained because they are fractures that have undergone a high-energy mechanism, and also have a higher rate of open fractures compared to isolated diaphyseal fractures. Soft tissue involvement is the main cause of this complication (Figure 6). [4,12]

Figure 6: Soft tissue involvement and open fractures are the main risk of non-union in the diaphysis.

It has recently been shown that the chances of complications in ipsilateral femoral neck and shaft fractures are lower with intramedullary nailing compared with plate and screw [18].

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