Case Report

Full Thickness Tear of Quadriceps Tendon Associated with Closed Intra-Articular Distal Femur Fracture: A Case Report

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Keywords

Full-thickness quadriceps tear · Distal femoral fracture · Distal femoral fracture with quadriceps tear · Complete quadriceps rupture · Closed intra-articular distal femur fracture · Quadriceps rupture in distal femur fracture

Abstract

Fractures of the supracondylar and intercondylar region of the distal femur usually result from high velocity injury that is uncommonly associated with violation of the integrity of the extensor mechanism. The consequences of missed quadriceps injury associated with a distal femur fracture are devastating. The present case report illustrates the importance of recognizing the rare association of quadriceps tear with distal femoral fractures, an appropriate surgical approach to repair the tear as well as fixation of fracture, and a protocol of postoperative rehabilitation to achieve a successful outcome.

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Introduction

Fractures of the supracondylar and intercondylar regions of the distal femur account for 3–6% of all femur fractures [1–3]. Approximately 5–10% of distal femoral fractures are open fractures [4, 5], and these fractures are associated with variable damage to the extensor mechanism [6]. However, complete quadriceps tendon rupture in a closed intra-articular distal femur fracture is very rare and, to best of our knowledge, so far the same has not been reported in orthopedic literature. Integrity of the extensor mechanism is of utmost importance in the postoperative rehabilitation, and its affection can lead to compromised functional outcomes following internal fixation. Thus, we report a case of complete quadriceps tendon

tear with Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association (AO/OTA) type 33C2 closed intra-articular distal femur fracture and highlight the importance of intraoperative assessment of the extensor mechanism to avoid postoperative restricted rehabilitation and functional outcomes.

Case Summary

A 34-year-old female patient presented to the emergency department following accidental fall from a height of second floor. The patient was evaluated and stabilized with standard advanced trauma life support protocols, and subsequently, secondary survey was done. After obtaining radiographs, she was diagnosed with a closed right-sided distal femur intra-articular fracture (AO type 33C2) with a undisplaced patella fracture and left-sided fracture of the shaft of the femur with an ipsilateral patella fracture (Fig. 1).

Computed tomography scan of the right knee was done to better understand the fracture morphology and for surgical planning. The patient was initially managed with skeletal traction on both sides, and on day 2, once the patient was stable, definite fixation was planned. Close reduction and femur interlock nailing were done for the left femur shaft fracture, and tension band wiring with encirclage wiring was done for the ipsilateral patella fracture simultaneously. After an interval of 3 days, definite fixation of the right intra-articular distal femur fracture was done using a lateral parapatellar approach [7]. On deep dissection, incidentally, a complete tear of quadriceps tendon was noted (Fig. 2). The tear was horizontally oriented, about 2.5 cm proximal to the superior pole of the patella. There was just the sleeve of the medial retinaculum found intact. The distal femoral comminuted fracture was fixed with an anatomical pre-contoured distal femoral locking plate (AO, Synthes), and the ipsilateral undisplaced patella fracture with intact retinaculum was managed conservatively (Fig. 3a).

Following the distal femur fixation, the quadriceps tendon was repaired end to end with Ethibond no. 5 suture using the Krackow technique (Fig. 4). The lateral retinaculum was also repaired with Ethibond no. 5 suture.

Fig. 1. 3D CT reconstruction suggesting right-sided distal femoral intra-articular fracture and undisplaced patellar fracture with contralateral shaft of femur fracture with comminuted patellar fracture. CT, computed tomography.

Fig. 2. Intraoperative images of full-thickness tear of quadriceps tendon.

Fig. 3. Immediate postoperative radiograph after fracture fixation (a) and healing fracture after 6 months (b).

The left knee was mobilized in the immediate postoperative period with partial weight bearing as tolerated. For the right side, the patient was given a hinged knee brace locked in extension for initial 6 weeks. After that, gradual and controlled knee flexion was started with a rate of 10° of flexion increment every week. At 16 weeks, 100° of knee flexion was achieved,

Fig. 4. Intraoperative images after surgical repair of quadriceps tear with Ethibond no. 5 and vicryl.

and the brace was discontinued. Strengthening exercises were started after 20 weeks. The patient was allowed to perform straight leg raising and active knee bending against resistance. At 24 weeks, knee range of motion achieved was 0–110°, and there was no extension lag. This protocol for rehabilitation was meticulously supervised by experienced physiotherapists. Radiographic ongoing healing was evident at 20 weeks. The left-sided femur shaft and patellar fracture achieved radiologic union at 16-week follow-up (Fig. 3b). Left knee range of motion was 0–130°.

The patient started full-weight bearing mobilization at 6 months and was pain-free with normal gait. Quadriceps muscle strength testing was done using a handheld dynamometer at 6, 8, and 12 months, which revealed nearly equal strength in bilateral quadriceps at 8 months. We used a handheld dynamometer because of convenience of use in the outpatient department. The Tegner Lysholm Knee Score was good (88) at the right knee and excellent at the left knee (97) at the final follow-up of one year. The patient was able to actively squat, though had difficulty sitting crossed leg on floor due to restriction of terminal knee flexion.

Discussion

Complete traumatic closed quadriceps tendon rupture is an uncommon clinical entity and a serious injury if undiagnosed [8]. Extensor mechanism disruption of the knee can involve the patellar tendon, quadriceps tendon, or both or be associated with a patellar fracture. Usually, patellar tendon avulsion occurs in patients younger than 40 years and quadriceps tendon rupture or avulsion in patients older than 40 years [9]. Quadriceps tendon can also rupture following trauma with pre-existing tendon degenerative conditions like endocrinopathy, chronic renal failure, collagen vascular disease, diabetes mellitus, rheumatoid arthritis, steroid and quinolone intake, gout, and calcium pyrophosphate dihydrate crystal deposition disease [10]. However, in the present case report, no such pre-existing condition was present. There was also no history of any previous knee surgery. In this case, the mechanism of injury of the quadriceps tendon tear associated with the distal femoral fracture is most probably by the violation of the tendon by the anterior and distal displacements of the sharp metaphyseal shaft fragment. The patient had a fall from height on the flexed knees which can cause eccentric quadriceps contraction, leading to stretching of the tendon, contributing to impalement by sharp bone fragments. Commonly, such severe trauma leads to compounding of the fracture with fracture fragments protruding through the skin. However, when closed, it becomes very difficult to

anticipate the associated quadriceps tear due to extensive soft tissue swelling and hematoma. The classical radiological image of the proximal fragment pointing toward the skin is also not encountered in routine radiographs as majority of these patients are referred with traction and splint in situ, which further averts the diagnosis of the underlying associated extensor mechanism tear.

The consequences of missed quadriceps injury associated with the distal femur fracture are devastating. Stable fixation is of little value if complete quadriceps tear is undiagnosed in the intraoperative period [8]. Hence, intraoperative critical assessment of the integrity of quadriceps tendon is of paramount importance. Usually, suspicious cases of isolated quadriceps tear are clinically evident by a palpable gap above the patella and inability to perform an active straight leg raise test, but these clinical examinations are practically not possible in cases associated with a fractured distal femur due to severe pain and swelling associated with the fracture.

Selection of a surgical approach for fracture fixation should be determined after careful assessment of fracture morphology. In this case, the fracture extended to the intercondylar notch, and significant anterior comminution was present. Thus, for direct visualization and ease in fracture reduction, we opted for a lateral parapatellar approach. This surgical approach allowed us to simultaneously assess the extensor mechanism and also the fracture reduction and fixation. The direct lateral approach may not have allowed us to do the same simultaneously. Thus, opting for a relatively extensive approach (lateral parapatellar approach) will prevent missing an undiagnosed associated extensor mechanism tear. During palpation of the quadriceps, we realized the full-thickness tear and repaired the same with the same approach. It would be difficult to repair the quadriceps if we approached the same fracture through the direct lateral approach.

There is controversy regarding the period of immobilization in full extension after the repair, due to low incidence of surgically repairable quadriceps tear as there is no statistically significant standardized regimen. The literature suggests immobilizing the knee in complete extension with a hinged knee brace for 6 weeks [11–13]. According to Amini [14], the brace is locked in extension during mobilization with crutches for the initial 6 weeks with intermittent active knee flexion up to 30° followed by gradual knee flexion after 6 weeks with the aim to achieve additional 10–20° of flexion per week in the brace, which is later discontinued when 120° flexion is achieved, and strengthening exercises started at 12 weeks. We did not immobilize the patient >6 weeks in complete extension as this may lead to knee stiffness and atrophy of tendon [15]. In this case, we did not allow >10° of flexion within the brace in a week to protect the tendon repair as well as consolidation of the distal femur and ipsilateral patellar fracture. At 12 months, we achieved satisfactory outcome.

Highlights

1. Quadriceps tendon integrity should be evaluated while performing ORIF for distal femoral comminuted intra-articular fracture.
2. Choice of approach for surgical fixation to be chosen appropriately to evaluate tendon integrity.
3. End-to-end suturing gives good results when intrasubstance tears are encountered, but the technique depends on surgeon preference.
4. Immobilization in extension for 6 weeks is sufficient after which gradual knee-bending exercises started with 10° gain of movement in each week.
5. Patient counseling regarding the role of supervised rehabilitation is of paramount importance for successful outcome.

Conclusion

Extensor mechanism integrity must be evaluated meticulously during internal fixation of the distal femur fracture.

Statement of Ethics

Written informed consent was obtained from the patient for publication of this case report, and written permission was also obtained for possible printing and circulation of the accompanying radiological images solely for educational and academic purposes.

Conflict of Interest Statement

The authors declare no conflicts of interest for publishing and preparing the manuscript. The authors declare no conflict of interest.

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Author Contributions

K.F., V.S., and S.K. operated the case. S.K. wrote the manuscript and followed up the patient. K.F., V.S., and H.B. guided in manuscript preparation.

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