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CASE REPORT

Occult fibular head fracture in association with posterolateral corner injury of the knee

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Introduction

An avulsion fracture of the head of the fibula has been described as an important indicator of posterolateral instability of the knee. Such a fracture has been termed the "arcuate" sign. Marrow oedema and an occult fracture of the fibular head may be evident on magnetic resonance imaging (MRI) in the absence of visible plain radiographic abnormality and, when these are seen, the integrity of the posterolateral structures of the knee should be assessed. We present the case of a woman with an occult fracture of the fibular head and associated injury of the posterolateral structures.

Case report

A 26-year-old woman presented with a history of acute left knee pain following a twisting injury on landing from a jump across a ditch. Plain radiographs showed no abnormality (Fig. 1). MRI performed several weeks after the injury revealed oedema which was most prominent in the medial aspect of the fibular head on the STIR sequence (Fig. 2), together with a curvilinear hypointense fracture line evident on the T1-weighted spin echo sequence (Fig. 3). Also identified was excessive fluid around a swollen and hyperintense popliteus tendon, indicative of a grade 1 sprain (Fig. 4). The lateral collateral ligament and biceps femoris tendons (BFTs) appeared intact. However, there was also evidence of swelling and hyperintensity of the superior half of the posterior cruciate ligament (PCL) consistent with a partial rupture. The anterior cruciate ligament (ACL) and menisci appeared intact. A diagnosis was made of popliteus tendon sprain associated with an undisplaced fibular fracture and partial PCL rupture (Fig. 5).

Follow-up MRI at 3 months revealed resolving bone oedema within the fibula and an apparently normal popliteus tendon. The overall picture was of an occult "arcuate" fracture associated with a mild posterolateral corner injury.

Discussion

The structures of the posterolateral corner of the knee are increasingly recognised as fulfilling an important role in maintaining knee stability.[1] Failure to identify injury of these structures can lead to chronic posterolateral knee pain and instability and can result also in failure of cruciate ligament reconstruction surgery.[2–4] People with isolated injuries to the posterolateral corner of the knee present with a history of minor trauma, pain localized to the posterolateral aspect of the knee and an occasional sensation of instability in extension and hyperextension. Initial physical examination usually yields minor and inconclusive findings such as mild tenderness and bruising.[5]

Stability in this region is maintained by a complex arrangement of ligaments and capsular structures including the arcuate ligament, the popliteus muscle and tendon, the popliteofibular ligament, the fabellofibular ligament, the BFT and the fibular collateral ligament (FCL). The FCL, also called the lateral collateral ligament, arises from the superior aspect of the lateral femoral condyle and extends posteriorly and inferiorly, merging with the more posterior BFT to form a conjoined tendon inserting

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(a)

(b)

Figure 1 (a) AP and (b) lateral radiographs of the left knee showing no abnormality.

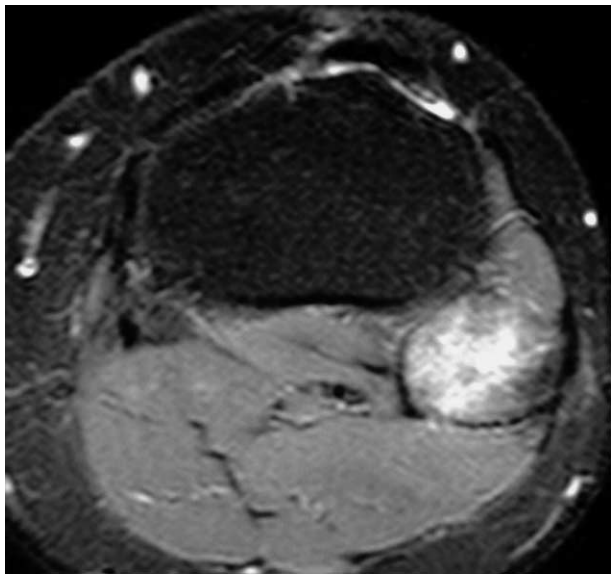

Figure 2 Axial STIR sequence demonstrates oedema within the fibular head, which is most marked medially.

on the lateral fibular head.[5] The Y-shaped arcuate ligament arises from the styloid process of the fibular head and has two limbs: a lateral limb coursing posteriorly to blend with the posterior joint capsule and a medial limb running superomedially to blend with the oblique popliteal ligament of Winslow.[6,7] The popliteus muscle arises on the posteromedial aspect of the tibia and extends superolaterally behind the knee joint to become the popliteus tendon. The bulk of this tendon pierces the meniscocapsular junction of the posterior third of the lateral meniscus at the popliteus hiatus and inserts on the small sulcus at the lateral aspect of the lateral femoral condyle.

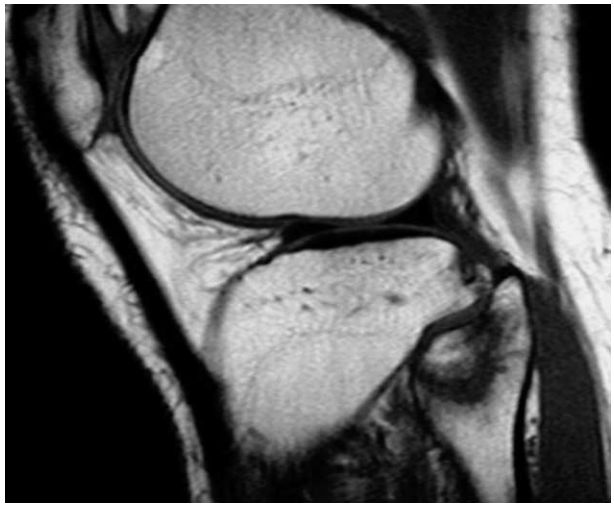

Figure 3 Sagittal T1W SE sequence demonstrates a curvilinear fracture line in the fibular head.

(a)

(b)

Figure 4 (a) Sagittal T2*W gradient echo sequence and (b) axial fat-suppressed T2W FSE sequence demonstrating fluid around a swollen, hyperintense popliteus tendon (arrow).

The popliteus muscle also has attachments to the posterior third of the lateral meniscus and a ligamentous attachment to the fibular styloid, the popliteofibular ligament.[8,9] The fabellofibular ligament extends from the fibula to the fabella, if the fabella is present.[6] Anatomical variability of the posterolateral structures exists, with reported prevalence of the fabellofibular ligament of 51–72%,[10,11] the arcuate ligament of 24–100%[8,10,11] and the popliteofibular ligament of 93–100%.[8,11]

Routine MRI does not always show the posterolateral structures, particularly the smaller ones.

Figure 5 Sagittal T2*W gradient echo sequence demonstrates thickening and hyperintensity of the femoral attachment of the posterior cruciate ligament, consistent with a partial rupture.

Yu et al.[12] reported visualization of the arcuate ligament in 46%, the fabellofibular ligament in 48% and the popliteofibular ligament in 53% on coronal oblique images as compared with 10%, 34% and 8%, respectively, on standard coronal imaging. In a more recent study, De Maesener et al.[13] demonstrated the arcuate ligament in 25%, the fabellofibular ligament in 33% and the popliteofibular ligament in 38% of 122 MRI studies employing standard coronal and sagittal planes. The FCL and BFT are always visualized on standard imaging.

Trauma to any of the above-mentioned structures constitutes a posterolateral corner injury. Several studies have demonstrated an association between disruption of the posterolateral ligaments and other acute ligamentous injuries, particularly of the ACL and PCL.[6,14–17]

An avulsion fracture of the head of the fibula has been described as an important indicator of posterolateral instability of the knee. The "arcuate" sign refers to an avulsed bone fragment related to the insertion of the posterolateral corner ligamentous structures (BFT, FCL, arcuate ligament, popliteofibular ligament). A bony arcuate injury may be more readily appreciated on plain radiographs than on MRI, but the latter best assesses the extent of associated ligamentous injury.[17] In one series of 18 "arcuate" fractures seen on plain radiographs, all cases had avulsed fragments attached to the FCL, BFT or both demonstrable on MRI.[16] Another study

included 13 cases with the "arcuate" sign on radiographs.[15] The fibular avulsion was identified on MRI in 11/13, with fibular head oedema in the other 2 cases. Disruption of the FCL was apparent in 7 of these cases and of the popliteus tendon in 1 case. Lee et al.[5] studied 12 individuals with imaging evidence of isolated injury to the posterolateral corner, and correlated the imaging with dissection of two cadaveric specimens. They were able to differentiate between a group of 8 cases with a small avulsion fracture of the fibular styloid or bone oedema medially in the fibular head, which was associated with injury to the arcuate ligament or popliteofibular ligament, and a second group of 4 cases with injury to the conjoined tendon or FCL, a larger avulsion fragment and more diffuse fibular head oedema.

In the present case, radiographs of the knee were normal but MRI demonstrated an occult fracture of the fibular head. Careful assessment of the posterolateral corner structures demonstrated excessive fluid around the popliteus tendon posterior to the lateral meniscus, together with swelling and hyperintensity of the tendon. The tendon was still intact, indicating a grade 1 sprain. The patient was treated conservatively and follow-up MRI approximately 3 months later demonstrated healing of the popliteus tendon and resolving oedema in the fibular head. The site of abnormality within the fibular head, being most prominent medially, would have been consistent with an injury to the popliteofibular ligament according to the findings of Lee et al.[5]

This case, together with those reported in the literature, indicate that the presence of fibular head oedema on MRI in the clinical context of trauma requires assessment of the posterolateral corner structures for identification of associated ligamentous injury.

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