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Osseous Injury Associated With Ligamentous Tear of the Knee

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Abstract

One of the most common knee injuries is ligament tear, which may initially manifest as an osseous injury in radiographs. Radiologists should therefore be able to recognize ligament tears of the knee as osseous abnormalities in images. This review focuses on the imaging features of knee ligament injuries and their related osseous injuries: anterior cruciate ligament (ACL) tear with Segond fracture; associated marrow contusion; ACL avulsion fracture; posterior cruciate ligament (PCL) tear with osseous avulsion of the ligament including arcuate sign; reverse Segond fracture; PCL avulsion fracture; medial collateral ligament tear with Pellegrini-Stieda disease; lateral collateral ligament tear with avulsion fracture of the fibular head; and patellar ligament injuries with Osgood-Schlatter and Sinding-Larsen-Johansson.

Résumé

Les déchirures ligamentaires figurent parmi les blessures au genou les plus courantes. Au premier abord, elles peuvent avoir l'apparence d'une lésion osseuse sur les radiographies. Les radiologistes doivent donc être en mesure de reconnaître les déchirures ligamentaires qui se présentent sous forme d'anomalies osseuses sur les images du genou. Cette analyse porte sur les caractéristiques d'imagerie des blessures ligamentaires et des lésions osseuses qui leur sont associées : déchirure du ligament croisé antérieur (LCA) avec fracture de Segond, contusion connexe de la moelle osseuse, fracture-avulsion liée au LCA, déchirure du ligament croisé postérieur (LCP) avec avulsion osseuse au niveau du ligament y compris le signe arqué, fracture de Segond inversée, fracture-avulsion liée au LCP, déchirure du ligament latéral interne avec maladie de Pellegrini-Stieda, déchirure du ligament latéral externe avec fracture-avulsion de la tête du fibula et blessures au ligament rotulien de type maladies d'Osgood-Schlatter et de Sinding-Larsen-Johansson.

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Although common in occurrence, knee injuries require early and accurate diagnosis for optimal management. The knee consists of the femorotibial and patellofemoral joints, with the cruciate ligaments between the femoral condyle and tibial plateau present to ensure stability and freedom of movement [1].

The anterior cruciate ligament (ACL) extends between the posteromedial aspect of the lateral femoral condyle and the anteromedial tibial spine. It becomes taut on knee extension, limiting anterior displacement of the tibia to the femur [1]. The larger stronger posterior cruciate ligament (PCL) extends from the lateral aspect of the medial femoral condyle to its insertion in the depression along the posterior aspect of the articular surface of the tibia [2]. It becomes taut on knee flexion and thereby restricts posterior displacement of the tibia.

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Figure 1. Bone bruise related to anterior cruciate ligament (ACL) tear of the knee. A 43-year-old man complained of knee pain and limited range of motion after a fall 3 weeks earlier. The knee radiograph (not shown) was unremarkable. Coronal T2-weighted fat-suppressed magnetic resonance imaging (MRI) reveals a high signal at the lateral femoral condyle (arrow), which is consistent with the presence of a bone bruise. A wavy, discontinuous ACL was identified on sagittal T2-weighted MRI (not shown), which was confirmed by arthroscopy.

The collateral ligaments of the knee, the medial collateral ligament (MCL) and the lateral collateral ligament (LCL), stabilize and support the medial and lateral aspects of the knee and resist valgus and varus loads, respectively [1].

This pictorial review will familiarise radiologists with imaging findings of knee ligament tear-related osseous injuries that commonly occur in contact sports.

Imaging Modalities

The radiograph is conventionally the first step in evaluating knee injuries and the first step in detecting ligament-tear related osseous abnormalities, which are visible in standard anteroposterior and lateral views.

The value of magnetic resonance imaging (MRI) in depicting ligament anatomy and pathology has been widely established. As a rule, the imaging is multiplanar in the coronal, sagittal, and axial planes, and MR protocols include both anatomic and fluid-sensitive sequences (eg, T1-weighted or proton density-weighted spin-echo images and fat-saturated proton density-weighted or fat-suppressed T2-weighted spin-echo images). On pulse-sequence images, fiber-containing, intact knee ligaments appear to be homogeneous and hypointense.

Osseous Injury Related to ACL Tear

ACL tear is one of the most common knee injuries with higher incidence in women [3]. The true prevalence of the incidence is not known mainly due to lack of well-defined population-based cohort studies and the fact that people with knee injuries may not seek treatment. A population based study by Nordenvall et al [4] showed an overall incidence of cruciate ligament injuries of 78 per 100,000 people.

Osseous injuries in patients with ACL tear typically occur when a strong valgus load causes knees (with the tibia in external rotation or the femur in internal rotation) to pivot shift [4].

On MRI, absence of the low signal of the normal ligament or abnormal morphology in the sagittal or coronal planes indicates ACL tear. ACL tear-related bony injuries include bone bruises [5], Segond fracture [6], the lateral femoral notch sign [7], and tibial avulsion fracture. Bone



Figure 2. Associated marrow contusion related to anterior cruciate ligament (ACL) tear of the knee. A 27-year-old woman complained of knee pain and swelling for several days after a fall. Radiograph (not shown) failed to reveal any fractures. (A) Sagittal T2-weighted fat-suppressed magnetic resonance imaging (MRI) shows associated marrow contusion (arrows; high signals at the lateral femoral condyle and posterior aspects of the lateral tibial plateau), which commonly occur in ACL tear cases. (B) Sagittal T2-weighted fat-suppressed MRI reveals the ACL tear (arrow), which was confirmed by arthroscopy.

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