

Not Your Father's (or Mother's) Meniscus Surgery

By Robert F. LaPrade, M.D., Ph.D.

ABSTRACT

Not so long ago, the accepted treatment for meniscal tears was removal of the entire meniscus. Today, orthopedic surgeons are doing everything possible to save the meniscus, especially in young patients, in order to decrease the chance of the patient developing arthritis. This article discusses 2 techniques for treating a torn meniscus: repair and transplantation. It also describes those patients who are best suited for each procedure and the challenges and outcomes associated with them.

It was only one short generation ago, during the 1970s and early '80s, that the accepted treatment for meniscal tears was removal of the entire meniscus. Usually done through an open incision created with a long knife or scissors, the surgery was often considered unsuccessful if some of the meniscus was left behind. In fact, at one point, the meniscus was felt to be such an unimportant structure that some college football team physicians suggested that the menisci of incoming freshman be removed to prevent having to treat tears later on. Although Fairbank noted back in 1948 that patients who had their menisci resected developed arthritis, it took many years for the medical profession to recognize the importance of this structure.¹

We have come a long way in the treatment of meniscal tears during the past 2 decades. We now try to repair them at all cost, especially in younger patients, and the practice of meniscal transplantation has greatly advanced as we attempt to slow the progression of arthritis in younger patients who have had their menisci excised for nonrepairable tears.

Role of the Menisci

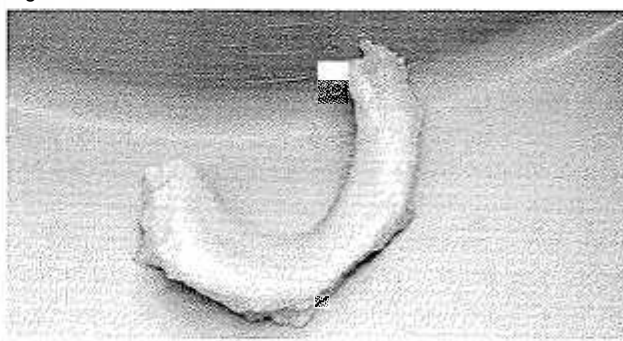
The menisci have commonly been called "cartilage" by the lay public. This has created some confusion as the true articular cartilage is the "gristle" that covers the ends of the bones, and the menisci are the fibrocartilage shock absorbers that help protect the articular cartilage. The majority of meniscal tears are now treated arthroscopically, and arthroscopic meniscectomies are the most frequently performed orthopedic procedures.

There are 2 menisci in the knee. The medial meniscus is on the inside of the knee and is C-shaped (Figure 1). It is rather rigidly attached to the tibia and is responsible for about 50% of

the shock capacity of the medial compartment. In addition to its important shock-absorbing capacity, the medial meniscus also helps to stabilize the knee from an anterior force and is the next-most-important structure for preventing anterior translation of the knee when an anterior cruciate ligament (ACL) is torn. It is for this reason that a large number of patients with ACL tears also have tears of their medial meniscus.

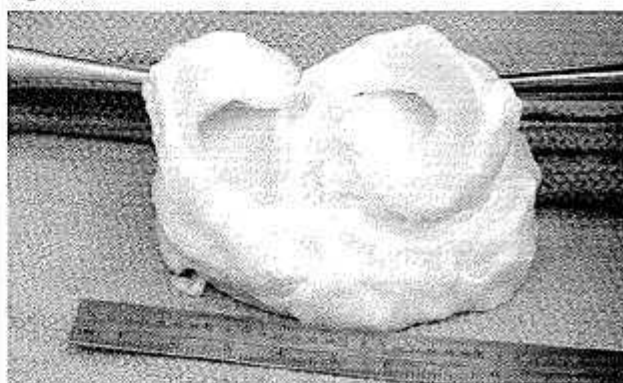
The lateral meniscus, located on the outside portion of the knee, is almost circular in shape and is much more mobile than the medial meniscus (Figure 2). As the knee moves, it shifts back and forth across the tibia and is thus less likely to be torn than the medial meniscus. Probably the most important function of the lateral meniscus is its shock-absorbing capacity. The lateral meniscus

Figure 1



Photograph of an excised medial meniscus (left knee).

Figure 2



Photograph of a left knee tibial plateau showing the C-shaped medial meniscus (left) and the almost circular lateral meniscus (right).

cus can absorb up to 70% of the shock to the lateral compartment of the knee. This is especially important in younger patients. It is not uncommon for teenagers who have their lateral meniscus resected to develop a rather rapid onset of arthritis of the lateral compartment of their knee because of the lack of shock absorption. Thus, we are especially wary of resecting lateral meniscal tears because of the significant effect the surgery can have on joint health.

As we age, the menisci become less rubber-like and flexible and more tough and friable. For those reasons, the incidence of degenerative meniscus tears rises significantly in persons older than 40 years. With these types of tears, the meniscus tears on the inside, closer to the midline of the knee. Because there is no blood supply to this portion of the meniscus, the only viable treatment is to resect the tear back to a stable edge. It is important that patients recognize that having even a portion of their meniscus resected places them at a higher risk of developing osteoarthritis further down the line.

Meniscus Repair

The ideal candidate for a meniscus repair is a younger patient who has a tear close to the edge of the joint lining. This portion of the meniscus still has blood supply, and repairing it with sutures can often result in healing. Again, it is very important to repair these peripheral tears as resection significantly increases the risk for developing arthritis in that compartment of the knee.

Although there are many techniques for repairing meniscal tears, the gold standard is still an inside-out arthroscopic-assisted suture. With this technique, a small incision is made on either the medial or lateral joint line down to the joint lining. Two long needles with sutures attached to each are then passed from the inside of the joint to the outside, against a retractor to protect the neurovascular structures. The sutures pull the meniscus into place against the joint lining. Vertical mattress sutures are best for healing, and in prospective studies permanent sutures have been found to work better than absorbable ones (Figure 3). Although many devices have been fabricated for all-inside meniscal repairs, which can be done arthroscopically without the open-skin incision, the incidence of re-tear among patients who have undergone the procedure is higher over time compared with that for patients who were given inside-out permanent sutures.

Approximately 90% of meniscal repairs performed with concurrent ACL reconstructions are successful, returning patients back to full activity. Those performed without a concurrent ACL reconstruction are approximately 50% to 60% successful.

Meniscus Transplantation

During the past 20 years, as the medical community began to recognize the impact of osteoarthritis on younger patients, more aggressive treatments to repair or replace a damaged meniscus have been undertaken. Although attempts to develop an artificial meniscus are only at the investigational stage, meniscal transplants have become more popular.

Meniscal transplantation is one of the most complex surgeries that we perform in sports medicine. These procedures are very involved technically and have a long learning curve. For those reasons, few surgeons perform them. However, they can be some of the more gratifying surgeries, as they are almost always performed in young patients who are showing signs of arthritis (Figure 4). Many of these patients will have pain and swelling with normal day-to-day activities. Patients who are candidates for meniscal transplantation are usually between the ages of 15 and 45 years, with the vast majority being between ages 15 and 25 years. A candidate should not have significant arthritis of the affected compartment of the knee, and the knee should not be malaligned or have any ligament instability. However, both conditions (malalignment or ligament instability) can be corrected either before or at the same time as meniscal transplantation.

Figure 3



Arthroscopic appearance of 3 vertical mattress meniscal repair sutures (medial meniscus, right knee),

Figure 4



Arthroscopic appearance of the lateral compartment of a 16-year-old patient with early-onset arthritis after a meniscectomy (left knee).

Figure 5



Arthroscopic appearance of a lateral meniscal transplantation graft (left knee).

Before the procedure, X-rays are taken of the patient's knees with sizing markers so that the precise width of their condyles can be measured. This is necessary because it is important that the size of the cadaver donor meniscus and the size of patients' tibial plateau are within a few millimeters of one another. Once a donor has been identified, the patient can choose a convenient time for surgery, as the majority of meniscal transplants are either fresh-frozen or cryopreserved. Since the meniscus has very little blood supply, patients do not need to take anti-rejection drugs when they have a meniscal transplant. Dutch surgeons have performed arthroscopies on a large portion of their meniscal transplant patients and have found that there is good healing of the meniscus transplant to the joint capsule by about 6 weeks after surgery.¹

Meniscal transplantation involves removing all the remaining edges of the patient's own meniscus. This is because it is important to get up to the bleeding rim of the native meniscus for the new transplant graft to heal. Once the entire meniscus has been removed, the tibia can be prepared for insertion of the meniscal graft. It has been found that meniscal transplants function much better if the donor attachments to bone are still attached to the graft. For medial meniscal grafts, small bone cylinders are prepared where the meniscus attaches and sutures are placed through these cylinders and pulled into place inside the knee. Tunnels are drilled at the back and front of the knee, and the small bone plugs are inserted into them. For the lateral meniscus, which has its attachment sites quite close to each other, a trough of bone is removed from the far medial edge of the lateral tibial plateau and a trapezoidal-shaped bone wedge with both the anterior and posterior aspects of the meniscus graft is placed into the knee (Figure 5).

Meniscal transplant grafts are quite large, and in order for them to be inserted into the joint, an open incision must be made next to the patellar tendon. In addition, a meniscal repair incision similar to that which would be made for repairing the native meniscus is also made on the side of the knee. For each meniscus, the bone plugs are slipped into the respective prepared holes and the graft is slipped into place in the knee. The meniscus is then sutured into place around its entire rim. In effect, doing a meniscal transplant is like repairing a super large meniscal tear, as the entire meniscus has to be sutured into place to maximize the chance of success.

Meniscal transplantation has its drawbacks. If the transplant graft doesn't have live meniscal cells, there is a high risk that it will fail. Because the quality of the meniscus diminishes with the age, donors need to be relatively young; most are between 15 and 39 years of age. Also, the graft cannot be sterilized, which means there is a very small risk of a serious infection. And, finally, the need for meniscal transplant grafts far exceeds the number of meniscal tissue donors. Consequently, while waiting for a transplant, some patients develop progressive arthritic changes and are no longer candidates for a transplant graft. Because of the scarcity of donors, scientists are attempting to develop artificial menisci made from biodegradable materials and the patient's own meniscal cells or

possibly mesenchymal stem cells. This research is primarily being performed in cell cultures at this point.

Most patients who undergo meniscal transplantation are able to return to high functional levels such as playing competitive sports. Overall, the success rate cited in peer-reviewed literature for meniscal transplantation is between 80% and 85% at approximately 5 years' follow-up.^{4,5} Although we still do not know if meniscal transplants arrest the development of arthritis of the affected compartment, it makes sense that if they stop or significantly decrease pain and swelling—the primary signs of osteoarthritis—it is likely that they are at least slowing down the progression of the disease. We do know that the initial patients who had meniscal transplantations in Germany in 1982 using transplant grafts similar to the ones that we use were functioning at a much higher level and had significantly less osteoarthritis in their knees compared with members of age-matched cohorts who had complete meniscectomies.⁶

Conclusion

To summarize, the treatment of meniscal tears in young patients is not like that which their fathers and mothers underwent. We are attempting to save the meniscus if possible, and we consider meniscal transplantation a viable option for those patients who have pain and swelling with activity after they have had a meniscectomy and who fit the criteria for a meniscal transplant. We have performed more than 150 meniscal transplantations at the University of Minnesota and are doing ongoing clinical outcome studies of those patients. It is not unreasonable to anticipate that the treatment of meniscal tears will continue to evolve over time and that an off-the-shelf patch similar to a dental filling will one day be available to treat nonrepairable tears. MM

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