Recently, there has been an increased anatomic, biomechanical, and clinical understanding of both the intact and injured collateral ligaments of the knee. This greater understanding has resulted in an evolution of our approach toward surgical treatment and rehabilitation of the traumatized medial and lateral collateral ligaments.

Anatomy

Medial Collateral Ligament
The medial collateral ligament (MCL) takes its origin from the medial epicondyle of the femur, inserting on the tibia approximately 4 cm distal to the joint line (Fig. 16–1). Warren and Marshall described a three-layered organization of the medial aspect of the knee. Layer 1 includes the crural fascia and is external to the superficial MCL. The crural fascia is defined by the fascial insertion of the sartorius muscle. The gracilis and semitendinosus tendons lie posteromedially between layers 1 and 2.

Layer 2 consists of the superficial MCL, the primary static stabilizer to valgus stress. The origin of the superficial MCL is reinforced by the vastus medialis obliquus. The superficial MCL has been shown to consist of both vertical and oblique portions which function differently with knee joint motion. The vertical fibers remain taut throughout the range of motion of the knee, with the oblique portion becoming lax with flexion. These oblique fibers are considered by Hughston and Eilers to represent a discrete structure commonly termed the posterior oblique ligament.

Layer 3 consists of the joint capsule and the deep MCL. The medial meniscus is firmly attached to this layer. The coronary, or menicotoribial, portion of the deep MCL remains a discrete structure, whereas the meniscofemoral portion of the deep MCL may fuse with the overlying superficial MCL. The superficial and deep portions of the MCL fuse posteromedially, blending into the tendon sheath of the semimembranosus.

Lateral Collateral Ligament
The lateral collateral ligament (LCL) originates on the lateral epicondyle of the femur and inserts into the head of the fibula (Fig. 16–2). The lateral aspect of the knee can be considered to consist of three layers. Layer 1 includes the iliotibial tract and the superficial portion of the biceps femoris. The iliotibial tract inserts into Gerdy’s tubercle; the biceps femoris inserts into the fibular head.

Layer 2 includes the extracapsular lateral collateral ligament, and is represented anteriorly by the quadriceps retinaculum and posteriorly by the two patellolofemoral ligaments and the patellomeniscal ligaments. Layer 3 consists of the joint capsule, including the arcuate and fabellofibular ligaments.

The lateral aspect of the knee can also be divided into anterior, middle, and posterior thirds. The anterior third consists of the joint capsule, which extends posteriorly from the lateral border of the patella and patellar tendon. The middle third includes the iliotibial band and the capsular ligaments deep to it, as well as the LCL, posteriorly. The posterior third is termed the arcuate complex and consists of the LCL anteriorly, the arcuate ligament, and the popliteus. The arcuate ligament arches from the posterolateral corner of the tibia to the femur. The popliteus muscle originates posteriorly on the proximal tibia, running laterally and superiorly to insert on the femur just anterior to the LCL. The posterior third of the lateral ligamentous complex is dynamically reinforced by the biceps femoris, popliteus,
The medial ligamentous support consists of the superficial medial collateral ligament, which extends distally under the pes tendons and the deeper capsular ligaments, attaching from the femoral condyle to the meniscus and then to the tibia. The posterior medial capsule, the posterior oblique ligament, is an expansion from the semimembranosus. (Reprinted with permission from Hughston JC, Eilers AF. The role of the posterior oblique ligament in repairs of acute medial (collateral) ligament tears of the knee. J Bone Joint Surg Am. 1973;55:923–940.)

Figure 16–1. The medial ligamentous support consists of the superficial medial collateral ligament, which extends distally under the pes tendons and the deeper capsular ligaments, attaching from the femoral condyle to the meniscus and then to the tibia. The posterior medial capsule, the posterior oblique ligament, is an expansion from the semimembranosus. (Reprinted with permission from Hughston JC, Eilers AF. The role of the posterior oblique ligament in repairs of acute medial (collateral) ligament tears of the knee. J Bone Joint Surg Am. 1973;55:923–940.)

and lateral head of the gastrocnemius. The lateral head of the gastrocnemius originates just posterior to the LCL on the femur.

The quadruple complex has been described by Kaplan as providing functional stability to varus stress. The complex includes the iliotibial band, biceps femoris, LCL, and popliteus.

Histology

Ligaments consist of dense, regularly oriented, parallel bundles of collagen which also contain regularly arranged fibroblasts as well as proteoglycans. Following injury to an extraarticular ligament, there is exudation of blood and associated blood products from disrupted vessels, organization of a fibrin clot, vascularization of the fibrin scaffold, proliferation of cells and synthesis of an extracellular matrix, and, finally, remodeling of the repair tissue. Laws and Walton emphasized that MCL lesions heal via a cellular response mediated by fibroblasts, and that an MCL 1 week after a grade II injury possessed only 13% of the tensile strength of a normal MCL. Frank et al showed that the injured MCL healed by bridging scar formation rather than true ligament regeneration, with some residual valgus laxity. Clayton and Weir demonstrated that surgically repaired MCLs had a more normal histologic appearance than nonsurgically treated MCLs. Woo et al demonstrated increased osteoclastic activity, resorption of bone, and disruption of the normal attachment of bone to ligament at the femoral and tibial insertion sites of immobilized MCLs. Gomez et al showed that in MCLs that were allowed to heal under tension, cellularity was reduced and collagen alignment was more longitudinally directed compared with MCLs that were allowed to heal without increased tension.

Biomechanics

Medial Collateral Ligament

Numerous studies have been performed to assess the mechanical properties of the medial collateral ligament. The MCL normally acts to resist external torque valgus moment and anterior tibial force (when the tibia is externally rotated). Kennedy and Fowler used clinical stress machines to prove that testing for medial laxity should be performed in partial flexion rather than in full extension and that medial capsular ligament injuries need not be present with anterior cruciate ligament (ACL) rupture. Warren et al used similar techniques to identify the superficial MCL as the primary stabilizer of the medial side of the knee against valgus and rotational stress, and emphasized the importance of the anterior fibers of the superficial MCL. Contraction of the sartorius and vastus medialis muscles has been shown to increase valgus stability substantially; however, the muscles act too slowly to augment the stiffness of the knee so as to prevent injury. Hughston et al emphasized that with an isolated medial compartment tear, the abduction stress test was negative at 0° and positive at 30° of flexion. In addition, the abduction stress test at 0° of flexion was shown to be the most specific test for an acute tear of the posterior cruciate ligament (PCL) with an associated MCL tear.

Grood et al performed selective ligament cutting studies in cadaveric knees and then recorded restrai