ELSEVIER

Canadian Association of Radiologists Journal xx (2017) 1−7

CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL

www.carjonline.org

Musculoskeletal Radiology / Radiologies musculo-squelettique

Magnetic Resonance Signal Abnormalities Within the Pericruciate Fat Pad: A Possible Secondary Sign for Acute Anterior Cruciate Ligament Tears

Ferdinando Draghi, MD[a], Mario Torresi, MD[a], Luigi Urciuoli, MD[b], Salvatore Gitto, MD[c,*]

[a]*Radiology Institute, Università degli Studi di Pavia, Pavia, Italy*
[b]*Radiology Institute, Seconda Università degli Studi di Napoli, Naples, Italy*
[c]*Postgraduate School in Radiodiagnostics, Università degli Studi di Milano, Milan, Italy*

Abstract

Purpose: The study sought to investigate the presence of magnetic resonance (MR) signal alterations within the pericruciate fat pad in patients with an acute anterior cruciate ligament (ACL) tear as well as evaluate its diagnostic value in comparison with the main secondary signs of ACL tears.
Methods: Two musculoskeletal radiologists retrospectively reviewed knee MR examinations performed from May to October 2015. The ACL was considered as torn or intact based on either previous arthroscopic findings or unequivocal MR imaging interpretation if arthroscopic correlation was unavailable. Abnormalities of the pericruciate fat pad were evaluated as increased signal on the fluid-sensitive sequences; the main secondary signs of ACL tears were identified. Sensitivity and specificity were calculated for each sign.
Results: A total of 182 patients entered this study: 22 with an acute ACL tear, 160 with intact ACL. Signal hyperintensity of the pericruciate fat pad was demonstrated in all patients with an acutely torn ACL, resulting significantly different between individuals with intact ACL and those with ligament tear ($P < .0001$). This sign was much more sensitive (100%) but less specific (72.5%-75%) than other secondary signs.
Conclusions: Signal hyperintensity of the pericruciate fat pad on the fluid-sensitive sequences is associated with acute ACL tears and could be considered as a possible indicator of these injuries.

Résumé

Objectif : L'étude avait pour objectif d'analyser la présence de signaux de résonance magnétique altérés dans le coussinet graisseux avoisinant les ligaments croisés chez les patients qui présentent une déchirure aiguë du ligament croisé antérieur (LCA). Elle visait aussi à comparer la valeur diagnostique d'une telle altération à celle des principaux signes secondaires de déchirure du LCA.
Méthodes : De manière rétrospective, deux radiologistes spécialisés en imagerie musculosquelettique ont analysé les examens d'IRM du genou réalisés entre mai et octobre 2015. La présence ou non d'une déchirure du LCA a été déterminée en fonction des résultats d'arthroscopies antérieures ou, à défaut de pouvoir établir une corrélation avec ces résultats, d'une interprétation sans équivoque des images d'IRM. Les anomalies du coussinet graisseux avoisinant les ligaments croisés ont été définies comme un signal plus intense sur les séquences sensibles aux liquides, et les principaux signes secondaires de déchirure du LCA ont été relevés. La sensibilité et la spécificité de chaque signe ont été calculées.
Résultats : Au total, 182 patients ont été pris en compte dans l'étude: 22 présentant une déchirure aiguë du LCA et 160 présentant un LCA intact. Tous les patients présentant une déchirure aiguë du LCA ont affiché un signal hyperintense dans le coussinet graisseux avoisinant les ligaments croisés, ce qui s'est traduit par une différence significative entre les cas de déchirure et de non-déchirure ($P < 0{,}0001$). En tant que signe, ce signal a été associé à une sensibilité grandement supérieure (100 %) à celle des autres signes secondaires, mais à une spécificité moindre (de 72,5 à 75 %).
Conclusions : L'hyperintensité du signal obtenu dans le coussinet graisseux avoisinant les ligaments croisés sur les séquences sensibles aux liquides est associée à une déchirure aiguë du LCA et pourrait être considérée comme un signe évocateur de cette blessure.

Key Words: Anterior cruciate ligament; Indirect sign; Knee; Magnetic resonance imaging; Pericruciate fat pad

* Address for correspondence: Salvatore Gitto, MD, Postgraduate School in Radiodiagnostics, Università degli Studi di Milano, Via Festa del Perdono 7, 20122 Milan, Italy.

E-mail address: sal.gitto@gmail.com (S. Gitto).

0846-5371/$ - see front matter
http://dx.doi.org/10.1016/j.carj.2017.04.003

Magnetic resonance (MR) imaging is a reliable and valuable tool in the assessment of both acute and chronic knee injuries [1−4]. It is considered the most effective radiological modality for determining the status of the anterior cruciate ligament (ACL) with a sensitivity of 90%-95% and a specificity of 95%-100% in ligament lesions [3−5].

MR diagnosis of acute ACL ruptures is based on both primary and secondary signs. The primary or direct signs of acute ACL tears consist of alterations in the morphology and MR signal characteristics of the ligament itself. These have been demonstrated to be the most reliable indicators of ACL tears with a sensitivity of 96% and a specificity of 94% [6−9]. In addition, several secondary or indirect signs of ACL injury have been described. These mostly include a bone contusion in the lateral compartment [9−11], the anterior displacement of the tibia [12,13], an abnormal angle between the lateral tibial plateau and ACL [14], an abnormal posterior cruciate ligament (PCL) angle [15], PCL buckling [16], and the PCL line sign [17]. Secondary signs may appear in up to 90% of acute ACL injuries, and corroborate their diagnosis [18]. They may also have additional value in clinical situations in which the entire ACL cannot be directly visualized (eg, in cases of an extensive hematoma or oedema spreading within the intercondylar region) or when its whole length is not included on 1 single sagittal image.

During routine reporting of clinical MR images of the knee, we anecdotally noted an altered signal within the pericruciate fat pad in several individuals with an acute ACL injury. The pericruciate fat pad is 1 of the periarticular fat pads included within the knee joint. It is located within the intercondylar fossa, being intimate with both cruciate ligaments. Signal alterations within the pericruciate fat pad have recently been correlated with inflammatory processes affecting the knee and associated with sports activity and posterior knee pain [19]. However, unlike the anterior fat pads of the knee, the pathology of the pericruciate fat pad has not been investigated in any depth.

To our knowledge, the abnormal MR signal of the pericruciate fat pad has never been described in the literature as a secondary sign of acute ACL tears. The objectives of this study were (1) to investigate the presence of MR signal alterations within the pericruciate fat pad in patients presenting with an acute ACL tear and (2) to explore the diagnostic value of this possible new sign in assessing acute ACL tears in comparison with the main secondary signs previously described in the literature.

Materials and Methods

Study Design and Population

This retrospective cross-sectional study evaluated MR examinations of the knee performed over a 6-month period, from May 1, 2015, to October 31, 2015, at the first author's institution. This is a university hospital and knee MR referrals are mainly for traumatic and degenerative disorders. Before MR examination, each patient was asked to provide clinical data through a standardized questionnaire aimed at reproducibly determining whether the knee was symptomatic or asymptomatic, the characteristics and location of symptoms, and the pertinent anamnesis with specific focus on both recent and past traumas; previous arthroscopic findings as well as significant results from physical examinations, such as the pivot-shift test, the anterior drawer test and the Lachman test, were also collected from the institutional medical records. Written informed consent for retrospective research was obtained from all patients involved in the study.

Patients were excluded from the study if they had (1) non-native ACL, (2) a long-standing ACL tear (either arthroscopically confirmed or detected on MR imaging; ie, MR examination was performed later than 6 weeks after injury) [20], or (3) ambiguous appearance of the ACL morphology and signal characteristics on MR imaging without any arthroscopic correlation.

MR Imaging Protocol

MR imaging of the knee was performed with a 1.5-T unit (Siemens Symphony, Erlangen, Germany) and a 0.26-T unit (Esaote E-scan, Genoa, Italy). Image acquisition included sagittal T1-weighted fast-spin echo (FSE) and 3 orthogonal plane fluid-sensitive sequences, such as short-time inversion recovery (STIR), proton density (PD)−weighted with fat saturation, or gradient echo (GE), depending on the machine employed. In both MR units a circular-polarized send−receive extremity coil was used.

The 1.5-T scanner acquisition protocol included: sagittal T1-weighted FSE sequences, 3.0 mm section thickness, field of view (FOV) 138 × 170 mm, and matrix 208 × 512 pixels; sagittal PD-weighted sequences, 3.0 mm section thickness, FOV 143 × 180 mm, and matrix 204 × 512 pixels; coronal PD-weighted sequences, 3.0 mm section thickness, FOV 200 × 200 mm, and matrix 204 × 512 pixels; axial PD-weighted sequences, 2.0 mm section thickness, FOV 180 × 162 mm, and matrix 187 × 512 pixels. The acquisition time ranged from 2 minutes 57 seconds to 5 minutes 34 seconds.

The 0.26-T scanner acquisition protocol included: sagittal T1-weighted FSE sequences, 4.0 mm section thickness, FOV 210 × 210 mm, and matrix 512 × 512 pixels; sagittal T2-weighted GE-STIR sequences, 4.0 mm section thickness, FOV 220 × 220 mm, and matrix 256 × 256 pixels; coronal T2-weighted GE-STIR sequences, 4.0 mm section thickness, distance factor 15%, FOV 200 × 200 mm, and matrix 256 × 256 pixels; axial T2-weighted GE-STIR sequences, 3.0 mm section thickness, distance factor 20%, FOV 220 × 220 mm, and matrix 256 × 256 pixels. The acquisition time ranged from 4 minutes 45 seconds to 6 minutes 48 seconds.

MR Imaging Analysis

An analysis of the MR images, in the light of clinical data, was performed in consensus by 2 experienced