Medial Collateral Ligament (MCL)

5

5.1 Anatomy

- MCL generally consists of three layers (Figs. 5.1 and 5.2), but the naming and classification of the layers that comprise MCL may vary according to different authors:
- Layer I: Thin sheet that overlies the two heads of the gastrocnemius and the structures of the popliteal fossa.
- Layer II: Superficial layer of the MCL (alternatively called tibial collateral ligament). Anteriorly, Layer II blends with Layer I through the split to form the medial patellar retinaculum. Posteriorly, it blends with Layer III via the posterior oblique ligament.
- Layer III: Deepest layer of the MCL called medial capsular ligament, which is continuous with the medial joint capsule.
- Fibrofatty tissue fills the space between Layer I and II, and the tendons of semitendonisus and gracilis run through this space.
- Small bursae are located within fibrofatty tissue between Layer II and II (Fig. 5.3).
- Superficial layer of MCL runs vertically and has a width of 15 mm, length of 8–12 cm, and thickness of 2–3 mm.
- The posterior oblique portion of the MCL (posterior oblique ligament) is fused with layer III and closely attached to the medial meniscus and also the tibia (Fig. 5.4).

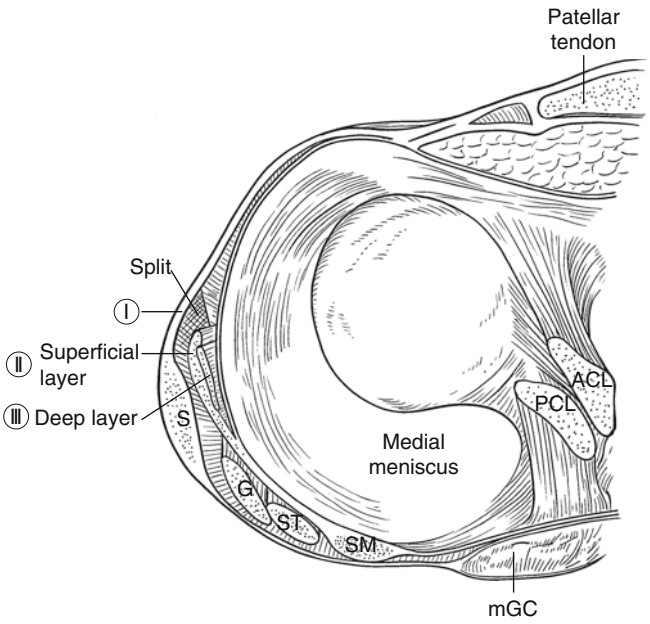

Fig. 5.1 Three layers of the MCL. *Layer I*: thin sheet that overlies the two heads of the gastrocnemius and the structures of the popliteal fossa. *Layer II*: superficial layer of MCL. *Layer III*: medial joint capsule including the deep layer of MCL. *S* sartorius, *G* gracilis, *ST* semitendinosus, *SM* semimembranosus, *mGC* medial head of gastrocnemius (Illustration adapted from Warren and Marshall)

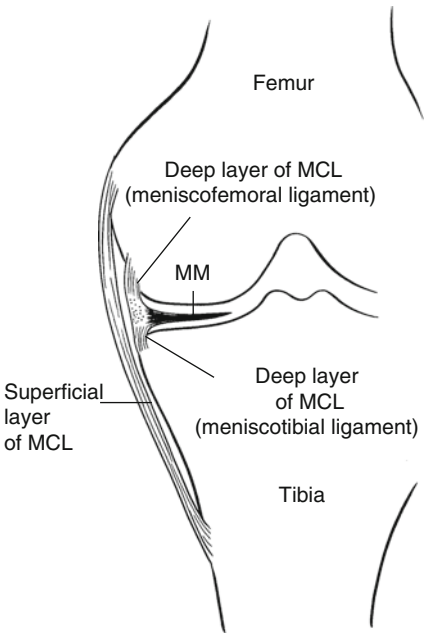

Fig. 5.2 Schematic illustration of the MCL. The superficial layer (also known as the tibial collateral ligament) and the deep layer (also known as medial capsular ligament). Superficial layer of MCL attaches to the tibia at 7–8 cm below the joint space (note the significant distance). The deep layer firmly attaches to the medial meniscus and is also known as meniscofemoral and meniscotibial ligament

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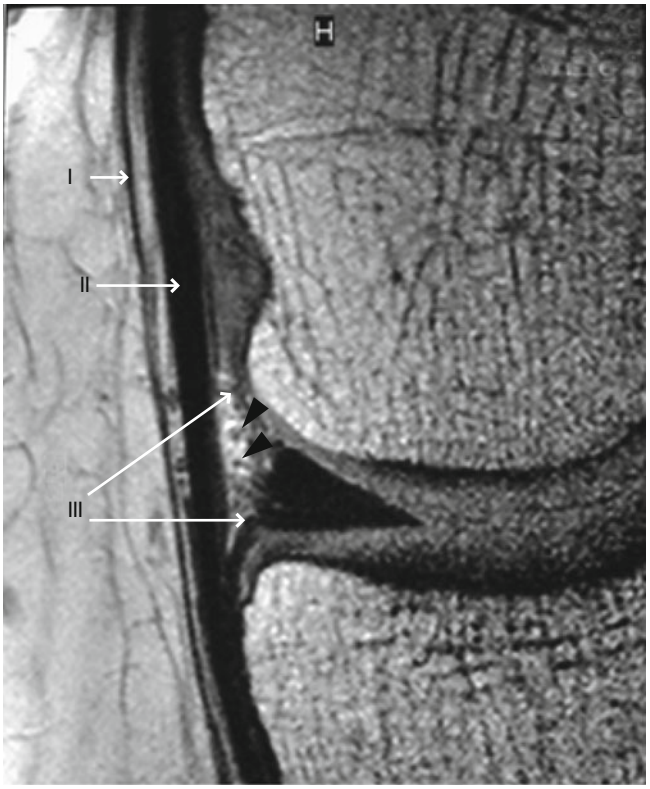

Fig. 5.3 High-resolution image of the medial compartment of the knee joint acquired using a microscopy coil (FOV 50 mm, slice thickness 1.5 mm). As shown in Fig. 5.1, *layer I*: thin sheet of fascia, *layer II*: superficial layer of the medial collateral ligament (MCL), *layer III*: deep layer of MCL, and a small bursa and small blood vessels (*arrowheads*)

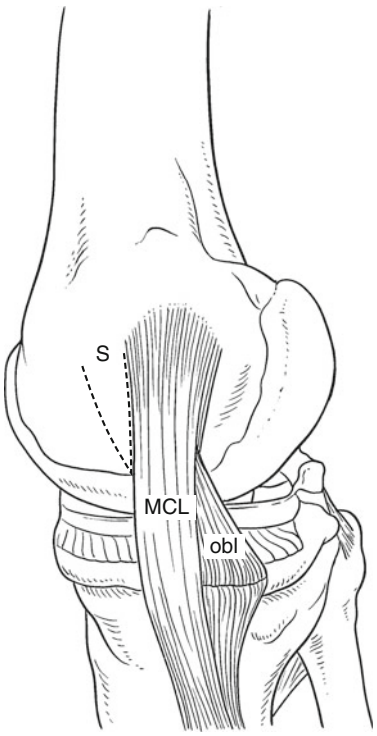

Fig. 5.4 Superficial layer of the medial collateral ligament (MCL) and posterior oblique ligament (obl). There is a split (S) anterior to the superficial layer of the MCL (see also Fig. 5.1)

- Superficial layer of MCL proximally attaches to the medial femoral condyle 5 cm above the joint space and distally attaches to the metaphyseal region of the tibia 6–7 cm below the joint space. For this reason, on MR imaging, care must be taken to include the inferior edge of the distal MCL within the FOV. The distal attachment lies beneath the pes anserinus.
- Deep to the vertical component of the superficial MCL, the capsule becomes thicker, forming the deep layer of MCL. This layer inserts directly into the edge of femur and tibial plateau and firmly attaches to the medial meniscus and thus divided into meniscofemoral and meniscotibial ligaments, respectively. However, in normal knees without joint effusion, these ligaments may not be delineated on MRI (Figs. 5.5).
- There is no direct connection between the superficial layer of MCL and the medial meniscus.
- MCL prevents resistance to valgus stress and external rotation of the distal lower limb.

References

Warren LF, Marshall JL. The supporting structures and layers of the medial side of the knee: an anatomical analysis. J Bone Joint Surg. 1979;61-A:56–62.

De Maeseneer M, Van Roy F, Lenchik L, Barbaix E, De Ridder F, Osteaux M. Three layers of the medial capsular and supporting structures of the knee: MR imaging-anatomic correlation. Radiographics. 2000;20:S83–9.

Fig. 5.5 Visualization of the deep layer of MCL (*arrow*) due to the presence of joint effusion. Damage to MCL or the medial meniscus led to accumulation of joint fluid between the superficial and deep layers of the MCL (*), enabling the delineation of the deep layer

Lee JK, Yao L. Tibial collateral ligament bursa: MR imaging. Radiology. 1991;178:855–7.
De Maeseneer M, Lenchik L, Starok M, Pedowitz R, Trudell D, Resnik D. Normal and abnormal medial meniscocapsular structures: MR imaging and sonography in cadavers. AJR. 1998;171:969–76.

Hamstrings and the Pes Anserinus (Fig. 5.6)
Hamstrings refer to the posterior thigh muscles that arise from the ischial tuberosity. (A commonly accepted origin of the name is that legs of ham used to be hung using the tendons behind the knee.) Medially, it comprises semitendinosus and semimembranosus, while laterally, it comprises biceps femoris. Pes anserinus ("goose's foot") is the insertion of the conjoined tendons of sartorius (arising from the anterior superior iliac spine), gracilis (arises from the anterior margin of the lower half of the symphysis pubis), and semitendinosus (arises from the tuberosity of the ischium). Semimembranosus attaches behind these three tendons.

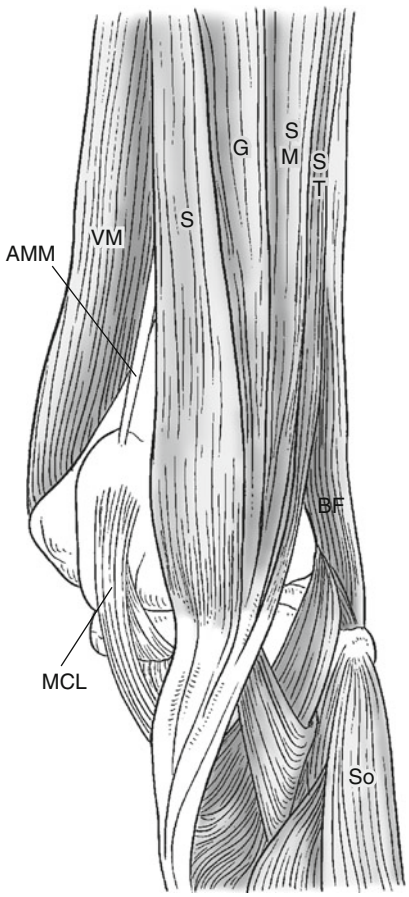

Fig. 5.6 Postero-oblique view of the medial compartment of the knee. *S* sartorius, *G* gracilis, *SM* semimembranosus, *ST* semitendinosus. Semimembranosus and semitendinosus form the medial component of the hamstrings, while sartorius, gracilis, and semitendinosus form the pes anserinus. (Only semimembranosus does not reach pes anserinus because it ends at the posterior aspect of the tibia.) *VM* vastus medialis, *BF* biceps femoris, *AMM* adductor magnus musle, *MCL* medial collateral ligament, *SO* soleus

5.2 MCL Tear

- MCL injury is the most common ligamentous injury in the knee.
- Injury of the MCL alone is likely to occur following valgus stress to the distal lower limb.
- MCL tear can be classified as the following three grades:
- Grade 1: sprain or strain, mainly consisting of elongation of the ligament without any functional loss. Treated conservatively.
- Grade 2: partial tear.
- Grade 3: complete tear.
- Differentiating between grade 2 and 3 may be impossible, even on MRI, and often written as "grade 2–3 tear."
- In grade 1 MCL tear, linear hyperintensity representing edema along the ligament's fibers due to sprain or strain can be seen (Fig. 5.7). However, this imaging finding can also be found in medial meniscal tear and knee osteoarthritis.
- In grade 2–3 MCL tear, discontinuity of the fibers and signal abnormalities due to edema and hematoma will be seen (Figs. 5.8 and 5.9).
- Edematous changes may not be limited to the MCL itself but can extend into the surrounding medial retinaculum and vastus medialis (Fig. 5.8).
- More than half of MCL tear occurs at the proximal (femoral) portion, but it can less commonly occur in the distal (tibial) portion (Fig. 5.10).

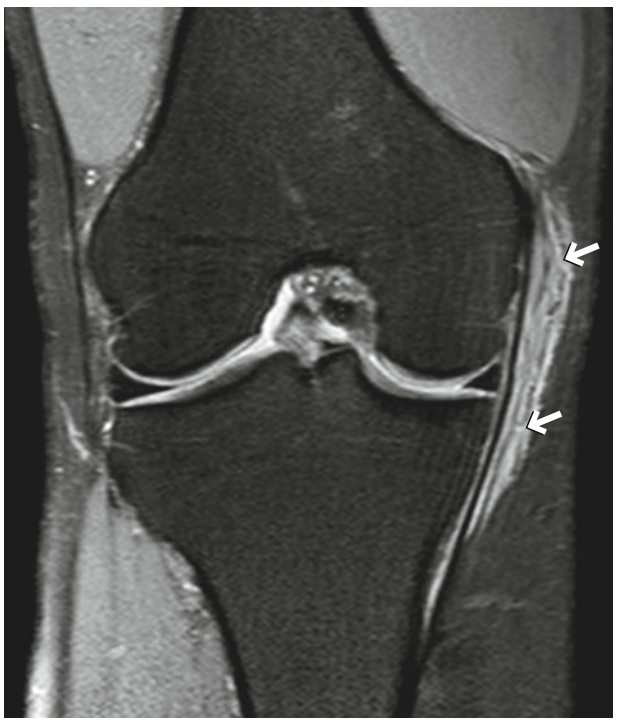

Fig. 5.7 Grade 1 tear (strain) of the MCL. A man in his 20s who had a ski injury the day before presentation. Coronal FS PDWI shows linear hyperintensity along the superficial layer of the MCL, representing edema due to strain (*arrows*)

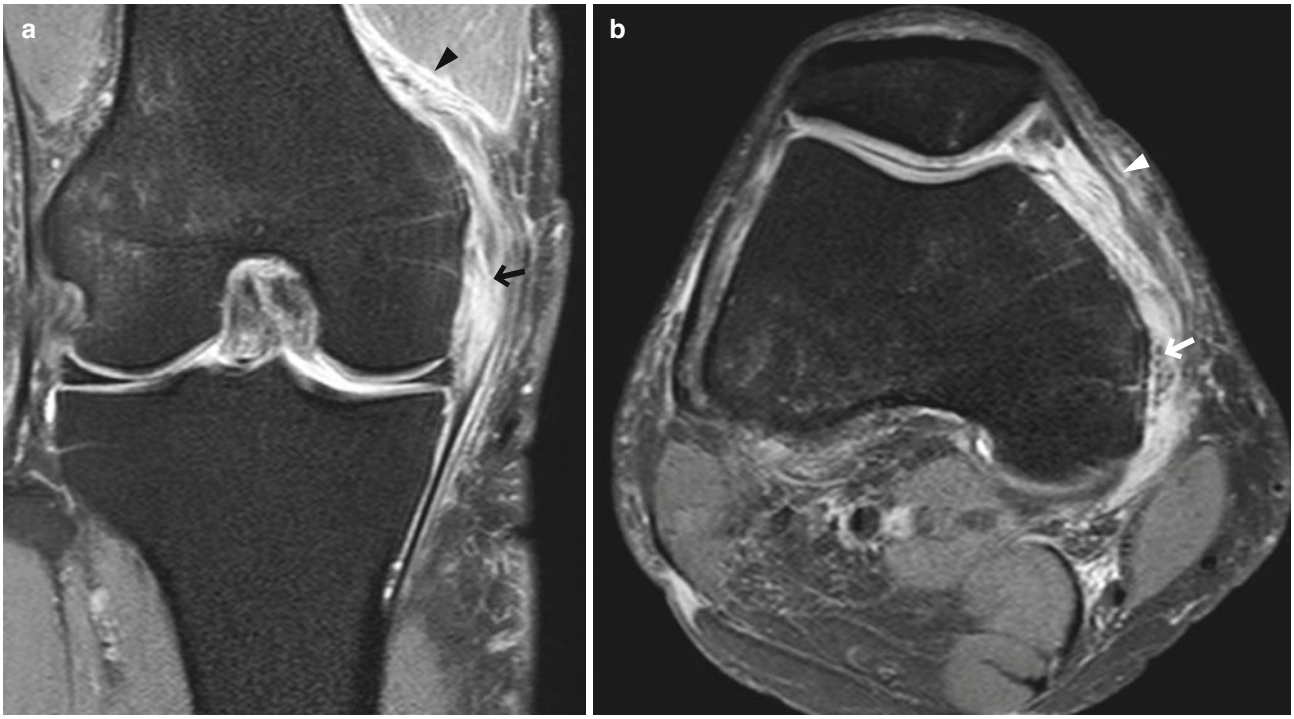

Fig. 5.8 Grade 2 tear (partial tear) of the MCL. A man in his 40s. (**a**) Coronal and (**b**) axial FS PDWI show edematous swelling and discontinuity of the superficial layer of the MCL (*arrows*). Edematous changes can also been seen around the medial retinaculum (*arrowhead*, **b**) and vastus medialis (*arrowhead*, **a**)

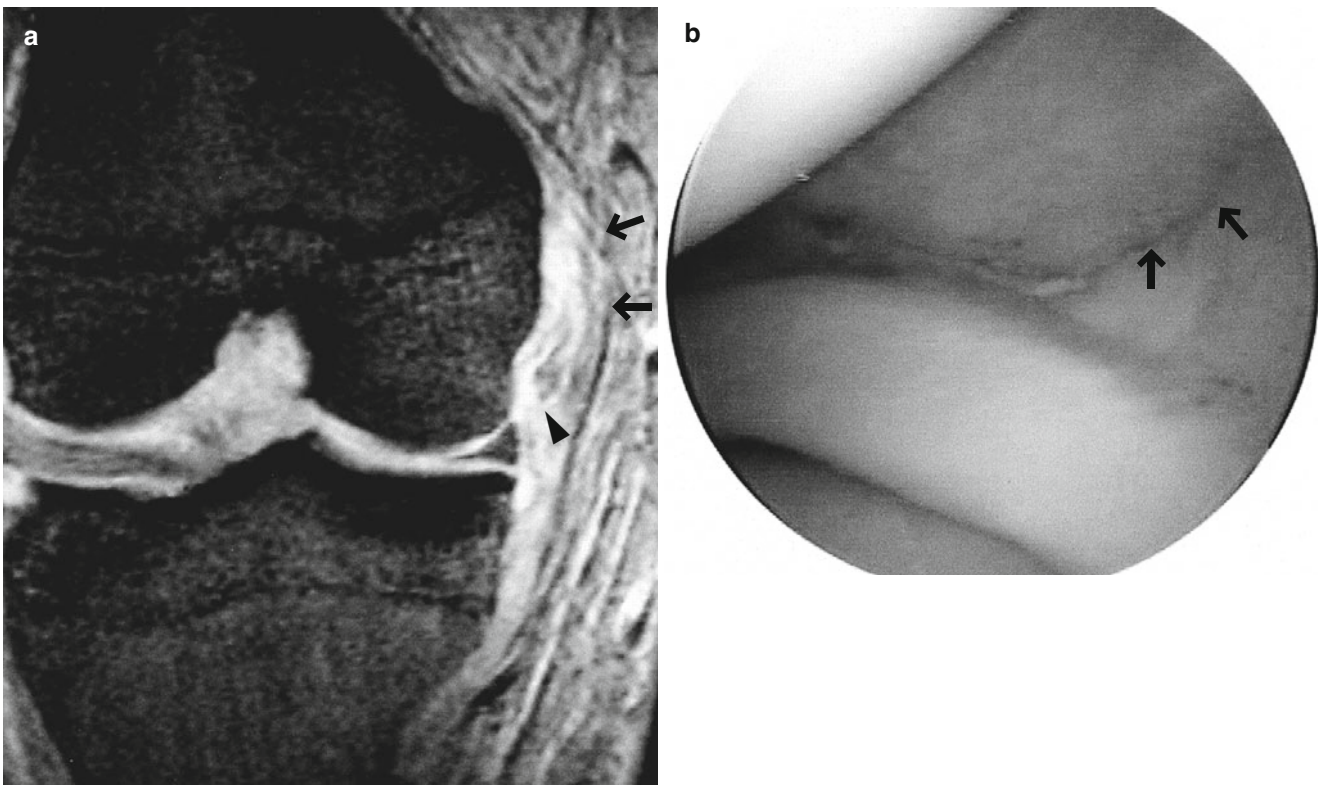

Fig. 5.9 Grade 3 tear (complete tear) of the MCL. A man in his late teens. (**a**) Coronal T2*WI and (**b**) arthroscopic image show complete tear of the proximal portion of the MCL (*arrows*), with surrounding edematous changes. In (**b**), rupture of the joint capsule (deep layer of the MCL, *arrows*) is seen. Note the torn meniscofemoral ligament (deep layer of MCL, *arrowhead* in **a**)

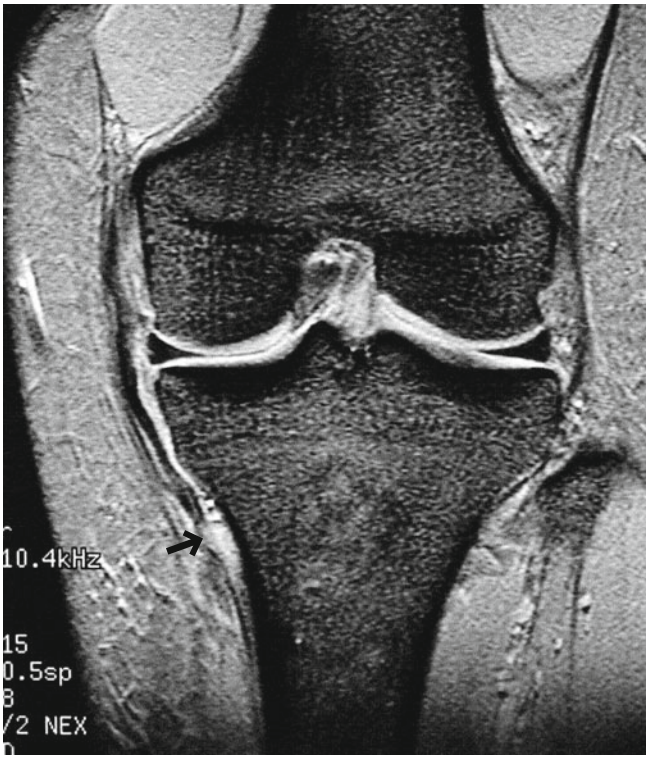

Fig. 5.10 Partial tear of the distal (tibial) portion of the MCL. A woman in her 20s. Coronal T2*WI shows torn superficial layer of the MCL (*arrow*) at the close proximity to its tibial attachment site

- IF MCL tear is accompanied by ACL tear and medial meniscal tear, this compound injury is called the classic 'O'Donoghue's unhappy triad'. It is known to occur while playing contact sports such as American football, but in daily clinical practice it is not so commonly encountered. However, more recent definition of 'unhappy triad' includes the ACL tear, MCL tear and lateral meniscal tear. This newer 'unhappy triad' is frequently seen in clinical practice.
- MCL injury is said to commonly accompany the peripheral longitudinal tear of the medial meniscus.
- MCL is an extra-articular structure, and its injury alone does not lead to joint effusion.
- Unless the deep layer of MCL is disrupted, arthroscopy will not reveal any pathological findings (Fig. 5.9b).
- Torn ligament will eventually be replaced by scar tissue. On MRI, the scar tissue may give the appearance of the normal MCL, but the functional loss is present on clinical examination (Figs. 5.11, and 5.13). However, in the varus knee in patients with knee osteoarthritis, MCL may appear thickened due to reduced tension because of the malalignment of the knee.

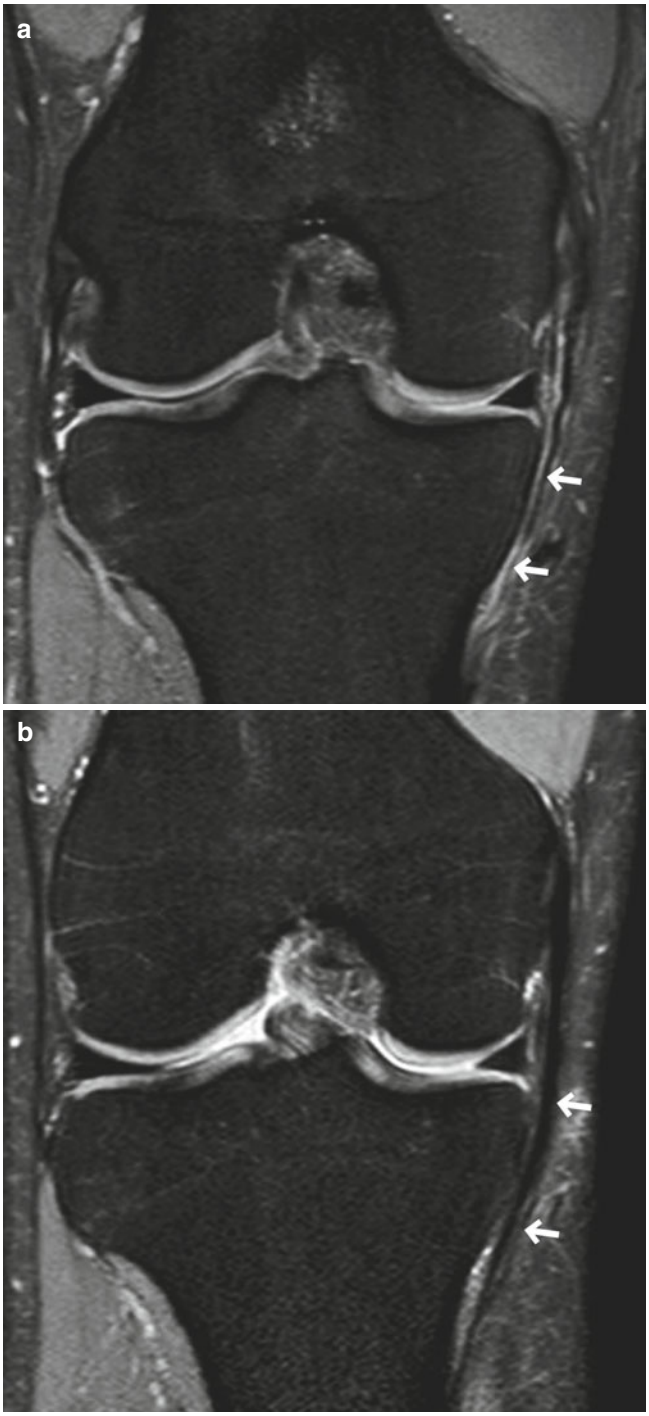

Fig. 5.11 Longitudinal follow-up of partially torn MCL. A woman in her 20s. Coronal FS PDWI acquired (**a**) immediately after the injury and (**b**) 7 months later. In (**a**), grade 1 tear of the superficial layer of the MCL is noted (*arrows*). In (**b**), the torn portion of the MCL demonstrates fibrous thickening (*arrows*)

References

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Blankenbaker DG, De Smet AA, Fine JP. Is intra-articular pathology associated with MCL edema on MR imaging of the non-traumatic knee? Skeletal Radiol. 2005;34:462–7.

Fig. 5.12 Avulsion fracture of the MCL attachment site of the femur. A man in his 30s. Coronal FS PDWI shows a small bone fragment (*arrow*) that has separated from the femur, corresponding to the avulsion fracture of the MCL attachment site

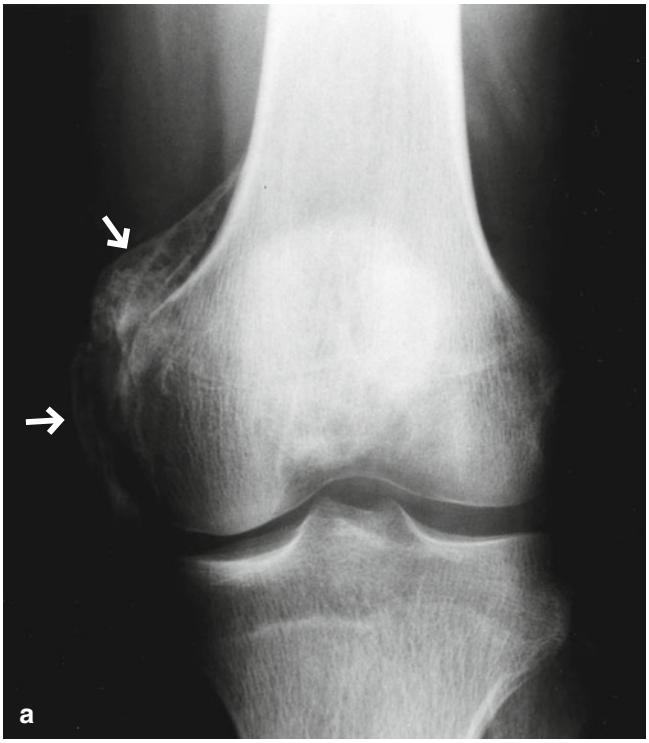
Fig. 5.13 Chronic tear of the MCL. A woman in her 30s. Coronal T2*WI shows torn MCL being replaced by fibrous scar tissue and thickened (*arrows*). It appears as if it is a normal MCL. Caution is needed when interpreting this type of cases

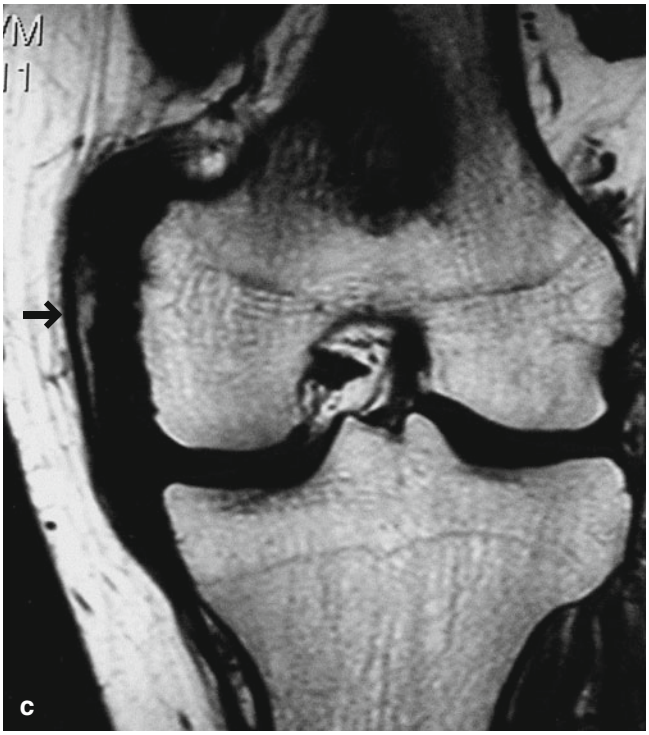
5.3 Pellegrini-Stieda Syndrome

- In patients with chronic MCL tear, the ossification of the proximal part of the MCL may occur, and it is called Pellegrini-Stieda syndrome.
- It can also be found in patients without history of knee trauma (incidental finding).
- It is commonly seen near the femoral MCL attachment site. Sometimes it may need to be differentiated from avulsion fracture of the MCL attachment site of the femur.
- Large calcification may contain ossified component with fatty marrow (Fig. 5.14).

Reference

Wang JC, Shapiro MS. Pellegrini-Stieda syndrome. Am J Orthop. 1995;24:493–7.





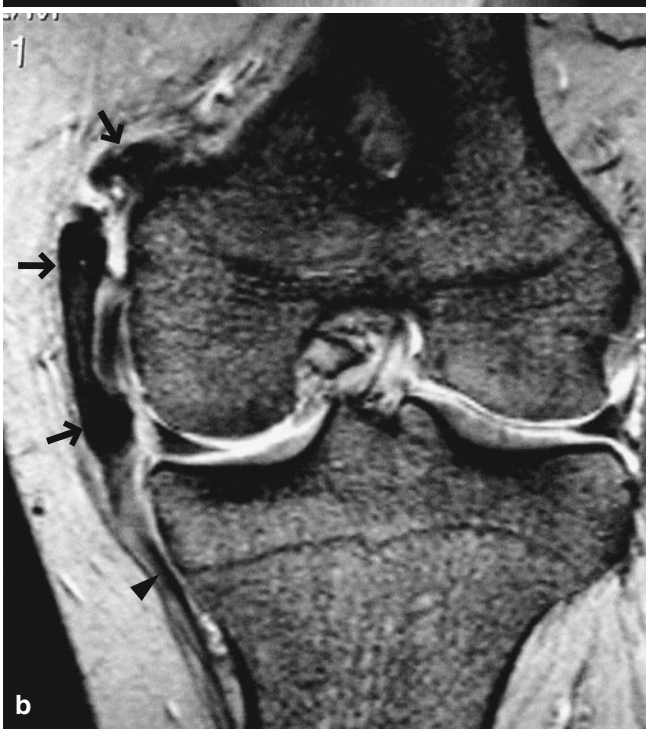


Fig. 5.14 Pellegrini-Stieda syndrome. A man in his 20s who had a knee injury due to a traffic accident 11 months prior presented with swelling of the medial side of the knee, pain during the knee motion, and mild stiffness. (**a**) Anteroposterior knee radiograph shows macrocalcification along the medial femoral condyle (*arrows*). (**b**) Coronal T2*WI shows signal void (*arrows*, **b**) corresponding to the calcification seen in (**a**) and discontinuity of the proximal portion of the superficial layer of the MCL. Note the distal portion of the superficial MCL is preserved (*arrowhead*, **b**). (**c**) T1WI shows hyperintensity (representing fatty marrow) within the calcified lesion (*arrow*, **c**)