

# Fractures of the Distal Femur Associated With a Complete Quadricipital Tendon Injury: Report of Two Cases

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## ABSTRACT

Fractures of the distal femur, especially open fractures, occur in association with high-energy trauma. The presence of associated injuries around the knee is common; however, the association with a complete quadricipital tendon injury has been poorly documented. Early diagnosis and adequate treatment of both injuries is essential to achieve good postoperative outcomes. We present two cases of exposed intra-articular distal femoral fractures associated with complete quadricipital tendon injuries. The repair of the associated tendon injury with transosseous tunnels after fracture fixation allows an early rehabilitation protocol, essential to obtain good functional outcomes.

**Key words:** Fracture; distal femur; injury; quadricipital tendon; extensor mechanism.

**Level of Evidence:** V

## Fractura de fémur distal asociada con una lesión del tendón cuadricipital: reporte de dos casos

## RESUMEN

Las fracturas de fémur distal, especialmente las abiertas, se asocian con traumas de alta energía. Las lesiones asociadas alrededor de la rodilla son frecuentes; sin embargo, la asociación con una lesión completa del tendón cuadricipital ha sido poco documentada. El diagnóstico temprano y un adecuado tratamiento de ambas lesiones son fundamentales para conseguir buenos resultados posoperatorios. Presentamos dos casos de fracturas intrarticulares de fémur distal expuestas asociadas con lesiones completas del tendón cuadricipital. La reparación de la lesión tendinosa asociada mediante túneles transóseos luego de la fijación de la fractura permite comenzar un protocolo de rehabilitación temprano, esencial para obtener buenos resultados funcionales.

**Palabras clave:** Fractura; fémur distal; lesión; tendón cuadricipital; aparato extensor.

**Nivel de Evidencia:** V

## INTRODUCTION

Distal femur fractures are complex injuries that represent between 3% and 6% of all femur fractures.<sup>1</sup> 5-10% are open fractures, generally associated with high-energy trauma in young patients.<sup>2</sup> Different types of knee injuries associated with femur fractures have been described, such as ligament injuries, patella fractures, proximal tibia fractures, vascular injuries, etc.<sup>3</sup>

Although the most frequent location of the exposure wound is the anterior aspect of the knee, very few reports mention the association with a tendon injury of the extensor apparatus. The lack of an early diagnosis and adequate treatment of this associated injury may determine a poor postoperative outcome with serious sequelae for the patient.<sup>4</sup>

The objective of this article is to report two cases of open fractures of the distal femur associated with a complete injury to the quadriceps tendon.

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### CLINICAL CASE 1

A 39-year-old man was admitted to our hospital 24 hours after a motorcycle accident. The initial diagnosis was an open fracture of the left distal femur associated with a fracture of the ipsilateral proximal ulna. At another institution, he had undergone surgical cleaning and stabilization of the distal femur fracture with an external fixator. The ulna fracture had been immobilized with a splint. Upon arrival at our hospital, the patient was hemodynamically stable. The exposure wound, about 10 cm long, located on the anterior aspect of the knee, was closed. The radiograph showed a comminuted fracture of the distal femur (type AO 33 C2) (Figure 1).



**Figure 1.** Anteroposterior and lateral radiographs of the distal femur upon admission. After placement of the transarticular external fixator, a type 33 C2 distal femur fracture is observed.

Antibiotic prophylaxis was indicated, and an exploration, a new surgical cleaning of the wound, and the reconfiguration of the external tutor were scheduled. During surgical exploration, a comminuted articular and metaphyseal fracture with loss of articular fragments of the external femoral condyle was confirmed (Figure 2).



**Figure 2.** Image taken during surgical debridement. The exposure wound and the complete quadriceps tendon injury can be seen.

At the same time, a complete avulsion of the quadriceps tendon was detected. The metaphyseal defect was initially treated with an antibiotic-loaded cement spacer and the fracture was stabilized with a transarticular fixator. The wound was closed primarily. 96 h after the initial treatment, definitive fixation was performed with a distal femur locking plate (Figure 3).



**Figure 3.** Intraoperative image of the definitive stabilization and tendon repair.

The exposure wound was used as the surgical approach. The eversion of the patella facilitated the complete exposure of the joint fracture. Following fracture reduction and fixation, the quadriceps tendon was repaired with transosseous high-strength sutures in the patella. For the first three weeks after surgery, the patient wore a continuous motion splint until 90° of knee flexion was achieved. After six weeks, he began progressive active knee extension exercises. Ten weeks after the intervention, the spacer was removed and the bone graft obtained from the contralateral femur by RIA (Reamer-Irrigator-Aspirator) was added via a retrograde approach,<sup>5</sup> and fixation was increased with a medial plate. At seven months, the fracture had healed (Figure 4) and knee range of motion was 0° to 100°.





**Figure 4.** Postoperative anteroposterior and lateral radiographs of the distal femur showing bone consolidation.

## CLINICAL CASE 2

A 41-year-old man arrived at our hospital 6 hours after a motorcycle accident. The only injury was an open fracture of the right distal femur. At the initial evaluation, he was hemodynamically stable. The exposure wound was 3 cm long and was located on the anterior aspect of the knee, proximal to the superior pole of the patella. The admission radiograph showed a fracture of the distal femur (type AO 33C2) (Figure 5). He received antibiotic prophylaxis with first-generation cephalosporin and underwent surgical debridement and temporary stabilization with an external tutor 3 hours after admission. During the surgical debridement of the wound, a complete injury to the quadriceps tendon was detected. After debridement, the wound was closed primarily without prior tendon repair. The fracture was stabilized with a transarticular fixator. At 72 h, definitive fixation was performed with a distal femur plate. The surgical approach was anterior with an external parapatellar capsulotomy that included the exposure wound (Figure 6).



**Figure 5.** Anteroposterior and lateral radiographs of the distal femur upon admission. A type 33 C2 distal femur fracture can be observed.

After the reduction and fixation of the fracture, the tendon repair was carried out with the same technique described for the previous case. Postoperatively, the patient used a continuous motion splint for the first three weeks until 90° of flexion was achieved. After six weeks, active extension began; and after 12 weeks, with full weight-bearing, knee range of motion was 120° of flexion and full extension. At six months, the fracture had healed.



**Figure 6.** Continuous motion splint for postoperative rehabilitation.

## DISCUSSION

Distal femur fractures, especially open ones, are associated with high-energy trauma.<sup>2</sup> Associated injuries around the knee are common; however, there are few reports documenting the association with a complete quadriceps tendon injury. This injury is rare, but serious if it goes unnoticed.<sup>6,7</sup> The description of these two cases seeks to alert to the possibility of a quadriceps tendon injury associated with an open fracture of the distal femur and to highlight fundamental aspects of its treatment.

An exposure wound to the anterior aspect of the knee, especially proximal to the superior pole of the patella, should raise suspicion for a possible quadriceps tendon injury. Certain fracture patterns, especially those with a supracondylar line from anterior to posterior and from distal to proximal, which generate a sharp edge of the anterior cortical bone of the proximal fragment, can produce the section of the tendon.<sup>4</sup> Regarding the mechanism of the tendon injury, it is also possible that the violent contraction of the quadriceps when the fracture occurs could cause injury by an avulsion mechanism. According to Nori, the quadriceps tendon can also be injured after trauma with pre-existing degenerative conditions of the tendon due to endocrinopathy, chronic renal failure, treatment with quinolones, diabetes mellitus, among other causes.<sup>8</sup> However, none of our patients had these backgrounds.

Karl et al. reported the case of a quadriceps tendon injury associated with a closed intra-articular fracture of the distal femur. The tendon injury was diagnosed at the time of the parapatellar surgical approach; therefore, the authors recommended, in all cases of joint fractures, broad approaches that allow assessing the integrity of the extensor apparatus.<sup>4</sup> In our patients, as they were open fractures, the tendon injury was diagnosed during surgical exploration of the wound. However, we agree with Karl et al. in recommending intraoperative exploration or preoperative evaluation with magnetic resonance imaging when there is a closed fracture of the distal femur with a supracondylar pattern from anterior to posterior and from distal to proximal (Case 2).

In both cases, the tendon repair was performed after reduction and fixation of the femoral fracture. This method has several advantages: first, the ability to completely evert the patella distally facilitates exposure of the articular surface. Second, after restoring femur length, it is easier to perform tenorrhaphy with adequate tension and thus avoid a knee extension deficit. Lastly, performing tenorrhaphy after fracture fixation allows us to more reliably assess the stability of the tendon repair during surgery and thus guide our postoperative rehabilitation protocol.

Different techniques have been described to achieve a stable tendon repair. Tenorrhaphy with high-strength sutures through transosseous tunnels achieves a stable repair that allows the establishment of an early mobility protocol with ranges of 90° flexion in the first three weeks.<sup>6,9,10</sup>

## CONCLUSIONS

In the event of an open fracture of the distal femur, especially when the exposure wound is on the anterior aspect of the knee, it is essential to explore the possibility of an injury to the quadriceps tendon. Repair of the associated tendon injury with transosseous tunnels after fracture fixation allows the establishment of an early rehabilitation protocol, essential to obtain good functional outcomes.

Conflict of interests: The authors declare no conflicts of interest.

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