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6 Lateral Collateral Ligament and Posterolateral Corner of the Knee Joint

Introduction • Relevant Anatomy • Clinical Evaluation • Radiological Evaluation • Treatment Options • Conclusion

6.1 Introduction

The lateral corners of the knee play an important role in maintaining the stability of the knee. Injuries of the anterolateral and posterolateral corner are rare, accounting for less than 2 % of ligamentous injuries of the knee.[1] However, these injuries have been associated with significantly complex intraarticular lesions. The concept of knee dislocation has been extended to include knees that reduce spontaneously. Chronic injury frequently leads to rotatory instability, posterolateral and anterolateral instability and has been associated with early osteoarthritis in the knee. These injuries, if not diagnosed and treated, are an important cause of PCL failure and ACL reconstruction.[2]

Although there is no consensus as regards treatment, recent studies have shown that early surgical treatment of the knee with multiple ligament injuries provides favorable functional and clinical outcomes.

Seebacher, J. R. et al. described the knee with a classical anatomical concept and identified three layers[3] referred to as the superficial (biceps tendon and iliotibial band), the middle (femoropatellar ligaments), and the deep layers (LCL, fabellofibular ligament, popliteofibular ligament, arcuate ligament and popliteal muscle). However, we consider it more practical to divide it into the central compartment, ACL and PCL and peripheral compartments: anterolateral, posterolateral, anteromedial and posteromedial.

The purpose of this chapter is to familiarize the reader with normal MRI anatomy of the antero- and posterolateral corner of the knee and its biomechanical properties, review the spectrum of radiological findings of combined injuries of the lateral corner in knee trauma, and present the basic options of surgical treatment.

6.2 Relevant Anatomy

6.2.1 Posterolateral Corner

Lateral corners of the knee emcompass a complex network of static and dynamic stabilizers that act jointly as a functional unit to provide posterolateral knee stability. These structures have been termed the arcuate ligament complex.[4] The latter acts as a unit and resists excessive posterior translation, varus, and external rotation. Static components include the lateral collateral ligament, the popliteofibular ligament, the arcuate ligament complex, the fabellofibular ligament, and the posterolateral capsule. The biceps tendon, the iliotibial tract, and the popliteus muscle tendon complex are the dynamic components. Of these complex and occasionally inconsistent structures, the most important contributors to stability are the LCL and the popliteus complex, especially the popliteofibular ligament (Figs. 6.1, 6.2).

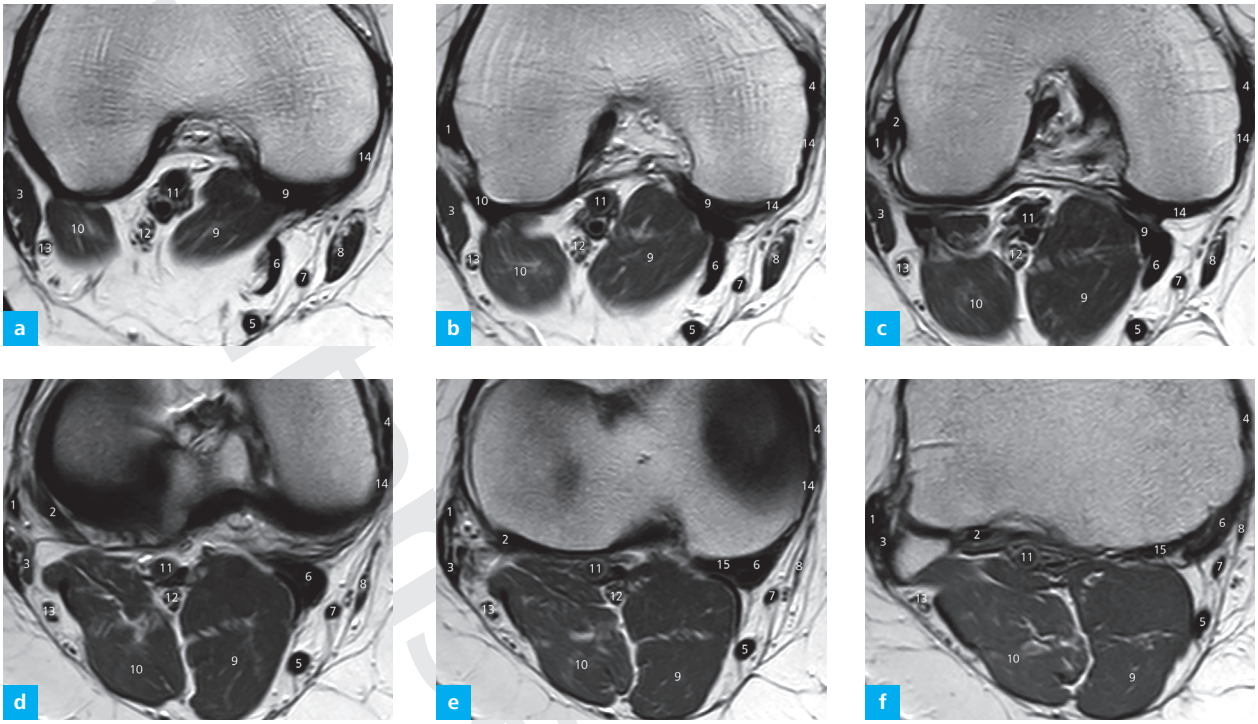

Fig. 6.1: Axial anatomy of the posterior corner of the knee. (1) Lateral collateral ligament (LCL), (2) popliteus muscle and tendon, (3) biceps femoris muscle and tendon, (4) medial collateral ligament (MCL), (5) semitendinosus tendon, (6) semimembranosus tendon, (7) gracilis tendon, (8) sartorius tendon, (9) medial gastrocnemius muscle and tendon, (10) lateral gastrocnemius muscle and tendon, (11) popliteal artery and vein, (12) tibial nerve, (13) common fibular nerve, (14) posterior oblique ligament (POL), (15) oblique popliteal ligament (OPL).

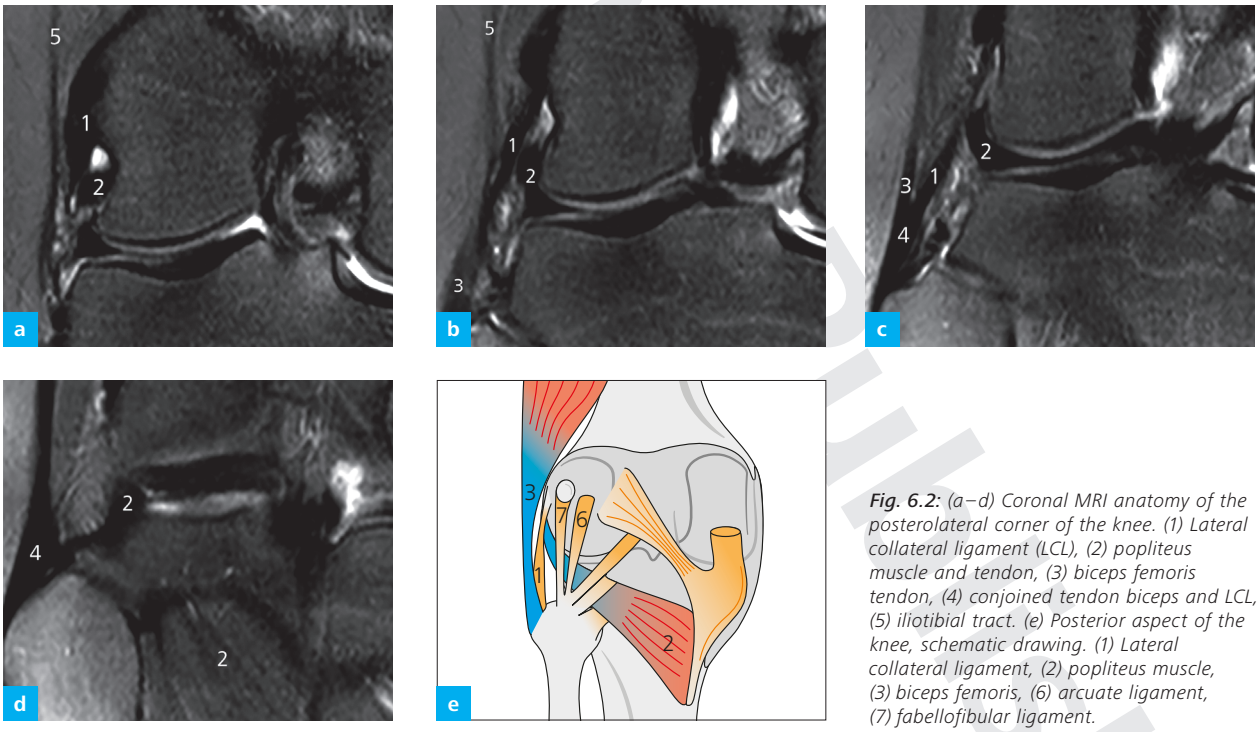

Fig. 6.2: (a–d) Coronal MRI anatomy of the posterolateral corner of the knee. (1) Lateral collateral ligament (LCL), (2) popliteus muscle and tendon, (3) biceps femoris tendon, (4) conjoined tendon biceps and LCL, (5) iliotibial tract. (e) Posterior aspect of the knee, schematic drawing. (1) Lateral collateral ligament, (2) popliteus muscle, (3) biceps femoris, (6) arcuate ligament, (7) fabellofibular ligament.

6.2.1.1 Static Stabilizers

The lateral collateral ligament (LCL), also known as the fibular collateral ligament, is a straight ligament originating proximally from the femoral sulcus superior to the popliteal tendon and anterior to the lateral gastrocnemius muscle, and inserting distally on the fibula, anterior to the arcuate or fabellofibular ligament. It primarily limits varus and secondarily resists external rotation and posterior displacement of the tibia (Fig. 6.3).[5]

The popliteofibular ligament (PFL) is a band-like structure extending from the myotendinous junction of the popliteal muscle to the apex of the fibular head (Fig. 6.4). It is the single most important stabilizer of the posterolateral corner, primarily preventing external rotation and secondarily posterior translation and varus angulation.[6] It has been found in 98 % of cadaver studies,[3] but was nonetheless referred to as less frequently visualized on radiological studies, probably due to variations in MRI technique and the use of low-resolution images; images

can be depicted on both coronal and axial images with higher resolution.[7–10] The cross-sectional area of the PFL is similar to that of the LCL (6.9 mm^2 versus 7.2 mm^2) and the popliteal tendon (Fig. 6.5).

Fig. 6.3: Coronal oblique MRI plane. This plane provides an outline of the lateral collateral ligament (LCL) on a single image (arrow), from its origin to its insertion.

The importance of the LCL and the PFL increases when the PCL fails. In varus, external rotation, and posterior translation forces increase, and the popliteal muscle becomes the most important stabilizer.[11] At 90° flexion, an intact PLC resists posterior translation, rotation and varus.

In chronic cases, combined injuries of posterior complex ligaments and the PCL increase medial patellofemoral loads secondary to posterior translation and higher quadriceps tendon contraction when the knee is extended.[12]

The fabellofibular and arcuate ligaments are not always present or visualized. The accessory fabella bone is seen in a mere 40 % to 68 % of knees (Fig. 6.6). A fabellofibular ligament in the absence of a fabella is clinically insignificant.[13]

The arcuate ligament is Y-shaped, with a lateral band from the femoral condyle to the popliteal tendon (Fig. 6.7). The medial band merges with the oblique popliteal ligament. This ligament has been observed in 47.9 % to 71 % of knees,[14] but is seen on MRI in a mere 24 % of patients. The size of the fabellofibular ligament and the arcuate ligament are inversely related as a biomechanical adaptation.[3]

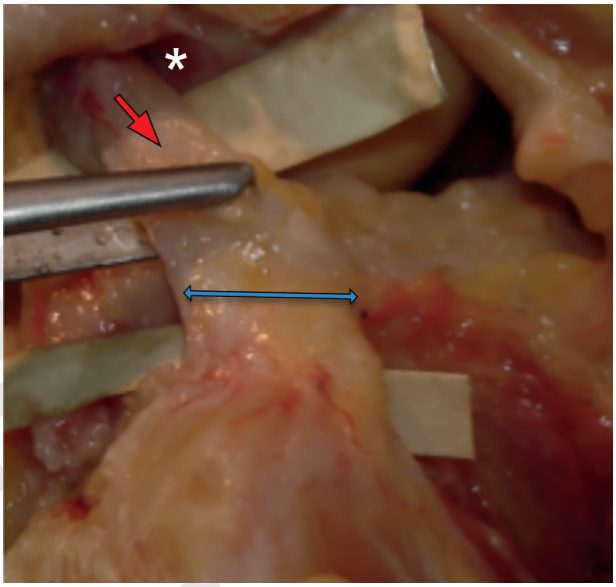

Fig. 6.5: Cadaveric sample of the PFL, showing that its size (blue arrow) is similar to that of the popliteal tendon (red arrow). The popliteal tendon turns intraarticular as it enters the popliteal hiatus (asterisk).

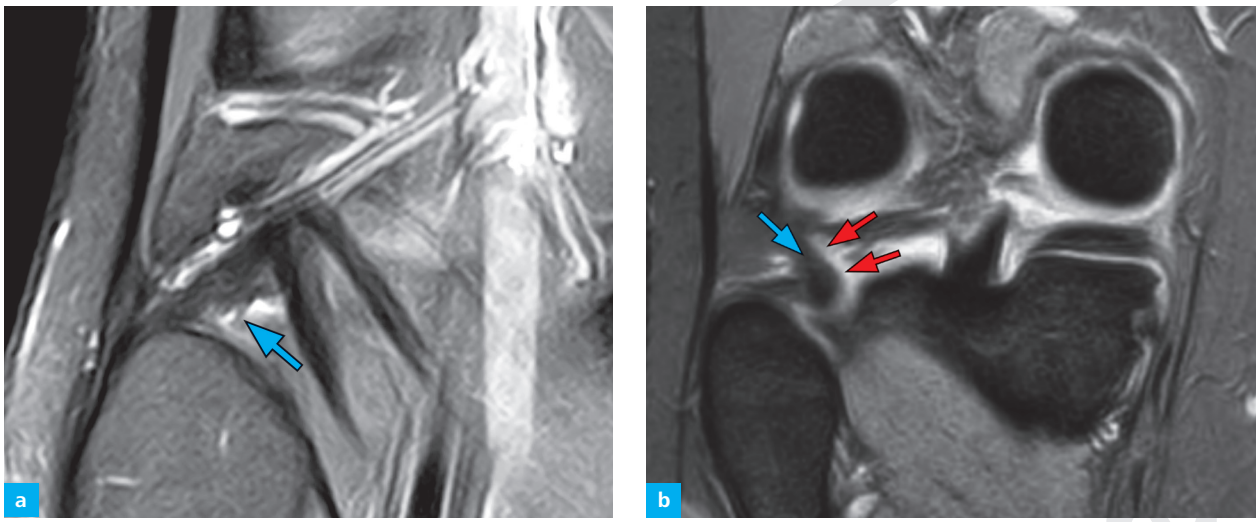

Fig. 6.4: Popliteal fibular ligament (PFL). (a) Coronal PD fat-saturated image. (b) Gradient echo 3D sequence. (a, b) The small quantity of fluid surrounding the popliteal tendon (red arrows) highlights the PFL (blue arrows).

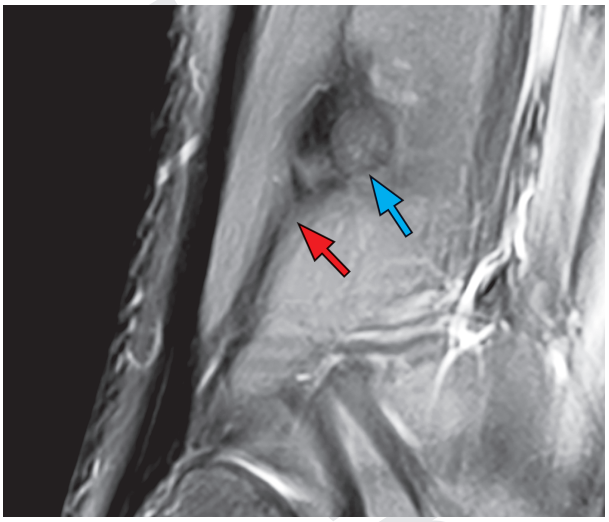

Fig. 6.6: Fabellofibular ligament (blue arrow) on a coronal T1-weighted image, extending from the fabella to the fibula (red arrow).

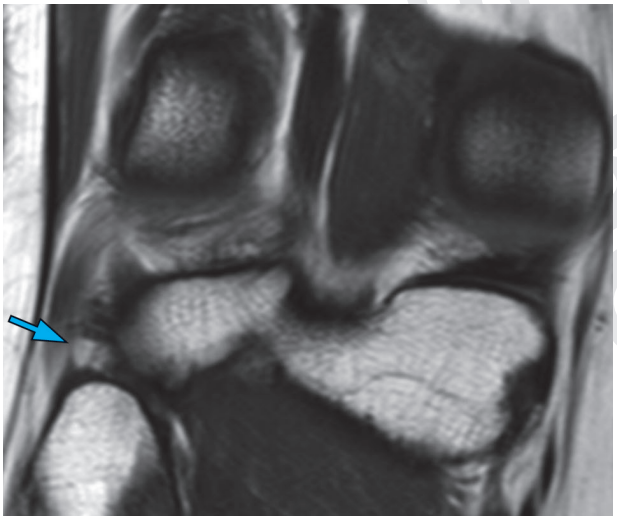

Fig. 6.7: The typical Y-shaped arcuate ligament is clearly seen on this coronal T1-weighted image (arrow).

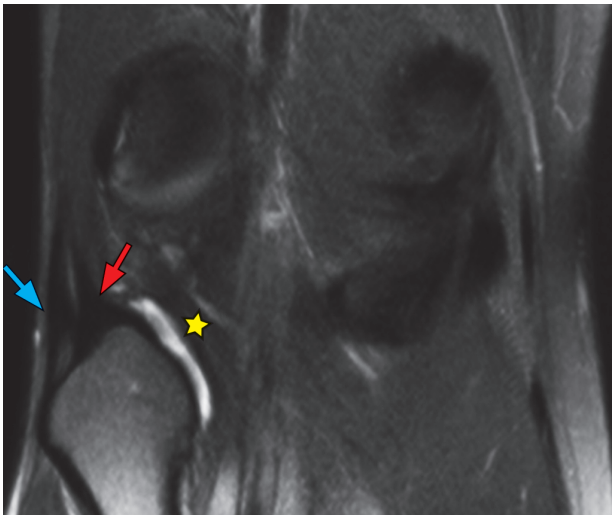

Fig. 6.8: The insertion of the biceps tendon (blue arrow) and the collateral ligament (red arrow) onto the fibular head is seen on this coronal T2-weighted, fat-saturated image. Usually its attachment is not separate as in this case (see Fig. 6.2). A small quantity of fluid through the popliteus hiatus clearly highlights the popliteal tendon (asterisk).

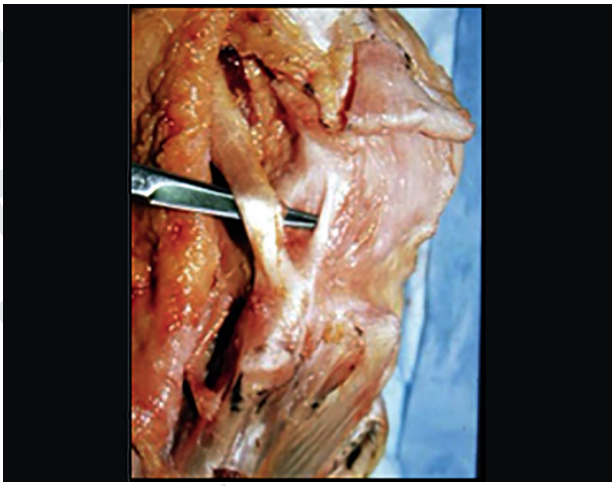

Fig. 6.9: Cadaveric anatomic sample showing the common fibular insertion of the biceps tendon and the LCL.

6.2.1.2 Dynamic Stabilizers

The biceps tendon has two arms: a short head reinforcing the posterolateral joint capsule in the interval between the LCL and the lateral head of the gastrocnemius; and a long head with a direct portion that attaches on the posterolateral aspect of the fibular head and an anterior arm inserting into the lateral aspect of the fibular head, lateral to the insertion of the LCL (Fig. 6.8).[4]

The popliteal tendon originates proximally in the sulcus of the femoral lateral condyle, deep and inferior to the LCL. Descending laterally through the popliteus hiatus, it turns extraarticular. At this site, it inserts the broad oblique popliteofibular ligament at the lateral aspect of the myotendinous junction (Figs. 6.8, 6.9).

The popliteus hiatus is formed by the fascicles of the lateral meniscus, i.e. the superior popliteomeniscal fascicle and the inferior popliteomeniscal fascicle. The medial edge is the lateral body of the meniscus. Popliteomeniscal ligaments prevent motion of the lateral meniscus during knee extension. The proximal part of the popliteal tendon is an extraarticular extension of the synovial membrane of the knee joint, surrounded by the popliteal bursa. The popliteus tendon is most commonly injured at the myotendinous junction. Disruption at its femoral attachment is rare. When this occurs, it is usually caused by high impact forces and is associated with major intraarticular injuries. Only femoral avulsion can be diagnosed on arthroscopy.