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REVIEW / *Musculoskeletal imaging*

The contribution of MRI to the diagnosis of traumatic tears of the anterior cruciate ligament

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KEYWORDS

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Abstract When faced with a clinical suspicion of knee ligament injury, MRI nowadays has a central role in the diagnostic strategy. In particular, it is essential for assessing the cruciate ligaments and any associated meniscal tears. The objective of this review is to present the various direct and indirect MRI signs of tearing of the anterior cruciate ligament (ACL) and then describe the lesions associated with it. The anatomical and clinical aspects are also discussed so that the contribution of MRI to the diagnosis and therapeutic management of an ACL tear can be better understood.

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Tearing the anterior cruciate ligament (ACL) of the knee is one of the most frequently encountered knee ligament injuries [1]. In France, 15,000 ACL tears occur per year while the individuals are skiing. In the United States each year there are nearly 175,000 ACL reconstructions. The tear usually results from a twisting mechanism in external rotation and flexion with a valgus force.

Clinical examination can provide the diagnosis if there is a positive anterior drawer test (Lachman's test [1]). Nevertheless, magnetic resonance imaging (MRI) is regularly requested to confirm the diagnosis and make a complete assessment of the lesion [2].

Many studies have evaluated the performance of MRI in diagnosing ACL lesions [1–5], the sensitivity of which for diagnosis of a tear is 92 to 96% [1,6–8] with specificity of 92 to 99% [6–8]. It is particularly informative when a clinical examination is impossible or doubtful, and also is of pre-operative use for detecting associated ligament and meniscal lesions.

The objective of this review is to provide the anatomical basis for analysing the ACL, to describe the direct and indirect signs of a tear, and to identify associated lesions.

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Anatomy

MRI analysis of the ACL is based on a thorough understanding of the anatomy of this ligament.

The ACL is composed of dense connective tissue joining the femur and the tibia and covered by the synovial membrane. It is composed of collagen (80% of the weight of the ligament), elastin, proteoglycans, glycolipids, glycoproteins and water [9,10]. The anterior cruciate ligament is viscoelastic and its mechanical properties may vary with time.

The ACL takes an oblique path downwards, anteriorly and medially. Several papers have given anatomical descriptions of the groups of fibres forming the cruciate ligaments. Depending on the authors, the structure of the ACL consists of two [11–14] or three main bundles [15,16], but all the literature agrees as regards the macroscopic description of the bony origin and insertion of the cruciate ligaments [11,15].

The femoral origin of the ACL is semi-circular in shape on the medial surface of the lateral condyle. The convex part of the semicircle follows the articular cartilage [17]. The most anterior superior fibres are attached to a point 2–3 mm in front of the junction between the roof and the lateral part of the intercondylar fossa. These measurements were made in a recent study [18] confirming Girgis' observations [11].

The most anterior part of the tibial insertion site is 2–3 mm behind the insertion of the anterior part of the medial meniscus and is convex anteriorly. In some cases, the tibial insertion of the ACL may be close to the anterior part of the medial meniscus. The maximum space between the anterior fibres and the medial meniscus is 8 mm [18]. There are no fibres inserted into the superior part of the medial intercondylar process. The area of tibial attachment of the ACL is constantly in relation with the anterior lateral meniscus.

The tibial insertion has a larger surface area than the femoral origin. The ACL thus gradually enlarges in a cranio-caudal direction, with physiological torsion of its fibres.

These fibres are parallel, but it is not always possible to isolate bundles macroscopically. Sometimes, there are grooves that allow the ligament to be separated into the two main bundles (Figs. 1 and 2), shown by anatomical studies of the ACL to be anteromedial (AMB) and posterolateral (PLB) [19]. Some describe an intermediate bundle [20,21]:

- the anteromedial bundle (AMB) is the longest and most voluminous: it has a more anterior and medial tibial insertion (Fig. 3) and its femoral origin is more posterior and higher (Fig. 4). It is this bundle which is most often damaged in traumatic injuries;
- the posterolateral bundle (PLB) is the more vertical: it is often spared in partial tears;
- the intermediate bundle, which varies in form, unites the other two bundles.

Biomechanical studies have shown that the variation in length of the two bundles during flexion/extension of the knee is different. For the same degree of flexion of the knee, the tension applied to each bundle is different [20]. The PLB is under more tension in complete extension while the AMB is under more tension in flexion. This could explain the partial nature of some ACL tears [20].

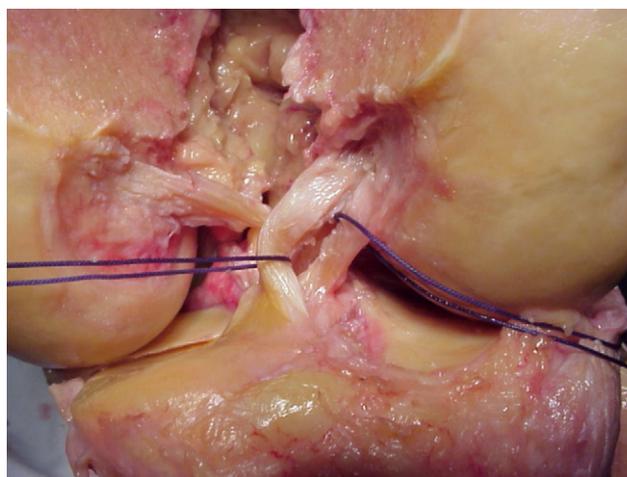


Figure 1. The two anteromedial and posterolateral bundles of the anterior cruciate ligament (ACL). Anterior view: the tibial insertion of the anteromedial bundle (AMB) (right thread) is more anterior and the femoral origin more posterior and higher than the posterolateral bundle (PLB) (left thread).

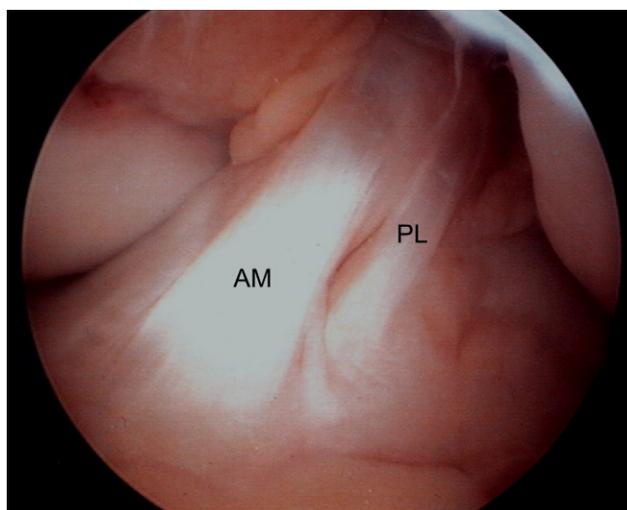


Figure 2. An arthroscopic view of the two main anterior cruciate ligament (ACL) bundles: anterior view; anteromedial bundle (AMB) (labelled AM on the arthroscopic image) and posterolateral bundle (PLB) (labelled PL on the image).

The synovial membrane completely covers the anterior cruciate ligament, which is extrasynovial [20]. The ACL is vascularised from the popliteal artery and its branches [22]. This artery is a continuation of the femoral artery on the posterior surface of the knee, in the popliteal fossa, and gives rise to five articular collaterals, two of which, the middle and inferior lateral genicular arteries, provide most of the vascularisation for the cruciate ligaments.

The synovial membrane covering the cruciate ligaments is richly vascularised from the anterior surface of the knee (via the infrapatellar fat pad) and from the posterior surface (via the intercondylar fossa).

Thus there is a periligamentous then endoligamentous arterial network with a less vascularised area in the middle third of the ACL. Moreover, as there is no blood supply from the tibia or femur, the areas of attachment of the ligament

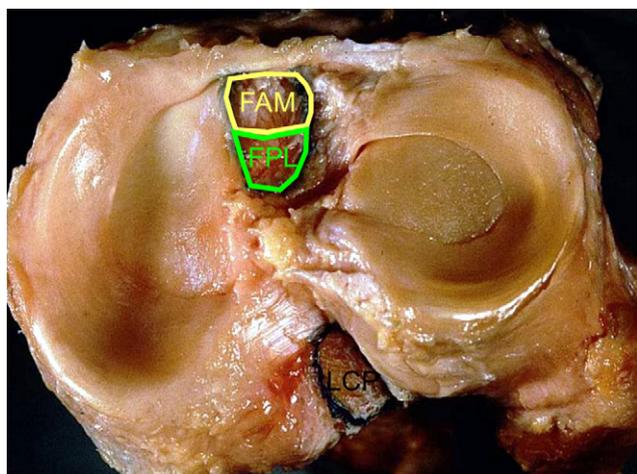


Figure 3. Superior view of an anatomical section of a cadaver tibia. Insertion of the two bundles of the anterior cruciate ligament: the AMB (labelled FAM) and the PLB (labelled FPL). Insertion of the posterior cruciate ligament (labelled LCP).

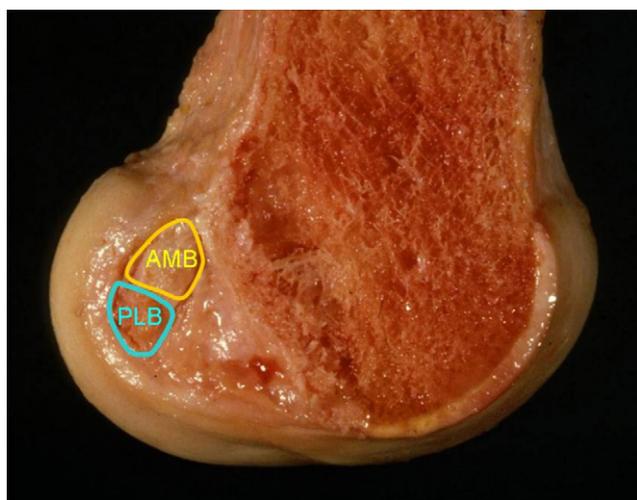


Figure 4. Anatomical section of a cadaver femur in the sagittal plane. Femoral origin of the two anterior cruciate ligament (ACL) bundles: anteromedial bundle (AMB), posterolateral bundle (PLB).

are very poorly vascularised. Innervation of the ACL is from the articular branch of the tibial nerve that penetrates the joint from behind.

Physiopathology

In France, five “at risk” sports are responsible for 90% of ACL tears: football, skiing, rugby, basketball and judo. The three mechanisms of injury seen are:

- valgus/flexion/external rotation (VALFE): responsible for damage to the medial collateral ligament (MCL), the posteromedial corner (PMC), the ACL and the lateral meniscus (LM);
- varus/flexion/internal rotation (VARFI): responsible for damage to the ACL, the posterolateral corner (PLC), the lateral collateral ligament (LCL), the LM and a Second fracture;

- a hyperextension accident in which the ACL is injured against the intercondylar fossa.

The ACL is usually torn as a result of external rotation and flexion with a valgus force. The external rotation results in the medial plateau advancing and this is stopped in the first instance by the medial collateral ligament and then by the ACL. The combination of valgus and external rotation stretches the MCL and tears the ACL. The instability produced frequently causes a meniscus tear.

Internal rotation, i.e., the movement of the tibia or toes medially, causes the lateral tibial plateau to move forward and the medial tibial plateau to move back. The first structure opposing advance of the lateral tibial plateau is the ACL, tearing of which can consequently in this case, be isolated.

Clinical picture

An audible crack is usually heard when the anterior cruciate ligament tears. An intra-articular effusion is shown clinically by the presence of a ballotable patella, indicating haemarthrosis. Lachman’s test [23] (or anterior drawer test in moderate flexion) assessing the sagittal tension of the ACL can generally be performed, and in an ACL tear, is positive: the knee is flexed a few degrees, the femur and the tibia held and an anterior drawer movement provoked. If there is a complete tear of the ACL an anterior drawer with a soft end point is observed; an anterior drawer with a hard end point indicates a partial tear or an ACL that has healed by attaching itself to the PCL.

The anterior drawer effect can also be evaluated on a knee flexed between 60° and 90° with the patient in the supine position, the foot being held by the examiner sitting on it. The drawer is said to be positive when there is abnormal unilateral forward movement of the tibia beneath the femur. If it is positive with no foot rotation it indicates at least an ACL tear.

The lateral pivot shift manoeuvre (or jerk test) is done by flexing the knee from the extended position while applying a valgus movement with internal rotation of the foot. This manoeuvre is based on reproducing the sensation of rotational instability felt by the patient.

The clinical diagnosis of ACL injury is often made by performing these three tests and with information provided by the case history or by arthrocentesis performed for analgesic purposes.

The place of MRI and techniques used

MRI is the reference imaging technique not only for confirming the diagnosis of a suspected ACL tear, but above all for investigating any associated lesions that may modify therapeutic management. Its sensitivity varies, depending on the studies, from 92 to 100% and its specificity from 82 to 100% [24–27]. Three Tesla MRI seems to improve diagnostic performance with sensitivity and specificity of 100% [5].

The usual MRI sequences for the knee are sagittal T1 [6], and proton density-weighting with fat saturation (PD fat-sat) in the three axial, coronal and sagittal planes. Additional



Figure 5. MRI of a normal ACL and its two bundles: a: coronal plane proton density weighting with fat saturation (PD fat-sat), right knee, anterior part of the intercondylar fossa: anteromedial bundle (AMB) (white cross) posterolateral bundle (PLB) (white star); b: axial plane PD fat-sat of right knee, slice through the tibial plateau: AMB (black arrow) and PLB (black arrowhead); c: axial plane PD fat-sat of right knee, slice high in the intercondylar fossa: AMB (black arrow) and PLB (black arrowhead).

coronal oblique [28–31] and sagittal oblique [29,31] proton density-weighted sequences have been proposed according to the theoretical spatial orientation of the ACL.

The three plane PD sequences can advantageously be replaced today by a 3D water sensitive volume sequence: the efficacy of this sequence, which takes approximately three to five minutes, is the same as of the usual sequences [32]. It provides a volume for the knee and can be positioned on reconstructions in the axis of the ACL, replacing the previously proposed additional sequences in this axis.

Normal MRI appearance

The ACL appears as a T1 and T2 hyposignal, less clear than the posterior cruciate ligament because of its heterogeneous structure. It is continuous, with clear contours, taut between the femoral origin and tibial insertion, and orientated at a more acute angle than the roof of the intercondylar fossa (or Blumensaat line). Its tibial insertion extends into a ‘fan’, showing the various parts of the ligament as linear hypersignals. The ACL is divided into two or three anatomical-functional bundles, which can be seen in MRI (Fig. 5).

ACL tears

The direct signs of an anterior cruciate ligament (ACL) tear [2,6,33,34]

There are two major direct signs:

- partial or total discontinuity in at least one reading plane. This is one of the most important signs in the diagnosis of ACL tears [2,33,35]: the ACL can be seen with an interruption to the fibres (Fig. 6). Sensitivity and specificity are respectively 66% and 100% [35]. Sometimes the distal part of the ligament falls forward into the intercondylar fossa as a bell clapper lesion and may be responsible for locking. Indeed, the ligament stump is displaced forward into the anterior joint recess, causing a flexion deformity

(Fig. 7). MRI can then eliminate a bucket handle meniscal tear, the main differential diagnosis in the case of flexion deformity;

- horizontalisation of the distal fragment of the ACL. Horizontalisation of the ACL is an excellent direct sign [2] of an ACL tear with sensitivity and specificity close to 100% [2,35]. It is seen clearly in sagittal slices: a difference of more than 15° relative to the roof of the intercondylar fossa, angulation of less than 45° to the tibial plateau [35]. The most frequent tear point is in the proximal portion of the ACL, the distal stump of which becomes horizontal and sometimes attaches to the PCL (which acts as a support) [35]. Healing of the ACL by attachment to the PCL is a possible development, which partially limits laxity.

In the literature [6,33,36] other signs are classed as direct signs but they seem less specific than the two described above [35]:

- an intraligamentary focal or diffuse hypersignal from the ACL;
- an ill-defined mass giving an abnormal signal in the intercondylar fossa;
- irregular, fuzzy, ill-defined contours with thickening of the ACL;
- complete lack of visualisation of the ACL [33].

Indirect signs of an anterior cruciate ligament (ACL) tear

These are the consequence of the ACL tear mechanism, or of secondary instability. They can help in the diagnosis of ACL tears, but cannot be used in this way if there is no direct sign of ACL tear:

- anterior subluxation of the lateral tibial plateau relative to the femur. This appears on sagittal slices through the middle of the lateral femoral condyle. It is defined by an increase of more than 5 mm in the distance between the posterior edge of the lateral tibial plateau and the tangent to the posterior edge of the lateral femoral condyle [7,35,37,38] (Fig. 8). This is a good sign for diagnosis of an ACL tear, with sensitivity of 74% and specificity of

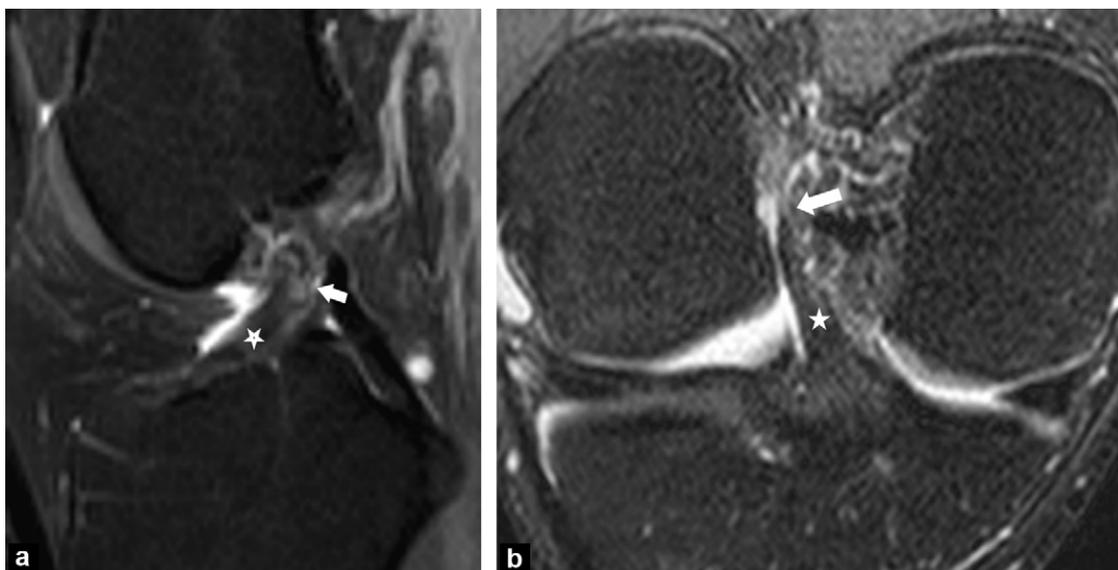


Figure 6. Anterior cruciate ligament (ACL) discontinuity. Sagittal (a) and coronal oblique (b) proton density weighting with fat saturation: a complete tear of the ACL confirmed by arthroscopy. The fibres of the distal part of the ACL remain visible (white star). There is a complete interruption halfway up the ligament (white arrow). Horizontalisation of the ACL.

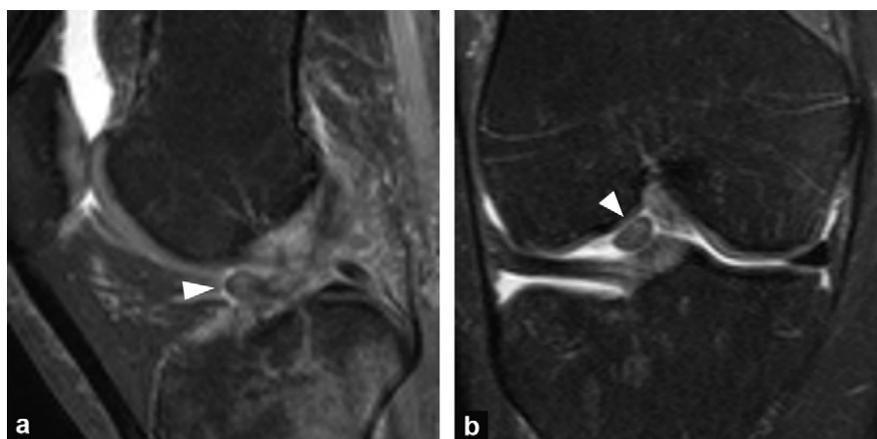


Figure 7. Complete tear of the anterior cruciate ligament (ACL) as a bell clapper lesion: a: sagittal proton density weighting with fat saturation: ACL stump (distal) remaining retracted in a bell clapper lesion, confirmed by arthroscopy; b: coronal proton density weighting with fat saturation: the stump is located in the intercondylar fossa.

96% [24,35,38]. Exposure (or posterior displacement) of the posterior horn of the lateral meniscus has also been described as a sign of anterior tibial displacement (the tangent to the posterior edge of the lateral tibial plateau cuts the posterior horn of the lateral meniscus);

- verticalisation of the posterior cruciate ligament [6,35] (Fig. 9). Its appearance is related to abnormal relaxation of the PCL. In the coronal plane, this is reflected by too long a portion of the PCL being visible on a single slice [2]. This sign in fact indicates anterior subluxation of the tibia [35]: the angle formed by two tangents to the proximal and distal portions of the PCL is measured. Decrease in this angle has been described in tears of the ACL and sensitivity of this sign is 70% with specificity of 82% for an angle less than 115° [35];
- distension or buckling of the patellar tendon [6,36]. This is a rare sign. ACL tearing and therefore anterior tibial translation reduces the angle of insertion of the patellar

tendon on the tibial tuberosity, which is responsible for shortening the distance between the patella and the tibial tuberosity;

- intra-articular effusion – non-specific.

Partial tears

Partial tears, which represent 10 to 35% of ACL lesions [21,39], are more or less serious lesions with a variable prognosis. Their definitive diagnosis is difficult because arthroscopy may be the cause of false positives (healing of a complete ACL tear by its becoming attached to the PCL) and of false negatives (tearing of a few ACL fibres without their being visible arthroscopically). A moderate anterior drawer with a hard end point is a clinically suggestive feature.

Partial tears are difficult to detect in MRI [1,6,30] (Figs. 10–12). A subtle increase in ACL signal intensity is

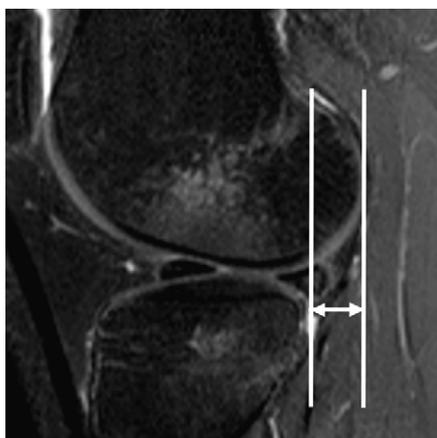


Figure 8. Anterior subluxation of the lateral tibial plateau. Sagittal PD fat-sat: 11 mm difference between the posterior edge of the lateral tibial plateau and the posterior edge of the lateral femoral condyle. Exposure of the posterior horn of the lateral meniscus indicating subluxation of the lateral tibial plateau.

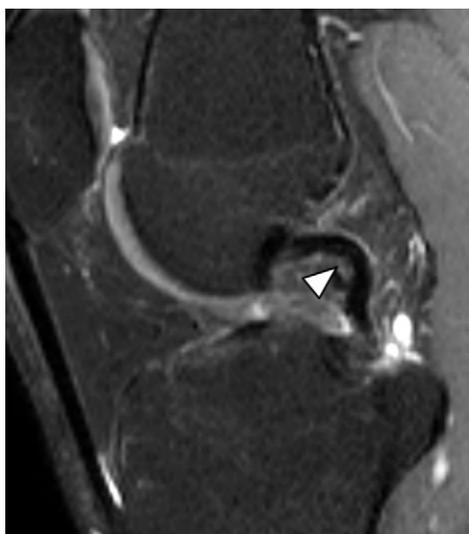


Figure 9. Verticalisation of the PCL on tearing the anterior cruciate ligament (ACL) confirmed by arthroscopy. Sagittal PD fat-sat: the distal portion of the PCL is vertical. The PCL is concave inwards (white arrowhead).

sometimes the only sign. The majority of fibres are still visible and the global axis of the ACL often remains normal. These tears most frequently affect the anteromedial bundle [20]. Partial tears can sometimes be diagnosed from MRI with the help of intrinsic abnormalities of the ACL:

- interruption of the bundles: either of the anteromedial or posterolateral bundle. Axial and coronal oblique slices or reconstructions are a great help;
- oedema, an abnormal focal ligament signal or focal thickening (T2 hypersignal; T1 hyposignal).

In the literature there are only very few studies [40] from which the sensitivity and specificity of MRI in detecting partial tears of the ACL can be assessed. It is important to establish the distinction between a partial and total tear since it modifies the therapeutic management: a partial tear can heal with functional treatment, which is not the case for

complete tears [1,41]. Improvements in the quality of MRI images (1.5 and 3 Tesla, multichannel knee coils) with thin slice acquisitions in the plane of the ACL (coronal oblique or sagittal oblique, or water sensitive 3D sequences) [28–31] should increase the sensitivity and specificity of MRI for this indication.

Associated lesions

Meniscal fissures

These fissures occur during trauma in flexion with rotation (Fig. 13). Most often the lateral meniscus (LM) is affected. Traumatic fissures are vertical, and are then aggravated by the two sagittal and rotatory components of knee instability when the ACL is torn [37,42].

The idea of corners [43]

Lesions of the lateral compartment of the knee are less common than those affecting the medial compartment [43]. However, lesions of lateral structures are clinically more disabling, so that we shall only discuss lesions in relation to these structures.

The structures on the anterolateral side are those that most frequently suffer trauma, which is usually associated with ACL injury. The lesions are secondary to varus strain with internal rotation of the tibia [43] and usually involve tearing of the posterior fibres of the iliotibial band. An avulsion fracture of Gerdy's tubercle can also occur.

Posterolateral instability is considerably less frequent than anterolateral instability. Most lesions of the posterolateral compartment are associated with ACL tears. The posterolateral corner includes the popliteal tendon (PT), which is attached to the lateral meniscus (popliteal meniscal ligament) and the styloid process of the fibula (popliteal fibular ligament), the lateral collateral ligament (LCL) and the articular capsule, which is strengthened by the arcuate (AL) and fabellofibular (FFL) ligaments [42]. The popliteal muscle is the main lateral stabiliser [43] (Fig. 14). The mechanism of posterolateral lesions is either direct varus strain while the tibia is externally rotated, or sudden hyperextension of the knee. This type of instability is difficult to objectify in a clinical examination. The clinical signs are subtle and are masked by the more obvious symptoms of an ACL tear. The lack of recognition of posterolateral lesions has been put forward as a cause of failure of ACL surgery, of chronic instability of the knee and long-term osteoarthritis [44].

Collateral ligaments

Damage to the medial collateral ligament frequently accompanies tearing an ACL [33,35]. In the acute phase MRI may show a thickened ligament, poorly limited or interrupted, with oedematous infiltration of medial and posteromedial soft tissue [45,46].

Contusion and bone impaction

This is damage to the subchondral bone secondary to impaction of the femur against the tibial plateau during an ACL tear [47]. It will appear as an oedematous signal, a T1 hyposignal and T2 hypersignal. Its specificity in the diagnosis of ACL tears varies between 97 and

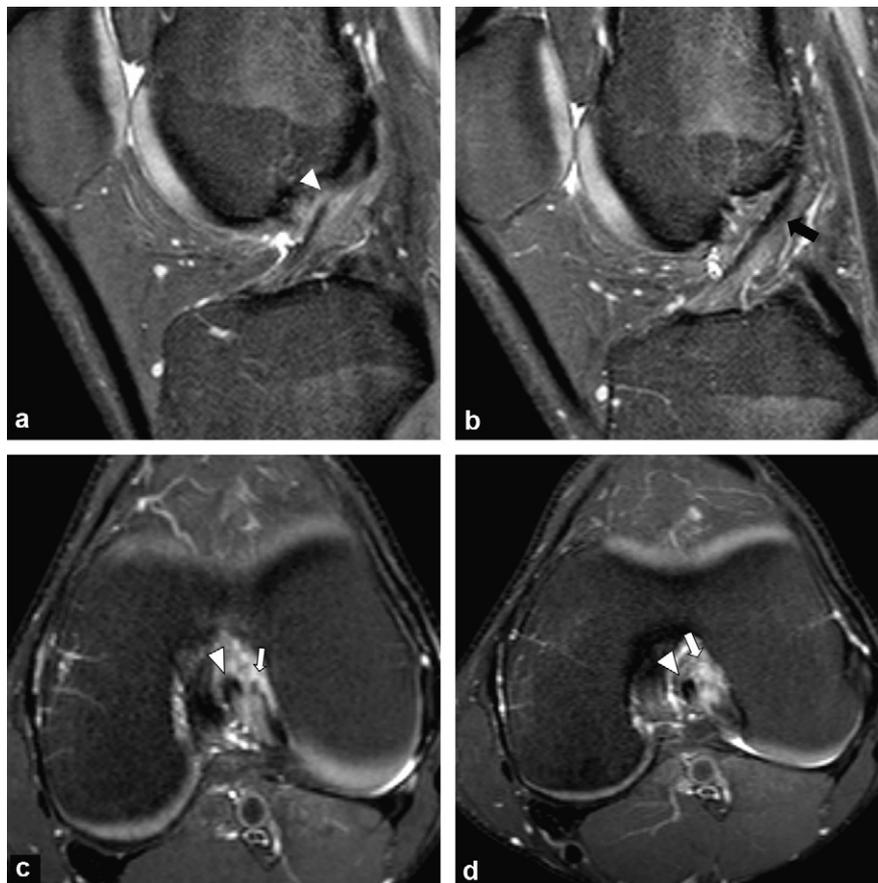


Figure 10. Partial tear of the posterolateral bundle of the anterior cruciate ligament (ACL): a: sagittal PD fat-sat: presence of some discontinuous fibres. Partial interruption of the fibres at mid-height can be seen (white arrowhead); b: sagittal PD fat-sat: in the same patient and in the same plane but on a different slice the fibres appear to be continuous (black arrow); c: axial PD fat-sat: the AMB (white arrowhead) and the posterolateral bundle (PLB) (white arrow) are visible; d: axial PD fat-sat: the AMB (white arrowhead) is complete and the PLB (white arrow) is discontinuous. A hypersignal can be seen on the path of the PLB suggesting a tear. In this patient it was a partial tear of the PLB confirmed by clinical examination and the favourable clinical outcome (the patient did not undergo surgery and has no instability after medical treatment).

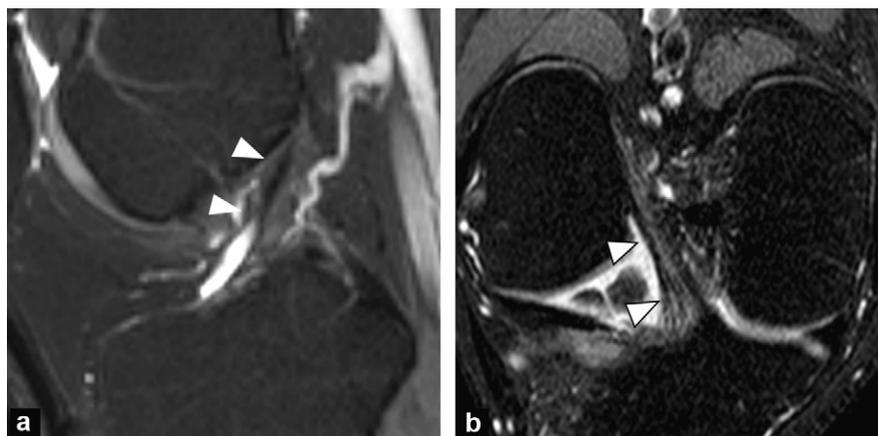


Figure 11. Discordance between MRI and arthroscopy: anterior cruciate ligament (ACL) tear considered as incomplete in the MRI and complete by arthroscopy: a: sagittal PD fat-sat: the fibres (indicated by the white arrowheads) are not clearly visible at their origin; b: coronal oblique PD fat-sat in the axis of the ACL: the fibres (white arrowheads) appear continuous throughout their path in this plane. Arthroscopy showed a complete tear of the ACL.

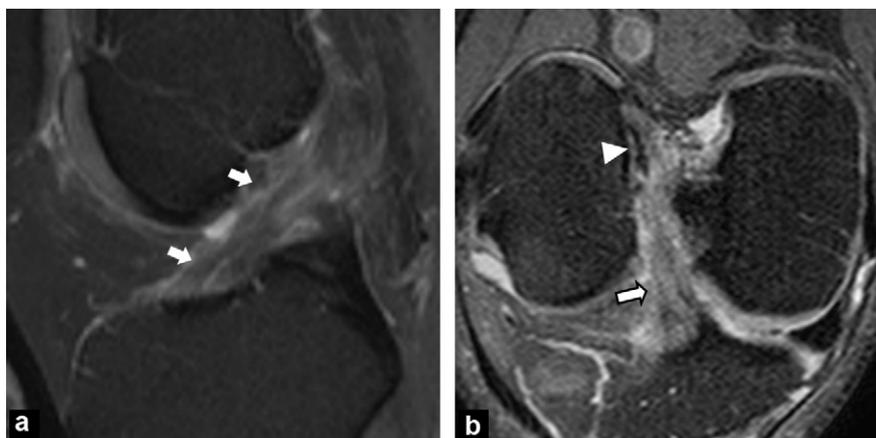


Figure 12. Discordance between MRI and arthroscopy: anterior cruciate ligament (ACL) tear considered as complete in the MRI and incomplete by arthroscopy: a: sagittal PD fat-sat: no continuous fibre visible (ACL marked by white arrows). A hypersignal was found, plus enlargement and horizontalisation of the ACL; b: coronal oblique PD fat-sat: a few fibres are visible at the origin of the ACL (arrowhead) then there is loss of fibre continuity (the arrow marks the ACL). Arthroscopy showed a partial tear of the ACL.



Figure 13. Bucket handle lateral meniscal fissures accompanying a complete tear of the anterior cruciate ligament (ACL) with arthroscopic confirmation. Sagittal PD fat-sat: double posterior cruciate ligament sign.

100% in adults [35]. In adolescents contusions of the lateral compartment can be observed without an ACL tear [6,21,48]. They are transient and disappear within a few months, and thus have no prognostic significance [49–51]. On the other hand, clear distortion of the associated subchondral bone lamina (impaction) is a factor for a poor prognosis with the possible development of osteoarthritis as a consequence of the irregularity of the articular surfaces. 80% of contusions affect the lateral femoro-tibial compartment [49]. They usually occur in the middle third of the femoral condyle and the posterior part of the tibial plateau.

Bone contusions of the medial compartment are less frequent and usually associated with damage to the lateral compartment. They mainly concern the posterior border of the medial tibial plateau, and are due to a contrecoup mechanism during reduction of the dislocation [51].

Chondral lesions

According to authors they are frequent but not very specific, and in two thirds of cases affect the medial femoral condyle [33].

Avulsion fractures

The Segond fracture (or avulsion of the lateral capsular insertion)

This occurs when cortical bone is torn off from the anterolateral border of the lateral tibial plateau, resulting from excessive internal rotation and valgus strain [52]. This fracture is pathognomonic of a torn anterior cruciate ligament [53]. Many studies have shown that a Segond fracture is associated with tearing the ACL in 75 to 100% of cases [54,55]. In MRI, the bone fragment is not always visible (one case in three), hence the importance of the standard A-P X-ray. However, the appearance of bone contusion of the lateral tibial border and oedematous thickening of the lateral capsular plane are invariable. Extension of the lesions may go as far as tearing the lateral collateral ligament including the iliotibial band. There is frequently meniscus damage [52].

Avulsion fracture of the proximal part of the fibula

This should suggest lesions to the anterior and posterior cruciate ligaments and reflects posterolateral corner lesions [42].

Avulsion of the insertion of the semimembranosus muscle

This is an avulsion fracture of the posteromedial part of the tibial plateau [53].

Avulsion of the tibial intercondylar processes

This occurs when the insertion of the ACL on the prespinal surface is torn out and more or less extends to the intercondylar processes [53]. This form of injury is the most common in children.

The advantages of classifying ACL lesions for therapeutic management

An ACL tear can be classified into five clinical groups that determine therapeutic management. In all cases the therapeutic decision for ligament reconstruction or orthopaedic treatment is multifactorial and is based on the age, type of work and sports activities of the patient.

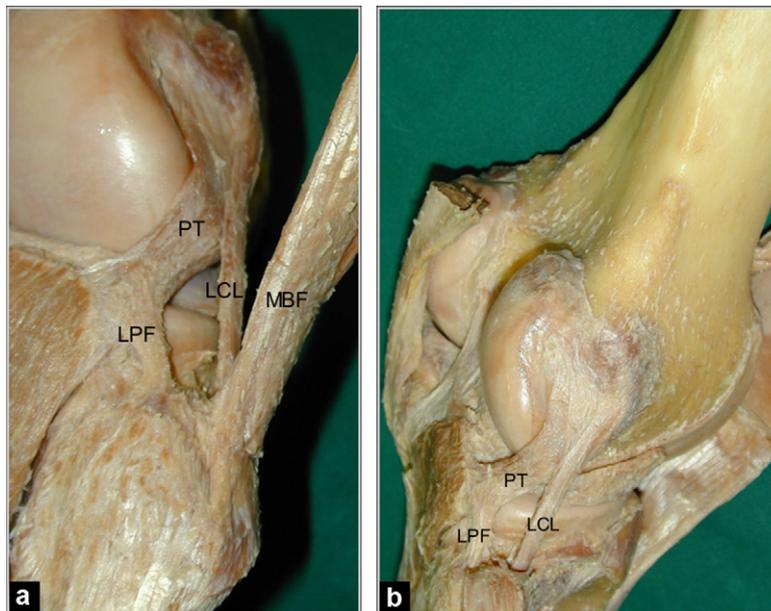


Figure 14. Anterolateral (a) and posterolateral (b) views of an anatomical preparation of the posterolateral corner: biceps femoris (MBF), lateral collateral ligament (LCL), popliteal muscle tendon (PT), popliteofibular ligament (LPF).

Isolated tears of the anterior cruciate ligament (ACL)

Physiotherapy should be early to relieve the patient's pain and recover mobility (range of joint movement). Ligament reconstruction is considered between occurrences where there is instability [12,21].

Anterior cruciate ligament (ACL) tears with a meniscal lesion

The meniscus should be preserved as much as possible to limit development of osteoarthritis. If there is bucket-handle locking, the meniscus should undergo surgery as early as possible to attempt to suture it rather than perform meniscectomy. ACL reconstruction can be performed simultaneously, or deferred.

Anterior cruciate ligament (ACL) and medial collateral ligament (MCL) tears

Normally the MCL should have been allowed to heal by orthopaedic treatment before considering ACL surgery. The MCL heals in 100% of cases.

Anterior cruciate ligament (ACL) tears with injury to the posterolateral corner

Corner surgery must be performed rapidly, within two weeks, because it never heals spontaneously. The timing of ligament reconstruction is discussed on an individual basis.

Partial tears

In the absence of instability, functional treatment is proposed as a first course of action. Ligament reconstruction will be discussed if instability occurs.

Conclusion

The anatomy of the ACL ligament is complex, reflecting its function of providing sagittal and rotational stabilisation of the knee joint. Direct and indirect signs of ACL tears must both be sought using MRI to obtain the excellent diagnostic performance described in the literature. Imaging partial tears seems to be more tricky, constituting an important prognostic issue. Finally, the detection of associated injuries, particularly meniscal lesions, is fundamental in guiding therapeutic management.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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