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Femoral-Sided Avulsion Fracture Treated with a Novel Arthroscopic Physeal-Sparing Method in a Skeletally Immature Patient

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Learning Point of the Article:

Arthroscopic physeal-sparing fixation allows stable anatomical reduction and bone-to-bone healing in rare femoral-sided ACL avulsion fractures in skeletally immature patients while minimizing the risk of growth plate injury.

Abstract

Introduction: Femoral-sided avulsion fractures of the anterior cruciate ligament (ACL) are exceedingly rare, particularly in skeletally immature patients. Because only isolated case reports exist, no standardized diagnostic or operative treatment guidelines have been established.

Case Report: A 13-year-old girl sustained a femoral-sided ACL avulsion during a skiing accident. Initial radiographs suggested a tibial eminence fracture, but computed tomography (CT) confirmed a femoral-sided avulsion. Magnetic resource imaging was not performed, as CT is the standard first-line imaging modality in Denmark for suspected osteochondral avulsion injuries and provided sufficient anatomical detail for surgical planning. Sixteen days post-injury, arthroscopic fixation was performed using a physeal-sparing technique. At 6-month follow-up with a private practitioner, the patient demonstrated a full symmetric range of motion and negative Lachman and pivot shift tests; however, no radiographic imaging was obtained.

Conclusion: Arthroscopic physeal-sparing fixation enabled stable anatomical reduction and bone-to-bone healing while minimizing the risk of growth disturbance in this skeletally immature patient.

Keywords: Anterior cruciate ligament; Femoral avulsion fracture; Physeal-sparing technique; Skeletally immature; Arthroscopy.

Introduction

Anterior cruciate ligament (ACL) fractures are rare and occur most frequently at the tibial insertion in skeletally immature patients [1-6]. Femoral-sided avulsion fractures are exceptionally rare, and no consensus exists on management [1,6-11] Misinterpretation as tibial eminence fractures on plain radiographs may delay definitive diagnosis, making advanced imaging essential [4,6]. Preserving the femoral physis is critical to avoid growth disturbance.

Case Report

Computed tomography (CT) imaging demonstrated a displaced femoral-sided avulsion fragment without comminutionse. See Fig. 1. Intraoperative arthroscopy confirmed intact ACL midsubstance and tibial insertion, supporting primary fixation rather than ligament reconstruction [6,7].

Surgical technique

Two loop sutures were placed at the ligament–bone junction. See

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Figure 1: Pre-operative 3D computed tomography reconstruction demonstrating displaced femoral-sided anterior cruciate ligament avulsion fragment.

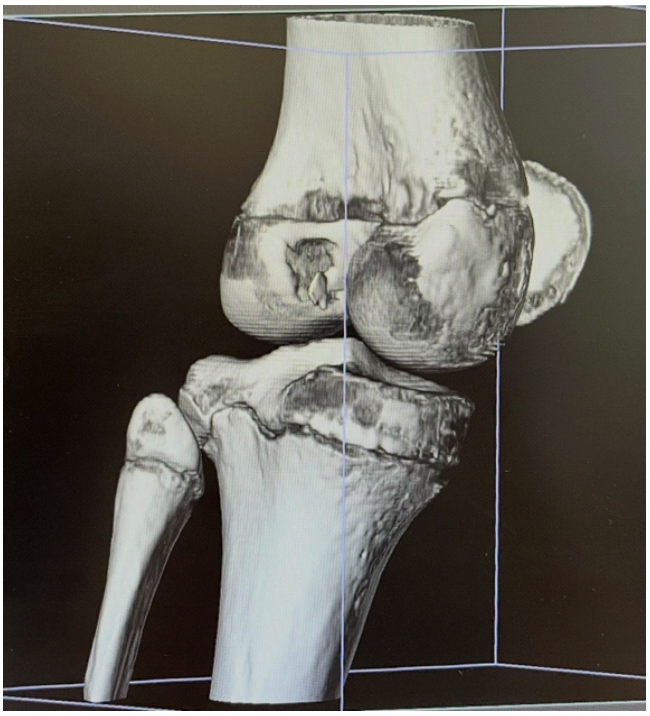

Figure 3: Six-week post-operative 3D computed tomography reconstruction demonstrating maintained fragment position.

Fig. 2. Two parallel 2.4-mm femoral tunnels were drilled under direct visualization and deliberately positioned distal to the femoral physis to avoid physeal violation. Anatomic reduction was maintained during tensioning to ensure stable bone-to-bone compression at the native ACL footprint.

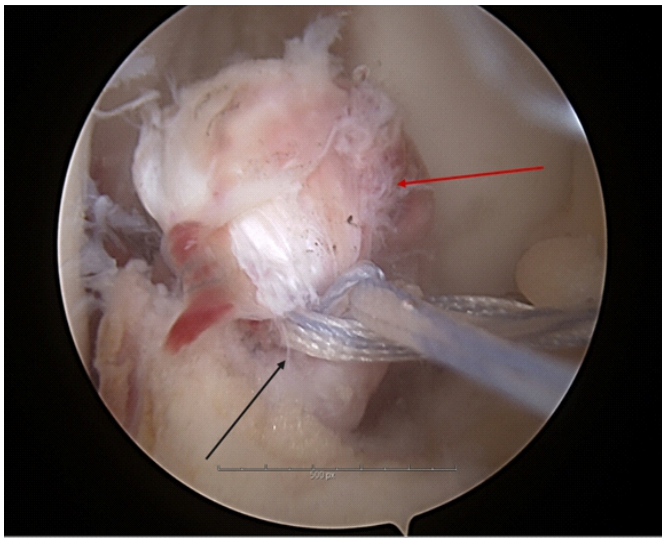

Figure 2: Arthroscopic intraoperative view showing displaced femoral avulsion fragment (red arrow) and suture passage beneath fragment (black arrow).

Post-operative outcome

Radiographic evaluation at 6 weeks demonstrated maintained reduction and anatomical restoration. See figure 3. At 6-month follow-up, clinical examination revealed a full symmetric range of motion and stable knee ligaments. No radiographic signs of growth plate disturbance were observed.

Discussion

Conservative treatment has been associated with persistent instability and inferior outcomes [1,8]. Primary fixation in cases with intact ACL substance preserves native ligament biology and proprioceptive function. The principal technical concern is the protection of the femoral physis. Small-diameter tunnels positioned distal to the growth plate minimize theoretical risk of growth disturbance while providing stable fixation [2, 6, 7,8,9,10]. Limitations include a single-case design and a limited follow-up duration.

Conclusion

Arthroscopic physeal-sparing fixation can safely restore knee stability and allow bone-to-bone healing in femoral ACL avulsion injuries among skeletally immature patients.

Clinical Message

Clinical Message: In skeletally immature patients with femoral-sided ACL avulsion fractures, arthroscopic physeal-sparing fixation provides stable anatomical restoration while minimizing the risk of growth plate injury.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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