Inside-Out Meniscal Repair: Medial and Lateral Approach

Jorge Chahla, M.D., Raphael Serra Cruz, M.D., Tyler R. Cram, A.T.C., O.T.C., Chase S. Dean, M.D., and Robert F. LaPrade, M.D., Ph.D.

Abstract: Preservation of meniscal tissue has been proven to be the best approach in most cases of meniscal tears. Currently available techniques for treating a peripheral meniscal tear include inside-out, outside-in, and all-inside techniques. Each of these techniques present potential advantages and disadvantages. Despite technologic advances in all-inside devices, because of implant-related complications, cost concerns, and device availability, the inside-out technique is still the preferred method among many surgeons. Although the inside-out repair technique is considered more technically demanding and requires additional incisions, it has several advantages such as the possibility for an increased number of sutures, creating a stronger construct, and greater versatility in their placement. This article describes the inside-out meniscal repair technique with its corresponding posterolateral and posteromedial surgical approaches.

The menisci play a key role in the knee. They contribute to load transmission and distribution, joint lubrication, proprioception, and cartilage nutrition and act as secondary stabilizing structures.[1] Untreated meniscal tears can lead to deleterious effects on the knee, predisposing the joint to early degenerative changes.[2] Although meniscal repairs have a higher reoperation rate than meniscectomy, they likely result in better long-term patient-reported outcomes, better activity levels, and slower progression to osteoarthritis.[3]

Meniscal repair techniques can be divided into the inside-out technique, the outside-in technique, and the more recently described all-inside technique.[4] Among these, the inside-out technique allows for fine precision, a greater number of sutures, and the advantage of not having a prominent intra-articular device. Indications and contraindications are listed in Table 1. The purpose of this article is to describe the surgical approaches and the arthroscopic procedure for lateral and medial meniscal repairs using an inside-out technique.

From the Steadman Philippon Research Institute (J.C., R.S.C., C.S.D., R.F.L.); and The Steadman Clinic (T.R.C., R.F.L.), Vail, Colorado, U.S.A.

The authors report the following potential conflict of interest or source of funding: Steadman Philippon Research Institute receives support from Arthrex, Ossur, Siemens, and Smith & Nephew. R.F.L. receives support from Arthrex; Smith & Nephew; Ossur; Health East, Norway; and National Institutes of Health R13 grant for biologics.

Received July 31, 2015; accepted October 29, 2015.

Address correspondence to Robert F. LaPrade, M.D., Ph.D., The Steadman Clinic, 181 W Meadow Dr, Ste 400, Vail, CO 81657, U.S.A. E-mail: drlaprade@sprivail.org

2212-6287/15719/$36.00

http://dx.doi.org/10.1016/j.eats.2015.10.017

Surgical Technique

The patient is placed in the supine position on the operating table. After the induction of general anesthesia, a bilateral knee examination is performed to assess for range of motion and evaluate for any concurrent ligament instability. A well-padded high-thigh tourniquet is subsequently placed on the operative knee, which is positioned into a leg holder. The contralateral knee remains in an abduction holder with a pneumatic compression device as a mechanical prophylaxis for deep venous thrombosis.

The anterolateral portal is created in a vertical fashion adjacent to the patellar tendon, and the joint is initially inspected. With the aid of a spinal needle to assess location, the anteromedial portal is created in a similar manner. The meniscal margins are probed, and repair is considered for any unstable peripheral meniscal tears.

Posterolateral Approach

Palpable anatomic landmarks for this approach include the Gerdy tubercle, superficial layer of the iliotibial band (ITB), lateral aspect of the fibular head, and lateral joint line. After the joint line is located with the use of an arthroscopic probe, a transverse oblique incision is performed following the posterior border of the ITB down to the Gerdy tubercle centered over the lateral joint line (Video 1, Fig 1).

Table 1. Indications and Contraindications

Indications
Posterior horn tears
Middle-third tears
Peripheral capsule tears
Bucket-handle tears
Contraindications
Root tears
Severe degenerative meniscal changes
Avascular zone tears

The superficial layer of the ITB is then incised along its posterior aspect. Care must be taken when making this incision to avoid injury to the fibular collateral ligament and deep lateral capsule. The incision through the ITB is positioned approximately 5 mm anterior to the posterior margin of the superficial layer of the ITB (Fig 2).

The inferior-lateral genicular artery overlies the popliteus musculotendinous junction and may be injured if the dissection is performed too distally. It is also important to stay proximal to the long head of the biceps complex during superficial dissection and anterior to the lateral gastrocnemius head during deep dissection to avoid iatrogenic injury to the common peroneal nerve. Blunt dissection must be performed (from the ITB window accessed in the previous step) toward the fibular head and proximal to the long and short heads of the biceps tendon (Fig 3).

Once a passage has been created, blunt finger dissection is performed, followed by use of a Cobb elevator, to release any adhesions between the lateral gastrocnemius and the posterior capsule. According to the senior author's experience (R.F.L.), the adhesions between the lateral gastrocnemius and the posterolateral joint capsule are less dense than those on the medial side. Lastly, a tablespoon can be placed in the interval (anterior to the lateral gastrocnemius and posterior to the posterolateral capsule) to protect the neurovascular bundle (Fig 4).

Posteromedial Approach

Palpable landmarks should be identified first. These include the adductor tubercle, posterior aspect of the tibial plateau, and medial joint line. An arthroscopic probe is placed inside the joint to help locate the planned incision and identify the joint line. An oblique vertical incision is performed from the adductor tubercle to the posterior aspect of the tibial plateau (2 cm distal to the joint line). Care must be taken not to make this incision too posteriorly because the saphenous nerve courses approximately 5 cm posteriorly to the adductor tubercle[5] (Fig 5).

Subcutaneous sharp dissection is performed down to the sartorial fascia, which is incised as proximally as possible to preserve the pes anserine tendons. After blunt dissection from the sartorial fascia incision, an anatomic "triangle" can be observed. This triangle is formed by the posteromedial joint capsule anteriorly, the medial gastrocnemius posteriorly, and the semimembranosus inferiorly (Fig 6).

Careful dissection of the posteromedial joint capsule away from adhesions to the medial gastrocnemius complex is performed to allow for improved visualization and to permit passage of the neurovascular protector. Furthermore, a Cobb elevator is then used to separate the medial gastrocnemius tendon and muscle from any posterior capsular adhesions. Lastly, a tablespoon or other device can be placed in this interval to act as a retractor, protecting the popliteal vessels (Fig 7).

Meniscal Suture

Before the repair is attempted, a complete evaluation of the lesion should be performed including size, stability, and state of the meniscus, as well as type and zone of the lesion. Typically, lesions that measure between 1 and 4 cm and are located in the red-red zone or red-white zone can be repaired. The tear should be anatomically reduced, and the sutures should be placed perpendicularly to the lesion to restore its anatomic position.

For an inside-out repair, a self-delivery gun fitted with a cannula (Sharpshooter; Ivy Sports Medicine, Montvale, NJ) is used to pass double-loaded nonabsorbable sutures (No. 2 FiberWire; Arthrex, Naples, FL) into the meniscus. To start passing the sutures, the knee is positioned in 20° to 30° of flexion and the meniscal needle is advanced through the superior or inferior aspect of the meniscus (Fig 8); the corresponding portion of the capsule is then penetrated with the second needle of the suture. To help the assistant retrieve the needle, the knee can be flexed to 70° to

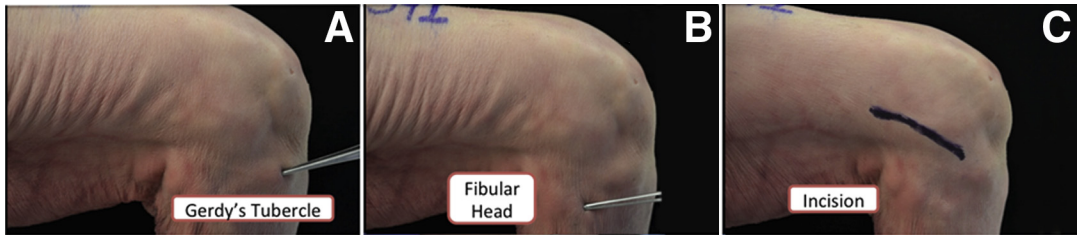

Fig 1. Anatomic landmarks for lateral approach in a cadaveric right knee: (A) Gerdy tubercle, (B) fibular head, and (C) marked transverse oblique–oriented incision.

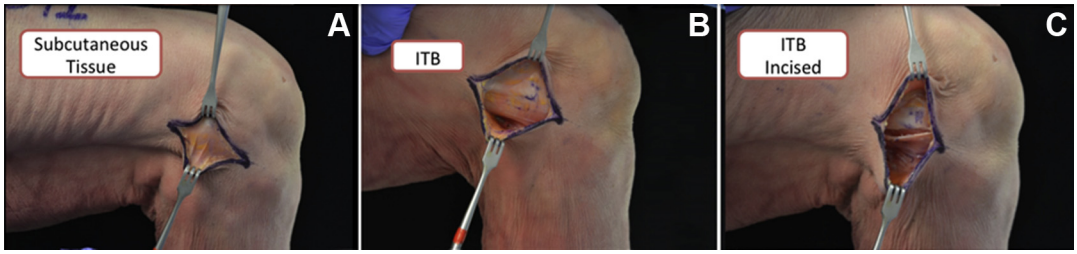

Fig 2. Cadaveric right knee showing (A) the subcutaneous tissue, (B) the iliotibial band (ITB) debrided from the subcutaneous tissue proximal and distally, and (C) the ITB incised 5 mm anterior to the posterior margin of the superficial layer of the ITB.

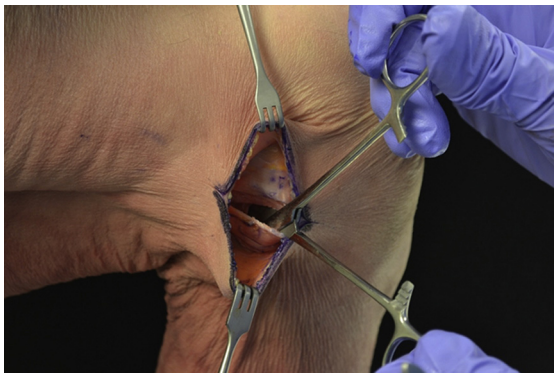

Fig 3. Cadaveric right knee showing blunt dissection toward the fibular head through a transverse iliotibial band window.

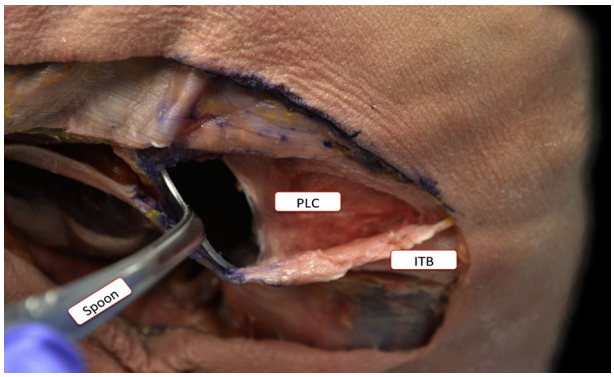

Fig 4. Cadaveric right knee with a metal spoon placed at the lateral interval (anterior to the lateral gastrocnemius and posterior to the posterolateral capsule [PLC]) to act as a retractor to protect the neurovascular bundle. (ITB, iliotibial band.)

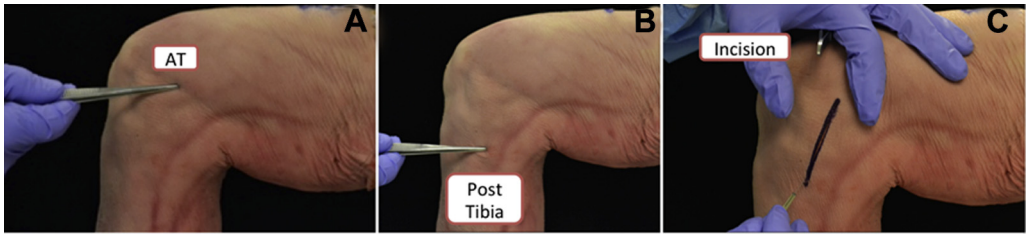

Fig 5. Anatomic landmarks for surgical approach in a cadaveric right knee: (A) adductor tubercle (AT) position, (B) posterior aspect of the medial tibial plateau, and (C) oblique vertically oriented incision centered on the tibiofemoral joint line.

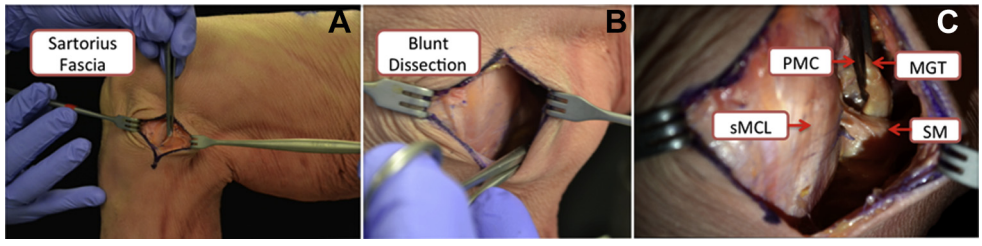

Fig 6. Right knee showing (A) the anterior incision to the sartorial fascia; (B) blunt dissection of the semimembranosus fascia; and (C) the anatomic triangle formed by the posteromedial capsule (PMC) as the anterior wall, semimembranosus tendon (SM) as the floor, and medial gastrocnemius (MGT) as the posterior wall and roof. (sMCL, superficial medial collateral ligament.)

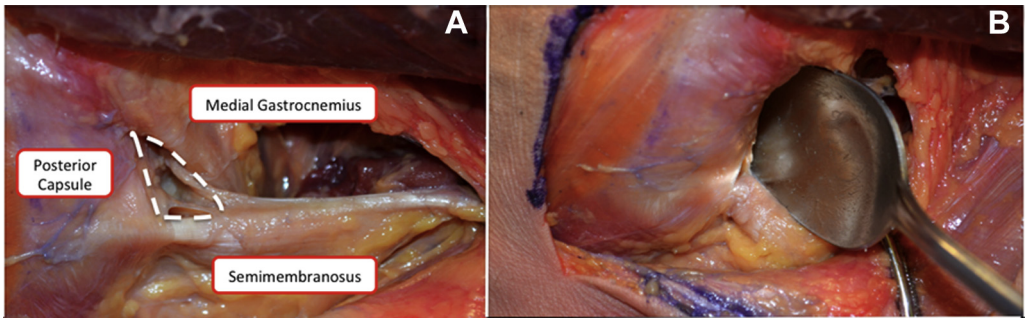

Fig 7. (A) Targeted triangle interval (dashed outline) and (B) magnified image with a metal spoon placed into the interval, protecting the popliteal vessels, in a right knee.

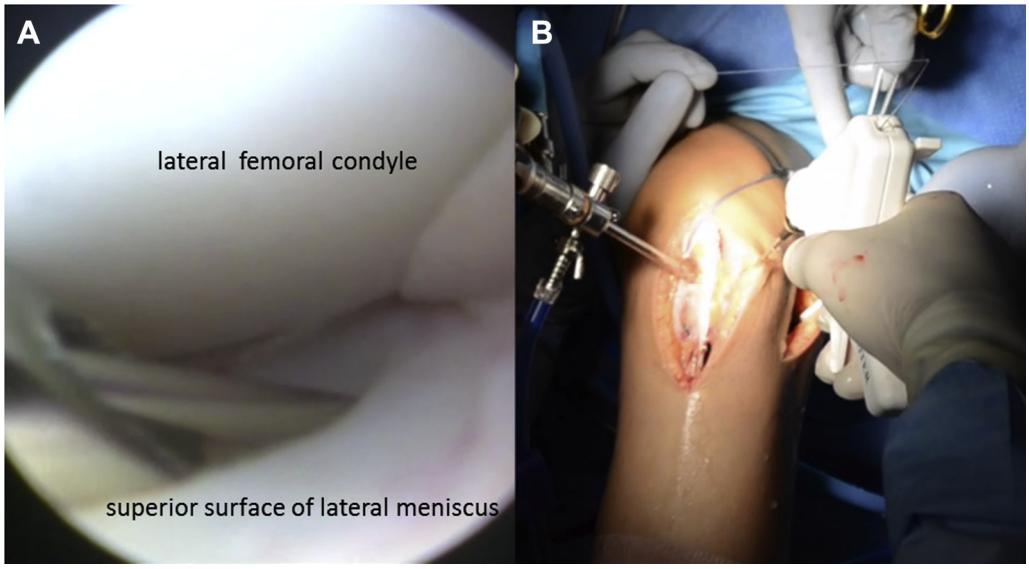

Fig 8. (A) Arthroscopic image of a left knee showing a suture needle penetrating the superior border of the lateral meniscus as viewed through the anteromedial parapatellar portal. (B) Intraoperative photograph of a left knee showing the use of a suture-passing device inserted through the lateral parapatellar portal, while the arthroscope is in the medial parapatellar portal. The assistant is preparing to retrieve the suture through the posterolateral portal for approach.

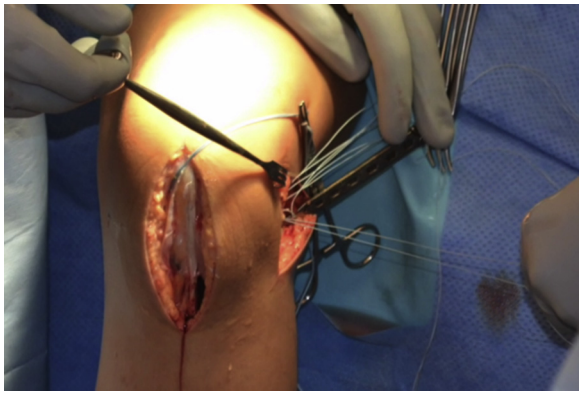

Fig 9. Intraoperative photograph of a left knee after the sutures have all been passed through the meniscus. The knee is flexed to 90°, and the sutures are tied, with care taken not to over-tighten the tissue.

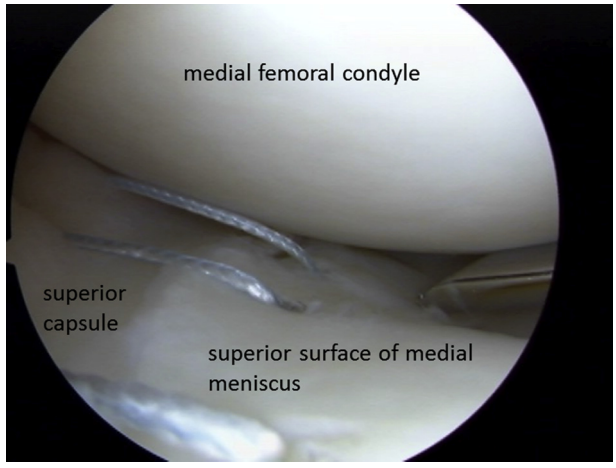

Fig 10. Arthroscopic image of inside-out meniscal repair showing suture placement through the superior border of the medial meniscus and through the superior capsule (anteromedial portal) of the left knee. The same procedure is performed on the inferior border of the meniscus and the inferior capsule.

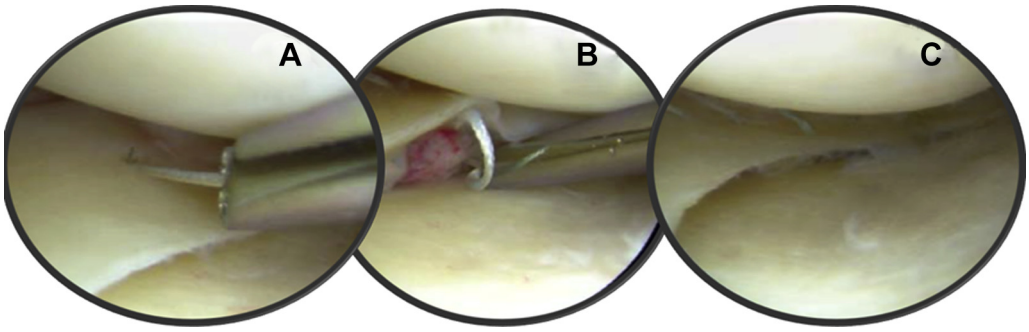

Fig 11. Arthroscopic images showing steps for meniscal suture placement in the left knee. (A) In 20° to 30° of knee flexion, a meniscal needle is advanced through the superior border of the meniscus. (B) The inferior capsule is penetrated with the needle. (C) Final result of repaired meniscus (femoral side).

90°. The needles are cut from the sutures, and the suture ends are clamped while slight tension is being maintained. The same process is repeated adjacent to the previous suture, with sutures in both the superior and inferior borders of the meniscus placed between 3 and 5 mm apart. On average, 10 to 12 sutures are used to create a stronger construct (R.F.L., unpublished data, December 2015). Lastly, with the knee in 90° of flexion, the surgeon ties all sutures, being careful not to over-tighten the tissue (Fig 9). When possible, a vertical suture pattern is preferred because it allows for greater capture of the strong circumferential fibers of the meniscus; however, oblique and horizontal patterns can also be used if necessary to reduce the meniscal tear[6] (Figs 10-12).

Postoperative Rehabilitation for Isolated Meniscal Repairs

Postoperatively, all patients with an isolated meniscus tear remain non–weight bearing for 6 weeks. Physical therapy emphasizes early quadriceps muscle activation and knee flexion from 0° to 90°. Knee flexion is increased as tolerated starting 2 weeks postoperatively. Six weeks postoperatively, weight bearing is initiated. At this time, patients also may begin using a stationary bike with low resistance settings and performing one-quarter–body weight leg presses to a maximum of 70° of knee flexion. Additional increases in low-impact knee exercises are permitted as tolerated starting 12 weeks postoperatively. We recommend that patients avoid deep squatting, sitting cross-legged, or performing any heavy lifting or squatting activities for a minimum of 4 months after surgery.

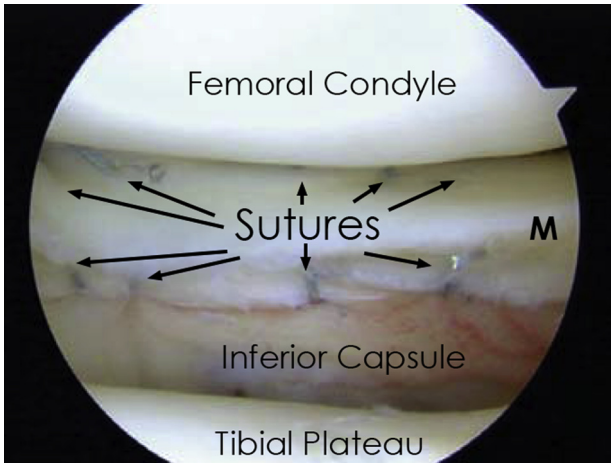

Fig 12. Arthroscopic image of the left knee showing the final result of the repaired medial meniscus (M) with sutures on both sides of the meniscus going through the capsule.

Discussion

The inside-out meniscal repair technique has shown improved subjective and objective patient outcomes[7] and remains the standard of care for meniscal repair.[8] This technique is best used for posterior horn, middle-third, peripheral capsule, and bucket-handle tears.[4] Advantages of the inside-out technique include the versatility of placing sutures, lower implant cost, and use of low-profile needles that allow for multiple sutures without compromising the structural integrity of the meniscus.[7] The senior author uses 10 to 12 sutures on average (R.F.L., unpublished data, December 2015) to create a strong construct repair. Drawbacks of this technique include additional incisions, the risk of neurovascular injury, the need for an assistant, and theoretically, an increased procedure time.[6,7] Pearls and pitfalls for this surgical technique are presented in Tables 2 and 3.

Table 2. Pearls

Placement of sutures should begin through the most unstable portion of the meniscus.
Sutures should be placed in both the superior and inferior aspects of the meniscus.
The distance between the sutures should be 3-5 mm.
The surgeon should use as many sutures as necessary to stabilize the tear.

Table 3. Risks and Pitfalls

Risks and Pitfalls	Methods for Avoiding Risks and Pitfalls
Lesion of popliteal artery and its branches	The surgeon should perform careful dissection and use the heads of the gastrocnemius to protect the vascular structures. A spoon should be used to protect the exit of the needles.
Lesion of saphenous nerve	Attention should be given to avoid placement of the medial incision too posteriorly.
Lesion of common peroneal nerve	The surgeon should keep the dissection anterior to the biceps and lateral head of the gastrocnemius tendons.
Flexion contracture or stiffness	The surgeon should not over-tighten the sutures. Early mobilization (0°-90°) with an experienced physical therapist is recommended.
DVT	Intraoperative and postoperative prophylaxis should be used.

DVT, deep venous thrombosis.

A meta-analysis of 7 studies showed that meniscal repairs are likely to result in better long-term outcomes than meniscectomy, although they have a higher reoperation rate.[3] Grant et al.[7] analyzed 19 studies comparing inside-out and all-inside meniscal repair techniques. They found no differences in clinical failure rates (17% *v* 19%) or subjective outcomes. Complications are associated with both techniques. Nerve symptoms are more commonly associated with the inside-out repair, whereas implant-related complications (soft-tissue irritation, swelling, and implant migration or breakage) are more common with the all-inside technique. Stärke et al.[9] reported that regardless of the repair technique used, there is a general trend of increasing failure rates with time (with success rates of 75% to 94% in the first year of surgery but 59% to 76% beyond the fourth year). Of note, the criteria for success and failure were heterogeneous among studies.

In conclusion, the inside-out meniscal repair technique needs to be a component of the armamentarium of the surgeon, especially when dealing with large tears. We recommend our approach for meniscal repair, which is easily performed with careful dissection. We encourage further studies by other groups to evaluate our surgical technique and the long-term subjective and objective patient outcomes.

References

1. Allen AA, Caldwell GL Jr, Fu FH. Anatomy and biomechanics of the meniscus. *Oper Tech Orthop* 1995;5:2-9.
2. Hede A, Larsen E, Sandberg H. The long term outcome of open total and partial meniscectomy related to the quantity and site of the meniscus removed. *Int Orthop* 1992;16:122-125.
3. Xu C, Zhao J. A meta-analysis comparing meniscal repair with meniscectomy in the treatment of meniscal tears: The more meniscus, the better outcome? *Knee Surg Sports Traumatol Arthrosc* 2015;23:164-170.
4. Goodwillie AD, Myers K, Sgaglione NA. Current strategies and approaches to meniscal repair. *J Knee Surg* 2014;27:423-434.
5. Wijdicks CA, Westerhaus BD, Brand EJ, Johansen S, Engebretsen L, LaPrade RF. Sartorial branch of the saphenous nerve in relation to a medial knee ligament repair or reconstruction. *Knee Surg Sports Traumatol Arthrosc* 2010;18:1105-1109.
6. Nelson CG, Bonner KF. Inside-out meniscus repair. *Arthrosc Tech* 2013;2:e453-e460.
7. Grant JA, Wilde J, Miller BS, Bedi A. Comparison of inside-out and all-inside techniques for the repair of isolated meniscal tears: A systematic review. *Am J Sports Med* 2012;40:459-468.
8. Laible C, Stein DA, Kiridly DN. Meniscal repair. *J Am Acad Orthop Surg* 2013;21:204-213.
9. Stärke C, Kopf S, Petersen W, Becker R. Meniscal repair. *Arthroscopy* 2009;25:1033-1044.