Abstract: Many meniscal root tears remain unrepaired, potentially due to under-recognition and the technical challenge of repairing them. A great effort is made to preserve the native meniscus and restore the circumferential fibers for hoop stress resistance. It has been well demonstrated in the literature that failure to repair this will lead to increased contact pressures in the medial compartment and early degenerative changes in the articular cartilage. Our technique is one that allows the meniscus to resume its important role of knee stability. A thorough understanding of meniscal root anatomy, as well as repair techniques, is important for the cruciate ligament surgeon.

Meniscal root tears have known patterns of injury and mechanical consequences if not repaired. Many meniscal root tears remain unrepaired, potentially due to under-recognition and the technical challenge of repairing them.

Load transmission and absorption are primary functions of the meniscus. The medial meniscus is exposed to a higher share of force and load than the lateral meniscus in a normally aligned knee. The effects of an absent meniscus have been demonstrated to correlate with increased contact pressures and early degenerative changes. The stability of the meniscus determines the kinematics and function of the knee. Restoring stability and hoop stress resistance is vitally important to the longevity of the knee.

Understanding the insertion site anatomy of the meniscal roots is a prerequisite for the successful repair of the meniscal root tear. Reproduction of anatomic insertion allows for a better chance of successful restoration of hoop stress resistance from the circumferential fibers. The posterior horn of the medial meniscus inserts directly anterior to the tibial insertion of the posterior cruciate ligament (PCL), on the down slope of the posterior intercondylar fossa behind the posterior horn insertion of the lateral meniscus.

Strategies for recognizing these injuries and reparative measures are currently evolving. Magnetic resonance imaging (MRI) studies have given the practitioner the ability to recognize abnormal anatomy. Axial, coronal, and sagittal images should be carefully reviewed for abnormalities of the meniscal roots. The anchor of the posterior medial meniscal horn to the tibia should be visible on 2 contiguous coronal cuts. Extrusion of the meniscus may be seen, once recognized, on the mid-coronal scan as well.

A posterior horn medial meniscal root avulsion is often associated with another intra-articular structural abnormality. This article presents 2 patients with significant injuries to the cruciates and the medial collateral ligament (MCL). The mechanism of injury for both patients was a hyperextension knee dislocation. In this mechanism, the posterior capsule is torn first. The cruciates follow with continued hyperextension of the knee. A valgus moment with an axial rotation applied to the knee then tears the superficial and deep MCL. The forces travel posteriorly through the relatively mobile posterior horn of the medial meniscus to the static meniscal root. The root is then avulsed from the posterior tibial footprint. The classic biomechanics work of Kennedy examined patterns of knee dislocation.

A thorough arthroscopic examination is essential for evaluating an abnormality of the posterior horn of the medial meniscus. Techniques
for visualization have been well described, including the Gillquist maneuver. This involves placing the arthroscope beneath the PCL in the notch of the knee and directing the visual field over the meniscal root. A 70° arthroscope may be used for improved visualization. The pathology may be easier to recognize than an isolated injury to the posterior horn of the medial meniscus due to the lack of capsular and ligamentous restraint from the cruciates and MCL. Abnormal medial-sided opening on valgus loading of the knee affords the surgeon greater posterior access and visualization.

After accurate diagnosis, repairing these injuries can be technically challenging. Transosseous and suture anchor techniques have been described in the literature. Regardless of the technique used, restoration of the circumferential fibers is the primary aim of repair.

**CASE REPORTS**

**Patient 1**

A 15-year-old male soccer player was involved in a collision with another player. The knee spontaneously reduced on the field of play. He presented 2 weeks after injury. Radiographs showed he was skeletally immature. Magnetic resonance imaging demonstrated anterior cruciate ligament (ACL), partial PCL grade I/II, and MCL injuries. Further review of MRI coronal sections revealed a meniscal root tear of the medial meniscus (Figure 1).

Surgery was performed 1 month postinjury, allowing him to perform muscular education and motion rehabilitation. Diagnostic arthroscopy revealed partial tearing of the PCL and complete tear of the ACL. The meniscal root tear of the posterior horn of the medial meniscus was evident on inspection when excessive opening medially occurred on valgus stress of the knee. The tibial footprint was bare and the posterior medial meniscal root avulsed (Figure 2). The meniscal root tear repair was performed with a nonabsorbable suture through the root of the posterior horn (Figure 3).

Many suturing techniques have been described. In a recent cadaveric study of sutur-
ing techniques, the modified Kessler suturing technique was found to provide the strongest primary fixation strength.\(^6\)

Once a nonabsorbable suture was passed through the root, transosseous tunnels were drilled. Using the standard anteromedial arthroscopic portal, the cruciate guide was placed through the notch of the knee to the footprint of the posterior horn of the medial meniscus. The guide was placed in the empty tibial footprint (Figure 3). A cruciate 2.3-mm beath pin was used to drill a tunnel for suture passage and reduction of the meniscal root tear to the tibial footprint (Figure 4). The sutures that were passed through the meniscal root were then shuttled through the tunnel and tied over post on anteromedial proximal tibia. This created an anatomic reduction (Figure 5).

**Patient 2**

An 18-year-old woman was ejected from a motor vehicle crash. Her injuries included tearing of the ACL, PCL, and MCL during a knee dislocation. Surgery was performed after 2 months of muscular education and motion rehabilitation. Arthroscopic examination revealed excessive opening medially on valgus stress of the knee. The meniscal root tear was seen clearly (Figure 6). After passage of nonabsorbable sutures in the posterior horn of the medial meniscus, the sutures were passed into the transtibial tunnel drilled for the PCL graft (Figure 7). The PCL graft was passed into the transtibial tunnel with the meniscal sutures. With reconstruction of the PCL completed, the meniscal sutures were tensioned to reduce the meniscal root tear (Figure 8). Passage of the sutures into the PCL tunnel allowed us to avoid drilling more tunnels into the tibia and posterior knee, which may have compromised our PCL reconstruction. The sutures were then secured over a post on the anteromedial proximal tibia.

**CONCLUSION**

A great effort is made to preserve the native meniscus and restore the circumferential fibers for hoop stress resistance. The medial meniscus serves as an important secondary stabilizer of the knee, particularly in the cruciate-deficient knee. It has been well demonstrated in the literature that failure to repair this will lead to increased contact pressures in the medial compartment and early degenerative changes in the articular cartilage. This technique is one of many that allow the meniscus to resume its important role of knee stability. With our understanding of the importance of meniscal preservation, repair will likely be every surgeon’s goal in knee surgery. A thorough understanding of meniscal root anatomy, as well as repair techniques, is important for the cruciate ligament surgeon.

**REFERENCES**