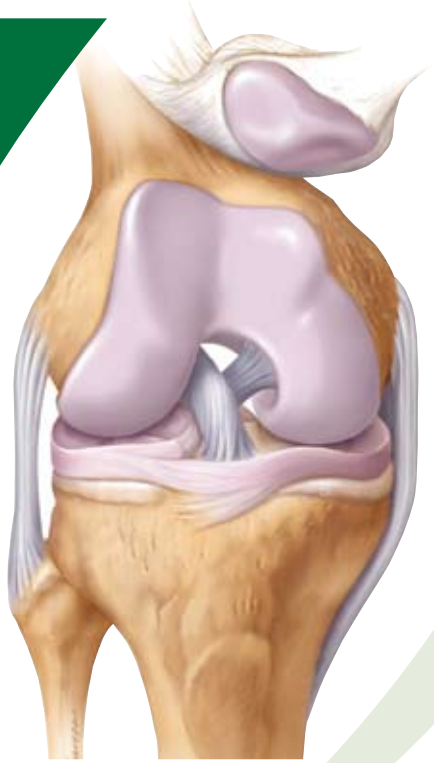
Arthroscopic Anatomic Aperture Fixation of Meniscus Allograft **without** Bone Blocks

(The Caborn Technique)

JOINT RESTORATION FOUNDATION™



David N. Caborn, MD, Charles B. Broome, MD, and Ruben González, MD

restoring **movement.**
restoring **life.**

JOINT RESTORATION FOUNDATION™

Introduction

Arthroscopic Anatomic Aperture Fixation of Meniscus Allograft **without** Bone Blocks
(The Caborn Technique)

This technique has been developed to provide a straight-forward, reproducible method to allow anatomic aperture fixation with suture anchoring of the meniscal horns without the technical challenges, invasiveness, or postoperative morbidity associated with the use of a bone block or bone tunnel techniques.

Europeans have extensive experience and good long-term clinical results with arthroscopic meniscal transplantation without the use of bone blocks.[1] Despite this success, this approach has not been adopted in the United States because of two drawbacks: the inability to re-establish the enthesial attachments of the meniscal horns arthroscopically, and the failure to reestablish the hoop stresses within the meniscus. These result in a failure to reduce the load transmission across the joint.[2,3]

Previous soft tissue fixation techniques failed to achieve restoration of the horns with true anatomic aperture fixation.[4] A recent study has shown that restoration of posterior horn avulsions is necessary to restore peak pressure and contact area.[5] This has been achieved with transosseous suture tunnels.

The Caborn Technique applies the same concept to fixation of the horns during meniscal allograft transplantation. Rather than rely on distal fixation via osseous tunnels, we use aperture fixation with suture anchors that provide anatomic fixation points. Experience gained from arthroscopic rotator cuff repair has afforded us a relatively facile technique to achieve restoration of the horns and anatomic aperture fixation.

Surgical Technique

Meniscus Allograft Preparation

We use an over-braided fiber tape suture, which is a 2 mm wide tape on a #2 FiberWire® core for fixation of the anterior and posterior horns (Figure 1). This suture material has proven, even when placed with a simple horizontal stitch, to have a load to failure upwards of 70 ft. lbs. We recommend a modified Mason-Allen stitch for fixation of the fiber tape suture to the horns (Figure 2), as described by Gerber et al.[6] The modified Mason-Allen stitch has two benefits: it increases pull-out strength (in the rotator cuff tendon it triples pull-out strength from 77 Newtons to 246 Newtons) and it has been shown to prevent tissue strangulation. One or two traction sutures of #2 FiberWire® are placed in a horizontal fashion and will later be used to help guide the graft into place.

Surgical Preparation

Standard arthroscopic anteromedial and anterolateral portals are made. Arthroscopic examination of the knee is performed. It is essential to clearly identify the meniscal horns as shown in the anatomical picture (Figure 3). After the horns are identified arthroscopically, the superior aspects of the meniscal horns are marked to maintain orientation later when passing the graft into the knee. The diseased meniscus is trimmed back to a thin rim of healthy tissue. For the medial side of the knee, a fenestrated release of the MCL with an 18 gauge spinal needle can help open the medial joint space. This is typically not needed to visualize the lateral side. For medial meniscal reconstructions, a posteromedial portal is established under direct visualization (Figure 4a). When reconstructing the lateral meniscus, a posterolateral portal is established between the fibular collateral ligament and the biceps femoris as described by Bennett7 (Figure 4b). The camera is passed through the notch near the posteromedial bundle of the PCL. With the light source pointed medially, a spinal needle can be inserted directly in the field of view for accurate portal placement.

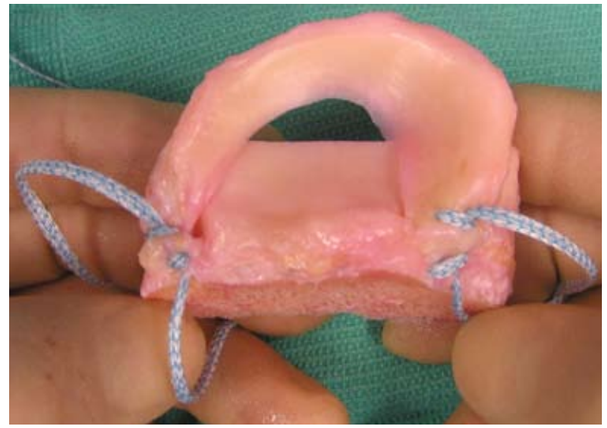


Figure 1: *Modified Mason-Allen stitch*

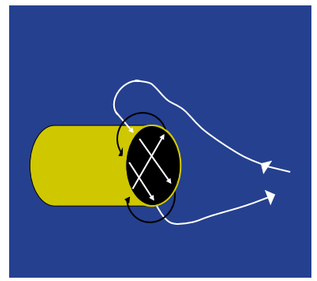


Figure 2: *Technique of Modified Mason-Allen stitch*

Figure 3: *Anatomical view of meniscus horns*

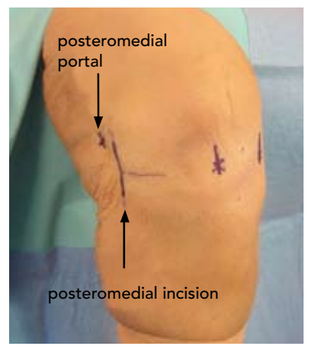


Figure 4a: *Posteromedial portal with optional incision for inside-out meniscus repair*

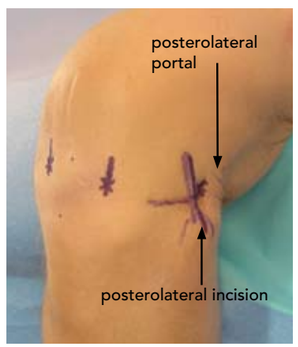


Figure 4b: *Posterolateral portal with optional incision for inside-out meniscus repair*

Arthroscopic Anatomic Aperture Fixation of Meniscus Allograft **without** Bone Blocks *(The Caborn Technique)*

Figure 5a: *Posteromedial portal*

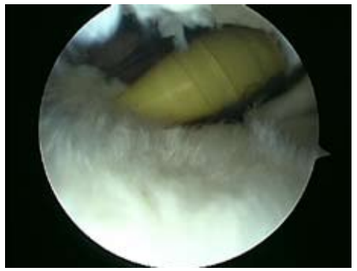


Figure 5b: Posterolateral portal

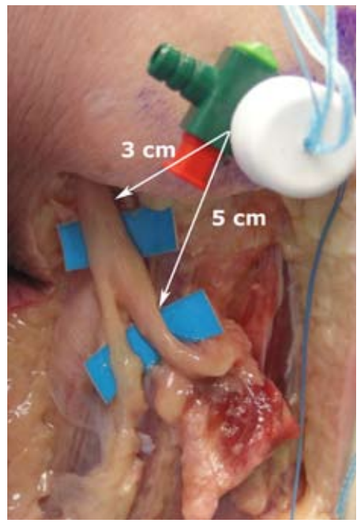


Figure 6: Peroneal nerve location with reference to posterolateral portal

A small notchplasty of the posterior femoral condyle is recommended for better posterior visualization (Figure 5a). A cannula is always used through these portals. Not only does this allow direct access to the horn for placement of the suture anchor, but it also allows the cannula to guide the sutures within the horn of the meniscus for passage around the femoral condyle (Figure 5a and 5b). A transseptal approach can be used to improve visualization as described by Ahn[8], but is rarely needed. Both of these posterior portals are placed while the knee is in 90 degrees of flexion to lessen the likelihood of neurovascular injury. Cadaveric studies in our lab have demonstrated safety with regard to the peroneal nerve (Figure 6).

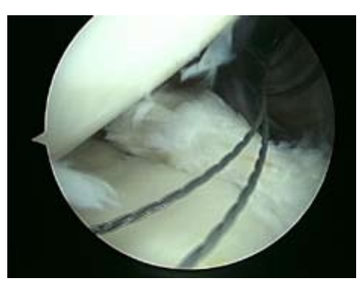


Figure 7a: Posteromedial *traction suture*

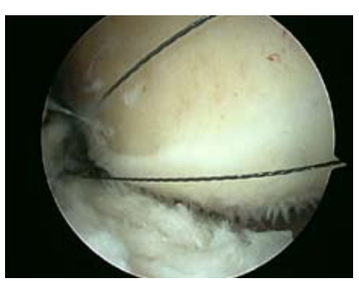


Figure 7b: *Posterolateral traction suture*

Step 1

~~Using arthroscopic visualization, a Micro SutureLasso® is passed through the posterior portal and brought out the front of the knee with a grasper. The Micro SutureLasso® is used to pull the FiberWire®, attached to the posterior horn of the graft, out the back of the knee through the cannula (Figure 7a and 7b).~~

Step 2

The anterior portal on the side of the graft must be slightly enlarged to allow graft passage. Under constant visualization, the graft is then gently ~~pulled~~ into the joint. ~~a~~ A probe can help maintain proper orientation while the graft is passed.

Step 3

Another Micro SutureLasso® is then passed percutaneously through the native meniscal remnant in a location corresponding with the traction suture on the graft. The second Suture Lasso® is used to pull the traction suture(s) through the skin and gentle traction seats the graft in place (Figure 8a and 8b). The most difficult anatomical feature to pass is the posterior horn, and it is paramount to maintain a good view of the sutures as they are passed to ensure they do not become entangled. We have found that by passing the posterior suture first, the chances for entanglement are minimized and it is easier to clear the graft around the femoral condyle ~~(Figure 9a and 9b)~~.

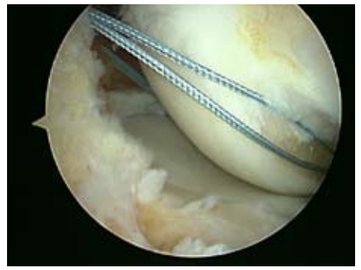


Figure 8a: *Passage of the meniscus using a mid-posteromedial traction suture*

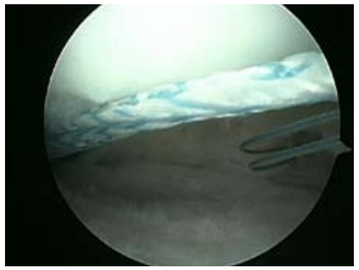


Figure 8b: *Passage of the meniscus using a mid-posterolateral traction suture*

Figure 9a: Meniscal passage with posteromedial and mid-medial traction suture

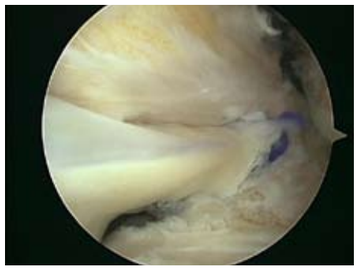


Figure 9b: *Passage of the meniscus on the femoral condyle using traction sutures*

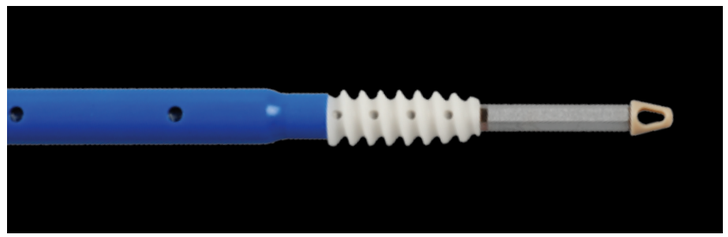


Figure 10: Cannulated SwiveLock™ C anchor

"Joint preservation, restoration of knee kinematics and improved functional outcomes are fundamental goals in achieving patient satisfaction. Our hope is that the all-inside meniscus reconstruction technique will provide a minimally invasive reproducible procedure that will help reestablish ACL synergy, protect the articular cartilage and serve as a salvage procedure to delay a TKA in younger patients."

- David N. Caborn, MD

Arthroscopic Anatomic Aperture Fixation of Meniscus Allograft **without** Bone Blocks *(The Caborn Technique) continued*

Step 4

To secure the meniscal horns into the bone, we use a cannulated SwiveLock™ C from Arthrex. This is a 5.5 mm, knotless anchor that requires a punch prior to insertion (Figure 10). A 5.5 mm punch is passed through the posterior cannula and used to make a socket for the anchor at the native footprint of the posterior horn.

Step 5

The cannulated anchor is introduced through the posteromedial or posterolateral cannula after the sutures are placed through the PEEK eyelet, and then passed down into the insertion socket. The length of suture between the eyelet and the horn of the meniscus is left to the desired length to anatomically re-establish the posterior horn of the meniscus. A two-fingered arthroscopic instrument is used to adjust the suture and reduce the posterior horn of the meniscus.

Figure 11a: *Fixation of the posterior horn of the medial meniscus using bioabsorble anchor*

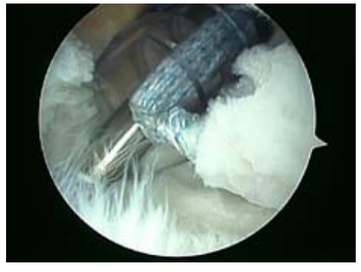


Figure 11b: *Fixation of the posterior horn of the lateral meniscus using bioabsorbable anchor*

Figure 12a: *All-inside medial meniscus suture fixation*

Figure 12b: *All-inside lateral meniscus suture fixation*

Step 6

The anchor is then sunk into the socket and the bioabsorbable screw inserted until it is flush with the aperture. This will allow reduction of the posterior horn to the desired location (Figure 11a and 11b).

Step 7

Standard inside-out sutures or an all-inside meniscal fixation device technique is used to re-establish the meniscus to the remnant remaining at the capsule. If we have a sufficient buttress, we prefer an all-inside technique (Figure 12a and 12b).

Step 8

The anterior horn of the meniscus is re-established under direct visualization by using the punch to create a socket. Using the prescribed technique for the SwiveLock™ anchor, the sutures of the fiber tape are introduced through the PEEK eyelet. The length is established to re-create the native horn position. A two-fingered arthroscopic instrument is used to reduce the anterior horn of the meniscus.

Step 9

The construct is sunk into the socket until the screw contacts the bone and then inserted per technique, thereby providing solid, stable fixation (Figures 13a and 13b). Because the anchor is cannulated, blood channeling occurs at the site of repair and is extremely beneficial to healing. Favorable bleeding also occurs from the posterior femoral condyle if a notchplasty is performed. In addition, platelet rich plasma (PRP) plugs are sutured to the periphery of the meniscus prior to insertion to promote early healing.

Note:
Photos of pre-op (Figure 14a and 14b) and post-op (Figure 15a and 15b) views of both the medial and lateral compartment are shown.

Figure 13a: *Fixation of anterior horn of the medial meniscus using bioabsorbable anchor*

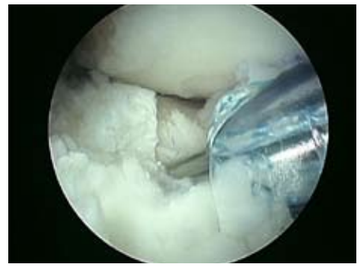


Figure 13b: *Fixation of anterior horn of the lateral meniscus using bioabsorbable anchor*

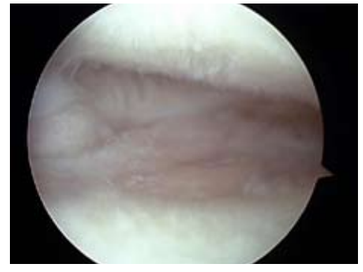


Figure 14a: Pre-op medial compartment

Figure 14b: Pre-op lateral compartment

Figure 15a: Post-op medial compartment

Figure 15b: Post-op lateral compartment

JOINT RESTORATION FOUNDATION™

Postoperative Protocol

Patients are discharged home the day of surgery with a cryotherapy device and protective brace. We prefer to treat all patients with viscosupplementation in the early postoperative period. Physical therapy is begun on the first day following surgery. Emphasis is made in therapy on strengthening of the dynamic stabilizers of the knee and hip. Patients are advanced to full weight bearing, because the hoop stresses provide beneficial compression along the periphery of the meniscus at the fixation sites. Flexion is limited to ninety degrees for six weeks to prevent excessive stress from extreme rollback. Continuous passive motion (CPM) machines are used two hours twice daily, beginning at thirty degrees and advancing ten degrees per day until reaching ninety degrees. After sufficient stability is achieved (usually six weeks post-op) more strenuous exercises are initiated. Full return to athletic activities is usually delayed for six months.

6933 South Revere Parkway
Centennial, CO 80112
www.jrfortho.org

Customer Service
1.877.255.6727

References

1. Verdonk PC, Verstraete KL, Almquist KF, et al. Meniscal allograft transplantation: long-term clinical results with radiological and magnetic resonance imaging correlations. *Knee Surg Sports Traumatol Arthrosc.* 2006;14(8):694-706.
2. Alhalki MM, Howell SM, Hull ML. How three methods for fixing a medial meniscal allograft affect tibial contact mechanics. *Am J Sports Med.* 1999;27:320-328.
3. Paletta GA Jr, Manning T, Snell E, et al. The effect of allograft meniscal replacement on intraarticular contact area and pressures in the human knee: A Biomechanical Study. *Am J Sports Med.* 1997;25:692-698.
4. Hunt S, Kaplan K, Ishak C, Kummer FJ, Meislin R. Bone plug versus suture fixation of the posterior horn in medial meniscal allograft transplantation: A biomechanical study. *Bull NYU Hosp JT Dis.* 2008;66(1):22-26.
5. Marzo JM, Gurske-DePerio J. Effects of medial meniscus posterior horn avulsion and repair on tibiofemoral contact area and peak contact pressure with clinical implications. *Am J Sports Med.* 2009;37:124-129.
6. Gerber C, Alberto R, Schneeberger A, Perren S, Nyffeler R. Experimental rotator cuff repair: A preliminary study. *J Bone Joint Surg. Am.* 1999;81:1281-90.
7. Bennett WF, and Sisto D. Arthroscopic lateral portals revisited: A cadaveric study of the safe zones. *Am J Orthop.* 1995;24(7):546-51.
8. Ahn JH, Ha, CW. Posterior transseptal portal for arthroscopic surgery of the knee joint. *JARS.* 2000;16(7):774-79.

restoring **movement**. restoring **life**.