Chapter 5

COMPLICATIONS OF ARTHROSCOPIC MENISCETOMY

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MENISCAL STRUCTURE AND FUNCTION

The menisci of the knee are semi-circular wedge-shaped fibrocartilagenous disks firmly attached to the tibia and the joint capsule (Fig. 5.1). The medial meniscus is wider posteriorly than anteriorly and forms a half circle. The lateral meniscus is uniform in width and forms almost three-quarters of a circle. The medial meniscus is attached to the capsule, medial collateral ligament, and tibial plateau. The lateral meniscus is attached to the capsule and tibial plateau but not to the fibular collateral ligament. The lateral meniscus also has posterior attachments to the medial femoral condyle (meniscal femoral ligaments), which attaches to the femur near the origin of the posterior cruciate ligament. The popliteal tendon courses through the popliteal hiatus at the posterolateral corner of the knee. The anteroinferior popliteomeniscal fascicle, and the posterosuperior popliteomeniscal fascicle attachments to help provide stability to the posterior corner. With knee motion both menisci translate on the tibial plateau, but the lateral meniscus is more mobile than the medial. The organic composition of the meniscus is 65% type I collagen. The majority of the collagen fibers are oriented along the long axis of the meniscus (i.e., following the natural curve) with a small number of fibers oriented obliquely, radially, and vertically. The peripheral 10% to 30% of the meniscal tissue is vascularized by synovial branches of the genicular arteries. The central 70% to 90% is nourished by diffusion from synovial fluid.

In 1985 Soren described the etiology of congenitally malformed menisci. Dissections of various vertebrates revealed menisci shaped like a plate, disk, or ring. Lateral menisci have been described in two cases with one meniscus overlying another (double-layered). Another lateral meniscal variant is the ring meniscus (making a complete circle). This ring meniscus has an intercondylar bridge between the two horns attached to the tibial plateau differentiating it from an old bucket-handle tear. Hypoplastic menisci have been described both medially and laterally; discoid menisci are more frequent laterally (n = 29) than medially (n = 1) in asymptomatic patients. Three types of lateral discoid menisci are described by Ikeuchi: complete, incomplete, and Wrisberg type.

Functionally, the menisci increase the surface area of the knee by filling the void between the curved femoral surface and the flat tibial surface, thereby decreasing the force per unit area on the femur and the tibia with axial load. Renström and Johnson demonstrated that the knee meniscus tissue acts as a stabilizing shock absorber force as axial loading causes the elongation of the circumferential meniscal collagen fibers and allows some extruding of the edges of the menisci out from underneath the joint surfaces peripherally (tensile strain). This hoop or tensile stress reduces the impulse loading of weight bearing, sparing the articular cartilage and the subchondral bone. The menisci also aid in the lubrication of the knee by extruding free fluid and by distributing synovial fluid over the distal femur with knee motion. Meniscal tissue has been shown to stabilize the knee in the anterior, posterior, and medial/lateral planes by acting as a mechanical stop to translation. However, this finding appears to become significant only when the major stabilizing ligaments of the knee have been injured. Biomechanical studies have demonstrated that 50% (knee in extension) to 90% (knee in flexion) of the compression forces across the knee are transmitted through the normal menisci. When the knee is
Figure 5.1. The menisci of the knee are semicircular wedge-shaped fibrocartilaginous disks firmly attached to the tibia and the joint capsule.

in 70 degrees of flexion, 100% of the load is transmitted through the posterior horn of the menisci.¹⁵,¹⁸-²¹

MENISCAL TEARS

When compression or shear forces exceed the structural design of the meniscus, clefts are created along naturally occurring planes between bundles of collagen fibers. Some clefts are along the circumferential fibers of the menisci, causing vertical longitudinal tears while others are obtained at right angles causing radial or horizontal tears (Fig. 5.4). Chronic instability of the knee due to cruciate or collateral ligamentous laxity can allow the menisci to migrate underneath the femoral condyle in a physiologically abnormal position, increasing the risk of tears. Acute anterior cruciate ligament (ACL) tears are associated with a high incidence of lateral meniscus tears; however, chronic ACL instability is associated more with medial meniscus tears.²²-²⁵ Occasionally, meniscal tears can occur at the capsular ligamentous junction rather than in the substance of the meniscus. In contrast to the intersubstance tears, these capsular meniscal tears are associated with spontaneous healing because of the close proximity of an adequate blood supply and the intensity of the inflammatory response.

Normal aging is associated with texture changes in the meniscus from firm and resilient to hard and brittle. Histologic studies have demonstrated color changes from normal white or opaque to yellow or brown, indicative of degeneration of meniscal tissue.²⁶,²⁷ Occa-

Figure 5.2. The majority of the collagen fibers are oriented along the long axis of the meniscus (i.e., following the natural curve), with a small number of fibers oriented obliquely, radially, and vertically.

Figure 5.3. The peripheral 10% to 30% of the meniscal tissues is vascularized by synovial branches of the genicular arteries.

Meniscal geniculate artery