Arthroscopy

CURRENT CONCEPTS IN MENISCAL REPAIR

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ABSTRACT

As the importance of meniscal preservation has become recognized, meniscal repair has become a more commonly practiced procedure. We briefly review the current, commonly accepted indications, techniques, and our rehabilitation protocol for meniscal repair. Both open and arthroscopic repairs are reviewed, including the arthroscopic techniques classified as inside-out, outside-in, and all inside. We conclude with a review of the results of meniscal repair and some thoughts on future directions.

The treatment of meniscal tears by direct repair was first described by Annadale in 1885.1 The significance of this was dismissed until the 1930s when King2 demonstrated the successful repair of menisci in dogs. However, the concept of meniscus repair was largely ignored. In 1948, Fairbank3 published his classic observations in patients following meniscectomy, but the concept of meniscus preservation was considered unimportant. At the time, the prevailing thought was that meniscus tears would produce significant articular damage, were incapable of healing, and would regenerate best after a complete meniscectomy.4,5 In the 1960s and 1970s multiple studies continued to define the role of the meniscus in force transmission,6–10 stability,11–14 and shock absorption.15,16 During this same time, additional clinical studies continued to document poor results after meniscectomy.12,17–22

Finally, interest in partial meniscectomy and meniscus repair began to grow. This interest was greatly influenced and aided by the use of arthroscopy. In the 1980s Arnoczky and Warren23,24 and Day et al25 performed injection studies that defined the limits of meniscal vascularity. This, along with a growing experience with open and arthroscopic techniques of meniscal repair, has allowed us to define our current understanding of meniscal repair.

INDICATIONS

Meniscal tears that are definitely suitable for repair have the following characteristics in common. First, a tear is located no more than 3 mm from the meniscosynovial junction. Second, there is minimal damage to the body of the meniscus. Third, the length of the tear is such that, with probing of the meniscus, it subluxes into the joint and is obviously unstable. Occasionally, the tightness of a compartment will not allow the torn meniscus to be displaced with a probe. In these cases, the length of the tear is the best gauge of stability. We have found that tears of less than 7 mm are usually stable. A torn meniscus that meets these criteria, even if it is a re-tear of a previously repaired meniscus, is suitable for repair.

An isolated meniscal tear should be suspected in a young patient with a history of intermittent locking, effusions, pain, and physical examination findings of joint line tenderness and a positive McMurray test. A second, more com-
mon presentation is in the patient with an unstable knee, who is 15 to 25 years of age and has a similar history and physical examination findings. In either case, it is always best to discuss the possibility of a repairable meniscus tear with the patient before surgery. A meniscal repair is a more extensive surgical procedure, often requiring hospital admission and involving an extensive postoperative rehabilitation protocol.

To identify a potentially repairable meniscus, both double contrast arthrography and magnetic resonance imaging (MRI) can be used. We have found arthrography to be most useful for chronic medial meniscal tears. MRI is becoming more accurate, but peripheral tears are still difficult to image.

The age of the patient should be taken into account, since vascular penetration has been shown to be greater in skeletally immature individuals. Unfortunately, an adult vascular pattern is already established in most teenagers. It has also been shown that repair of acute tears tends to yield slightly improved results compared to repair of chronic tears.

Although preoperative information from patient profiling and diagnostic studies can identify potentially repairable tears, the final decision is based on an arthroscopic evaluation. One must visualize and probe each meniscus to determine the exact type and length of the tear, its location relative to the meniscosynovial junction, and its stability. Whenever posterior compartment visualization is not adequate from the anterior portal, additional portals or a 70° scope positioned through the notch must be used. Tears seen well with the arthroscope placed in the posterior compartment are amendable to either arthroscopic or open repair. Those not seen well posteriorly, but still less than 3 mm from the meniscosynovial junction, are best treated arthroscopically.

Observable bleeding at the tear site is definitive evidence for vascularity, but lack of bleeding is not definitive evidence of ischemia. The tourniquet should not be inflated during this portion of the procedure. Also, good outflow needs to be established so that elevated distention pressures do not occlude fine capillary circulation. A tear in the outer 3 mm of a meniscus is a repairable tear even if bleeding is not seen.

Tears that are not suitable for repair include those greater than 5 mm from the meniscosynovial junction and tears where the replaceable portion of the meniscus is grossly deformed and/or torn. Tears within 3 mm to 5 mm of the meniscosynovial junction are questionably repairable. Serious consideration should be given to using healing enhancement techniques, such as a fibrin clot, to increase the healing potential of tears in this area. Finally, radial tears extending to the meniscosynovial junction, especially in the lateral meniscus, have a questionable repairability.

TECHNIQUE

A thorough examination of the knee under anesthesia, followed by a thorough arthroscopic evaluation of the knee, are prerequisites to meniscal repair. There are certain important principles that all successful meniscal repairs have in common. A correct and accurate understanding of the nature of the tear is needed. Posterior incisions must be utilized to protect neurovascular structures when repairing middle and posterior one third tears. Also, appropriate preparation of the repair site is important. The capsular bed opposite the tear, the rim of the remaining meniscus, and its adjacent meniscal surface should all be abraded and not resected. All unstable central meniscal flap tears should be resected. Finally, enough sutures should be placed, vertically if possible, to provide enough stability to allow for early motion.

Open Medial Meniscal Repair. The techniques for repair of peripheral tears not associated with collateral ligament injuries were developed in the late 1970s by DeHaven, Cassidy and Shaffer, Hamberg et al., and Dolan and Bhaskar. A 2 in., vertical, posteromedial skin incision is centered at the joint line with the knee flexed. An effort is made to identify and protect any branches of the saphenous nerve. The dissection is carried down through the deep fascia to expose the posteromedial capsule. An oblique capsular incision is made along the posterior edge of the posterior oblique ligament. The meniscus rim and the capsular bed are then freshened to enhance the vascular response. A double-armed suture with needles of two sizes is utilized to place vertically oriented sutures to anatomically reapproximate the capsular bed back to the meniscus rim. The smaller needle is passed from below upward through the meniscus rim; the larger needle is utilized to go from below upward through the capsular bed. Individual sutures are placed 3 mm to 4 mm apart from posterior to anterior.

Sutures can be absorbable or non-absorbable and can be tied inside the capsule or passed through the capsule and tied over the capsule. It is the authors' preference to use 4-0 absorbable suture tied inside the capsule. Others prefer heavier, non-absorbable suture tied outside the capsule. A heavier 2-0 absorbable suture is utilized to repair the capsule securely back to the
meniscus rim at the site of the capsular incision. If a concomitant ligamentous procedure is planned, the meniscus repair sutures are tied after the ligamentous procedure has been completed.

Open Lateral Meniscus Repair. A 2 in., vertical posterolateral incision is centered just below the joint line with the knee flexed. The iliobial band is then split in line with its lower-most fibers, just anterior to the fascia over the biceps femoris. An oblique incision is made through the capsule along the posterior border of the popliteus tendon. Again, the tear is identified and freshened. The small end of a 4-0 absorbable suture is first passed from above downward through the meniscus rim. The same small needle is passed through the deep layer of strong but relatively avascular capsular tissue. A second bite is taken through the more vascular and superficial synovial tissue. The repair sutures are tied inside the capsule from posterior to anterior and the capsular incision is carefully closed.

Arthroscopic Meniscus Repair. Ikeuchi performed the first arthroscopic meniscus repair in Tokyo in 1969, but surgeons did not take notice of this technique until after Henning pioneered arthroscopic meniscus repair in the United States in 1980.35,36 Since then, individual contributions have been made by many others.37-44 There are two basic types of repair, and a third is being developed. The inside-out repair and the outside-in repair are most commonly used, and the all-inside repair is gaining acceptance. Arthroscopic techniques permit repair of meniscal lesions that are 3 mm to 5 mm from the meniscosynovial junction. This is an area of questionable vascularity and it is important to consider using one or more of the available healing enhancement techniques. These include rasping the meniscal tear surfaces and the parameniscal synovial fibrin clot insertion, vascular access channels23 or a facial sheath over the fibrin clot and meniscus.29

Arthroscopic techniques also have the advantage over open techniques in the repair of posterolateral meniscus tears because less dissection around the popliteal tendon is needed to obtain a stable repair. Arthroscopic techniques differ from open repairs in that it is much easier to place horizontal sutures than to place vertical sutures. The true significance of this difference remains to be documented. Lastly, the meniscus tear and the adjacent capsule must be abraded arthroscopically prior to the meniscal repair.

Inside-Out Arthroscopic Repair. The inside-out technique was pioneered by Henning with subsequent contributions by Clancy and Graf (personal communications), Rosenberg et al., Cannon,47 and others. Sutures are placed under arthroscopic control using a single or double lumen cannula system to place the needle in the desired area. The needle passes through the meniscus body, rim, and capsule and is retrieved through a standard posterior incision. For posterior third repairs, an incision is made prior to meniscus repair to protect and retract the neurovascular structures and the sutures are tied over the posterior capsule. Various absorbable and non-absorbable sutures have been used by different surgeons. No study has been published that shows any injurious effects on the meniscus or the articular cartilage as a result of the sutures. Currently, we prefer a 2-0 Ethibond suture.

Outside-In Arthroscopic Repair. The outside-in techniques were developed by Johnson, Warren, and Morgan and Casscells.2 A spinal needle is placed through the skin, capsular bed, and across the tear site. The repair suture is then passed through a spinal needle into the joint. With Johnson's technique, a second spinal needle is inserted nearby and the suture is retrieved through the second spinal needle so that the end of the suture is brought back out through the capsule to be tied. In the techniques of Warren and Morgan, the suture is retrieved from inside the joint and a knot is tied in the end of the suture. The knot is pulled snug against the meniscus to hold it against the peripheral rim. Adjacent sutures are tied to one another posteriorly over the capsule. An absorbable PDS suture is recommended for this technique to minimize the chance for any intraarticular irritation.

All Inside Arthroscopic Repair. Recently, a technique for repair of posterior peripheral meniscal tears has been developed by Morgan and Mulholland. By using large cannulas in posterior portals, one can use hollow suture hooks to place vertically oriented sutures. A special knot tier allows the entire repair to be done inside the joint. Clinical experience will determine if this technique will obviate larger posterior incisions.

Rehabilitation

Following meniscal repair there are two fundamental principles. First, there must be early protection to allow for healing. Second, there must be adequate time to allow for maturation of the healing response before subjecting the repaired menisci to significant stresses. Initially, knees were kept immobilized for 4 to 6 weeks after a repair. Most people now believe that limited knee motion can be permitted without affecting healing rates. Currently, most protocols make use of a hinged knee brace for the first 4 to 6 weeks and progress to allow full unrestricted range of motion (ROM) at the end of this time. Early weight bearing is believed to be
potentially deleterious to the healing meniscus. Laboratory studies by Newman (personal communications) indicate that weight bearing restrictions may not be necessary for all types of meniscus repairs.

At this time, for isolated meniscus repairs, we recommend minimal weight bearing with crutches for 6 weeks. A hinged ROM brace locked in extension is used for the first 2 weeks. At 2 weeks, ROM from 20° to 80° is allowed. At 4 weeks, the brace is removed and free motion is allowed. After 6 weeks, the patient progresses to full weight bearing and full ROM and begins strength training. From 3 to 6 months, patients are limited to low impact, in-line sports, such as swimming, cycling, cross country ski simulator, rowing machine, and jogging on a straight, level surface. At 6 months, return to agility sports is allowed if the patient has adequate muscle strength. When meniscus repair is performed in conjunction with anterior cruciate ligament reconstruction we follow our standard protocol for the ligament reconstruction with the addition of minimal weight bearing for 6 weeks.

RESULTS

The early results of both open and arthroscopic repair have been promising. Several authors have reported 90% or higher healing rates for tears within the vascular zone of the meniscus. Decreased healing rates have been reported with tears of increasing distance from the meniscosynovial junction. The longest available follow up is in open meniscal repair by DeHaven et al. In an average 5-year follow-up study, there was an 89% survival of repaired menisci. There was an increased incidence of retear in unstable knees, 38% vs 5% in stable knees. Sommerlath and Gillquist have reported similar clinical results of intermediate range follow up. A minimum 10 year follow-up study by DeHaven and Arnoczky has documented a 79% survival rate of repaired menisci. Again, there was an increased incidence of retears in unstable knees, 42% vs 11% in stable knees.

There was also compelling radiographic evidence for biomechanical function of successful repairs, as 85% of patients with successful repairs had normal weight bearing radiographs. This is in contrast to only 43% of patients with retears who underwent partial meniscectomy. Finally, Henning et al. showed a decrease in the failure rates in stable knees from 41% to 8% for isolated arthroscopically repaired meniscal tears using a fibrin clot.

FUTURE DIRECTIONS

As more long-term data become available, we will be able to identify the true strengths and weaknesses in our current methods of meniscal repair. Hopefully, further development of techniques to enhance healing, such as fibrin glue and specific growth factors, will enable us to successfully repair more complex meniscal tears. Laboratory data are needed to clarify the issue of weight bearing and safe ranges of motion in the early postoperative period. The possibility of meniscal transplantation could potentially benefit patients of all ages.

CONCLUSION

Meniscus repairs have proven to be an important advancement in the treatment of meniscal injuries. Even in the unstable knee, meniscal repair can offer the majority of patients a significantly improved knee anatomically and functionally.

REFERENCES

44. Cannon WD. Arthroscopic meniscal repair as related to ligamentous instability. Presented at the ACS Meeting; October 1984; San Francisco, Calif.