Surgical Approaches for Medial and Lateral Meniscal Repair

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Summary: Many peripheral meniscal tears are amenable to repair. An important aspect of these repairs is a safe, reproducible surgical approach for effective meniscal repair; retractor placement, and, most important, minimization of the potential for a neurovascular complication. This article reviews surgical approaches for medial and lateral meniscal repair. Key Words: Peripheral meniscal tears—Medial meniscal repair—Lateral meniscal repair—Surgical approaches.

ANATOMY

The posterolateral corner of the knee (Fig. 1) has been studied by Seebacher et al. (35). They identified, in 35 cadaveric dissections, three discrete layers. The most superficial layer (Layer I) comprises two parts: the iliobial band with its anterior expansion and the superficial portion of the biceps with its posterior expansion. The common peroneal nerve lying posterior to the biceps tendon is deep to Layer I. Layer II is an incomplete layer posterior, with fiber attachments to the lateral intermuscular septum, fabella (when present), insertions of the posterolateral capsular reinforcements, the lateral head of the gastrocnemius on the femoral condyle, and the patellomeniscal ligament. Layer III is made up of the deepest layer and includes the joint capsule as well as the fabellotibial and arcuate ligaments. Seebacher et al. (35) noted three anatomical variations: reinforcement of the capsule by the arcuate ligament in 13%, reinforcement of the capsule by the fabellotibial ligament in 20%, and the combined reinforcement of the capsule by both the arcuate and the fabellotibial ligaments. The authors noted that if a fabella was present, the fabellotibial ligament was large and no arcuate ligament would be present. If a fabella was not noted, only the arcuate ligament was present. In clinical practice, these variations have not altered our approach for lateral meniscal repair.

The anatomical relationship between the popliteal artery and tibial nerve within the popliteal space must always be of primary consideration when performing meniscal repairs of the posterior third of the lateral or the medial meniscus (Fig. 1). The posterior tibial neurovascular bundle courses between the popliteus muscle and the heads of the gastrocnemius. The common peroneal nerve lies posterior to the common tendon of the biceps femoris and distally winds around the head of the fibula. A retractor placed anterior to the short head of the biceps will protect the common peroneal nerve, but does not necessarily protect the neurovascular bundle. When it is placed anterior to the lateral head of the gastrocnemius, both the neurovascular bundle and the common peroneal nerve are protected. These observations must be kept in mind when surgically approaching the posterolateral corner for lateral meniscal repair.

POSTEROLATERAL SURGICAL APPROACH

After diagnostic arthroscopy has verified that there is a repairable lateral meniscal tear, the arthroscope is transferred to the inferomedial portal, and an arthroscopic probe is inserted into the inferolateral portal. Through this portal, the blunt end of the probe is placed along the lateral joint line, and mild pressure is applied so that its tip may be palpated through the subcutaneous tissues posterolateral in the 10 o'clock position (right knee). This method aids the surgeon in
FIG. 1. Seekhaver et al. (35) studied the posterolateral corner of the knee joint in 35 cadaveric knees and developed a three-layered picture of its anatomy. Layer I comprises the iliotibial band and the enveloping superficial fascia of the biceps. The common peroneal nerve is enveloped within Layer I posterior to the biceps tendon. Layer II includes, laterally, the vastus lateralis and its expansions and the patellofemoral and patellomeniscal ligaments. Layer III is made up of superficial and deep laminae, including the posterior capsule, envelopes the lateral collateral ligament, and ends at the variably sized patellofemoral ligament. The inferior geniculate artery courses within the interval between the superficial and deep laminae of Layer III. This diagram depicts the cross-sectional anatomy of the knee with reference to the neurovascular bundle, the popliteus, and lateral head of the gastrocnemius. Reproduced from Bach and Bush-Joseph (6) with permission. © Pat Thomas and Bernard Bach.

FIG. 2. A 1.5-inch incision is used to expose the anterior edge of the biceps femoris tendon. The incision is made posterior and parallel to the lateral collateral ligament at the level of the joint line. Reproduced from Bach and Bush-Joseph (6) with permission. © Pat Thomas and Bernard Bach.

Placement of the posterolateral incision for repair and reduces the possibility of a misplaced surgical incision. The tendency is to make the incision too proximal, and it is critical to place this incision properly so that all meniscal repair needles will easily exit within the confines of the meniscal repair retractor. A 1.5- to 2-inch vertically oriented incision is made parallel and posterior to the lateral collateral ligament with the knee flexed 30°–45° (Fig. 2). The dermis is infiltrated with 1:300,000 epinephrine for hemostatic purposes while the tourniquet is deflated. Sharp dissection is extended down to the fascia with exposure aided by the use of small retractors (Senn or Ragnell). Next, the fibular head is palpated for orientation, and the most anterior edge of the biceps femoris tendon inserting onto the fibular head is noted. The fascia directly anterior to the edge of the biceps femoris is incised in the direction of the tendon (Fig. 3). The
muscular fibers of the short head of the biceps are thus exposed and retracted posteriorly (Fig. 4). The tendinous fibers of the lateral head of the gastrocnemius may be visualized. The thin fascia lateral to the tendon is incised creating an entrance that allows placement of the surgeon’s finger around the posterolateral corner of the knee in the interval between the lateral head of the gastrocnemius and the capsule (Fig. 5). Dorsiflexion of the foot with the leg in extension will result in a discernible tightening of this space, and confirmation of this sensation will reassure the surgeon of appropriate surgical exposure. At this point, a meniscal repair retractor may be placed (Fig. 6), the arthroscope reinserted, and the meniscal repair cannulas positioned. Placement of sutures (via an inside-out or outside-in suture placement technique) is then performed (Fig. 7). If these steps as outlined are followed, it is unlikely that the needles will exit inadvertently above or below the retractor.

**MEDIAL MENISCUS**

**Anatomy**

The anatomy of the medial side of the knee has been reviewed by Warren and Marshall (Fig. 8) (45, 46). They dissected 154 fresh cadavers and established three discrete layers similar to those of the lateral side of the knee. Layer I consisted of a deep or crucal fascia. This layer is defined by the investing fascia of the sartorius muscle, and, in fact, the insertion in the muscle is through this fascia. It extends from the patella anteriorly to the popliteal space posteriorly. It can be easily separated from the deeper Layer II structures posterior to the superficial medial collateral ligament, but slightly anterior to the superficial medial collateral ligament, Layer I blends with the deeper
FIG. 5. The correct surgical approach may be confirmed by placing a finger in the interval between the lateral head of the gastrocnemius and capsule, extending the knee and dorsiflexing the foot. A discernible tightening of this interval will be noted, thus confirming appropriate placement for the retractor. Reproduced from Bach and Bush-Joseph (6) with permission. © Pat Thomas and Bernard Bach.

tissues of Layer II into one single layer. Deep to Layer I, but superficial to Layer II, are the distinct tendons of the gracilis and semitendinosus coursing toward their insertion at the pes anserinus separating the first two layers.

Layer II is defined by the parallel superficial medial collateral ligament fibers that are ~1.5 cm wide and 11 cm long, coursing from the medial epicondyle to a distal insertion 6–7 cm below the joint line. The fibers of the posterior border of the superficial medial collateral ligament become more oblique to form the posterior oblique ligament as they sweep back to the posterior medial corner. This ligament envelops the medial condyle posteriorly. Progressing more posteriorly, the layer merges with Layer III (the capsule) and the fibrous sheath and extensions of the semimembranosus tendon. The semimembranosus and its sleeve contribute various insertions at the posterior medial corner of the knee. These include: (a) a direct insertion into the bone just below the joint line at the posterior medial corner; (b) a second or anterior insertion into the bone via an anterior extension around the medial side of the knee also just below the joint line (this may

FIG. 6. A meniscal repair retractor, spoon, or disassembled vaginal retractor may be placed in the interval between the lateral head of the gastrocnemius and the capsule. Meniscal repair may then be initiated. Reproduced from Bach and Bush-Joseph (6) with permission. © Pat Thomas and Bernard Bach.
FIG. 7. This cross-sectional diagram depicts the placement of a meniscal repair retractor within the interval of the lateral head of the gastrocnemius thus protecting the common peroneal nerve and the neurovascular bundle. Reproduced from Bach and Bush-Joseph (6) with permission. © Pat Thomas and Bernard Bach.

serve to protect the medial meniscus; (c) the oblique popliteal ligament, a fan-shaped insertion extending upward over the medial femoral condyle and across the back of the knee toward the lateral femoral condyle; (d) a distal extension blending with a posterior oblique ligament; and (e) a distal insertion across the substance of the popliteus tendon.

The actual third layer consists of the true "capsule," which attaches along the articular margins. Anterior to the superficial medial collateral, this tissue is easily separable, thin, and actually provides no stability. Directly deep to the superficial medial collateral ligament, the tissue becomes thicker, more vertically oriented, and turns into bands of short fibers which are termed the deep medial ligament. At the anterior edge, this is readily separable but 1–2 cm posteriorly, these tissues blend in with Layer II tissue, and reinforce the posteromedial corner as a composite structure.

The saphenous nerve is a major cutaneous branch of the femoral nerve. Its two divisions are the sartorial and the infrapatellar branches which supply sensation to the anterior medial leg (Fig. 9) (3, 4, 22). During medial meniscal repair, either branch of the saphenous nerve is at risk and must be protected.

The saphenous nerve takes origin from the femoral nerve in the proximal thigh, and lies lateral to the femoral artery. It enters the adductor canal of the adductor magnus coursing medial to the femoral artery. The nerve exits the adductor canal with the saphenous branch of the inferior geniculate artery, at which point it divides into its two terminal branches. The sartorial branch travels vertically along the medial knee behind the sartorius. It becomes subcutaneous posterior and distal to the medial femoral epicondyle by emerging between the sartorius and the gracilis muscles along the posterior border of the sartorius. From that point, it travels down the leg with the long
surahvenous vein. At the joint line the sartorial branch is extrafacial, and if dissection is taken directly to Layer I and the subcutaneous tissues superficially are retracted posteriorly, the nerve will be protected.

Medial Surgical Approach

Prior to starting surgery, a leg holder or lateral post is placed well proximal to the popliteal area to allow easy access to the posteromedial corner. Access is technically easier if a leg holder is used. After verification of an unstable yet repairable medial meniscus tear, a probe is once again placed through the inferior medial portal and pushed against the posteromedial corner to the 2 o'clock position (right knee). The probe is palpated with the finger to help identify the joint level and to guide an appropriate incision. It should be noted that 40% of the incision should be proximal and 60% distal to the joint line. This incision varies from 1.5 to 2 inches depending upon the amount of subcutaneous tissue. More proximal incisions make the dissection more difficult, require more retraction, and increase the likelihood of errant needle passage. Our experience has been that needles that do not exit within the confines of the meniscal repair retractor usually exit distal to the retractor. The posterior edge of the superficial medial collateral ligament is palpated. A 1.5- to 2-inch skin incision is made posterior to the medial collateral ligament at the joint line, with the knee flexed between 45° and 90° (Figs. 9 and 10). The more the knee is extended, the more anterior the saphenous vein and nerve lie. The subcutaneous tissue is bluntly spread away with the use of Metzenbaum's scissors, and small right-angle retractors are then put in place. The superficial fascia is easily identifiable. It should be noted at this point that the saphenous vein and nerve should lie near the inferior portion of the incision and slightly posterior if the...

FIG. 10. After incising skin and mobilizing the subcutaneous tissues, Layer I is incised in a longitudinal fashion. © Pat Thomas and Bernard Bach.

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knee is flexed, and slightly anterior if the knee is in
extension. A 3- to 4-cm vertical incision is then made
in the superficial fascia parallel and posterior to the
superficial medial collateral ligament (Figs. 9 and 10).
Small retractors are placed deep to this layer, and a
finger is swept inferiorly to palpate the pes anserinus
tendons to verify their position. In contrast to the lat-

eral meniscal approach, we do not make a concerted
effort to define the surgical plane between the medial
head of the gastrocnemius and capsule. The medial
head of the gastrocnemius is more toward the midline
than its counterpart laterally. However, this can be
done and at times one must release a small portion of
the semimembranosus fibers to allow access to this
interval, if needed. This interval can often be defined
bluntly. One should be able to palpate the posteromed-
dial joint line extracapsularly (Fig. 11). Retraction of
Layer I posteriorly along with the subcutaneous tis-
sues will allow placement of a meniscal repair retractor
in this interval (Fig. 12). If a Henning meniscal
repair retractor is not available, a disassembled small
adult vaginal speculum or sterile spoon makes an ex-
cellent retractor (5). At this point inside-out, or out-
side-in repair can be performed (Fig. 13).

Whether performing medial or lateral side repairs,
we place our arthroscope in the ipsilateral portal and
place our meniscal repair cannulas from contralateral
portals to maximize visualization and to angle our
cannulas away from the posterior compartment.

**DISCUSSION**

Several studies have shown the vascularity and heal-
ing potential of the peripheral one-third of both lat-
eral and medial menisci (1, 2, 26, 33, 41, 47). Inside-
out and outside-in meniscal repair techniques have
been used in the surgical repair of the menisci. Clin-
cal follow-up reports have noted excellent healing
rates both by subjective and objective “second-look”
arthroscopy and by imaging studies. Many techniques

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FIG. 11. A retractor is placed deep to the Layer I fascia and blunt
finger detection is carried around the posteromedial corner. The
posterior joint line should be palpated extracapsularly. The inser-
tion of the semimembranosus may be palpated at its insertion on
the posteromedial tibia. The medial head of the gastrocnemius is more
toward the midline than its counterpart laterally; defining the inter-
val between the capsule and medial head of the gastrocnemius is not
mandatory. © Pat Thomas and Bernard Bach.

FIG. 12. A Henning retractor (Stryker Inc., Kal-
amazoo, MI) is placed posteromedial to protect
the saphenous nerve and vein. If properly placed,
needles placed via an “inside-out” technique
should exit within the confines of the retractor. ©
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augmenting the healing potential of the menisci have been used, including synovial fringe preparation, placement of a vascular access channel, fibrin clot insertion, and new chemotherapeutic techniques along with fibrin injections. These seem to be important areas of research. Interestingly, little attention has been directed toward the surgical approaches for meniscal repair. Improper surgical exposure will result in the possibility of misplaced needles and potential neurovascular injury as well as increased anxiety for the surgeon. Surgeons should avoid incising the iliotibial band to gain access to the posterolateral corner because this approach will result in the tendency to place the meniscal repair retractor proximally with subsequent distal exiting of the meniscal repair needles. We have found the surgical approaches described here to be safe and effective and to facilitate meniscal repair.

REFERENCES
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