

All-Inside Meniscal Repair Scientific Update

A review of the design rationale, techniques, and outcomes

An increase in published orthopedic literature on meniscus function, pathology, and repair is improving the understanding of the importance of meniscal preservation. The meniscus is a fibrocartilaginous structure in each compartment of the knee that helps disperse compressive forces. Multiple contributing factors, such as direct trauma, overuse, previous injury, and increased age, can lead to meniscus damage.

Advancements in technology and innovation have produced better techniques and instrumentation for meniscus repair. This document summarizes published studies that describe meniscal anatomy, biomechanical data, surgical techniques, and clinical data.

About 10 years ago, the standard for meniscus surgery was to resect all the damaged tissue from the joint, causing more damage to the knee. Studies show that meniscus repair is crucial to maintaining the well-being of the whole knee joint. Results suggest an all-inside technique allows for the most anatomic repair with the greatest preservation of surrounding soft tissues.



Primary fixation of single stitch all-inside and inside-out meniscal devices for repairing vertical longitudinal meniscal tears: a human microscopic imaging and biomechanical study.

Bachmaier S, Krych AJ, Seil R, Smith PA, Bedi A, Woiczinski M, Wijdicks CA

- › Authors compared human meniscal repairs using the FiberStitch™ 1.5 implant, Fast-Fix Flex system (Smith and Nephew), and inside-out repair.
- › The FiberStitch 1.5 implant:
 - › Outperformed the competitive device and inside-out repair in all categories: initial load, initial stiffness, and ultimate stiffness
 - › Achieved significantly lower gap formation and higher ultimate strength compared with the competitive all-inside device
 - › Showed overall higher stiffness, resulting in less gap formation and therefore a lower measure of laxity in the final construct

Takeaway: The FiberStitch 1.5 implant demonstrated better performance in key areas as compared to a competitive device and traditional inside-out meniscal repair.

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Primary fixation and cyclic performance of single-stitch all-inside and inside-out meniscal devices for repairing vertical longitudinal meniscal tears.

Bachmaier S, Krych AJ, Smith PA, Herbort M, Ritter D, LaPrade RF, Wijdicks CA

- › Evaluates short-term patient-reported outcomes (PROMs), complications, and reoperations after all-inside meniscus repair using FiberStitch™ implants.
- › Patients showed significantly improved PROMs at 6 months postoperatively, which were maintained through final follow-up, and demonstrated an overall 6.35% failure rate.
- › There were zero cases of hardware-related complications.
- › Patients who undergo concomitant ACL reconstruction with meniscal repair tend to have better PROMs than those who undergo standalone meniscus repair. In this study, patients with a standalone meniscus repair also received notch microfracture, which may have contributed to similar PROMs as those patients who underwent concomitant ACL reconstruction.

Takeaway: Knotless, tensionable, all-suture implants may be a safe and reliable for all-inside meniscus tear repair. The FiberStitch implant was superior in all areas as compared to other methods tested.

Am J Sports Med. 2022;50(10):2705-2713. doi:10.1177/03635465221107086

Biomechanical characteristics of all-suture meniscal repair devices compared with PEEK-anchored devices and inside-out suture for meniscal repair: a porcine study.

Barber FA, Davidson PA, Henninger HB

- › All-inside meniscal repair is widely accepted and reduces potential complications seen in the inside-out technique, including wound problems, nerve injury, and scarring.
- › Evaluated repair strength of FiberStitch™ repair (Arthrex), SuperBall meniscal repair system (Arcuro Medical), Fast-Fix 360 meniscal repair system (Smith and Nephew), and a vertical mattress inside-out suture repair using a Ti-Cron no. 2-0 braided polyethylene terephthalate suture (Covidien Medtronic).
- › FiberStitch repair strength and failure load surpassed other devices; no difference was found in cyclic displacement between repair types.

Takeaway: All-inside, all-suture repair with the FiberStitch implant demonstrated superior strength as compared to PEEK anchors and the classic inside-out, sutured meniscal repair.

Orthop J Sports Med. 2024;12(5):23259671241245127. doi:10.1177/23259671241245127

Superior load-to-failure in an all-suture anchor system for all-inside meniscal repair compared to a PEEK-cage anchor system in an experimental cadaveric test setting.

Pichler L, Kiss G, Sator T, Schuller A, Kandathil SA, Hofbauer M, Koch T, Hirtler L, Tiefenboeck T

- › Compared biomechanical properties of latest-generation all-suture anchor repair device (ASARD) and PEEK-cage anchor repair device (PCARD) for meniscal repair.
- › A total of 26 menisci were studied for load to failure, stiffness, displacement, and mode of failure.
- › ASARD showed a 61% higher load to failure than PCARD and trended toward higher stiffness, which may be conducive to tissue healing.

Takeaway: All-suture meniscal repair showed a significantly higher mean load to failure than PCARD.

J Exp Orthop. 2024;11(3):e12110. doi:10.1002/jeo2.12110

Avoiding injury to the popliteal neurovascular bundle in all-inside suturing of the posterior horn of the lateral meniscus: an a magnetic resonance imaging assessment of portal selection and safety.

Gilat R, Agar G, Shohat N, Dahan M, Beer Y, Lindner D

- › This study assessed the risk of injury to the popliteal neurovascular bundle (PNVB) while suturing the posterior horn of the lateral meniscus (PHLM).
- › All-inside suturing of the PHLM was simulated using MRI of 60 knees.
- › Of 1200 measurements performed, the simulated suturing trajectory transected the PNVB 28% of the time.

Takeaway: All-inside suturing of the PHLM at 0 mm from the PCL is safer with a more lateral portal. Beyond 3 mm from the PCL, a more medial portal carries a lower risk to the PNVB.

Arthroscopy. 2020;36(2):492-498. doi:10.1016/j.arthro.2019.08.041

Tips and pearls for all-inside medial meniscus repair.

KMalinowski K, Góralczyk A, Hermanowicz K, LaPrade RF

- › The medial meniscus is one of the most commonly injured structures in the knee, and management of meniscus tears is a key issue for the well-being of the entire knee joint.
- › An all-inside technique seems to allow for the most anatomic repair with the greatest preservation of surrounding soft tissues.
- › Study shows that there are no technical limitations for all-inside meniscal repairs with nonabsorbable sutures.

Takeaway: An all-inside technique has advantages, including preservation of anatomy, restoration of normal range of motion and biomechanics, reduced risk of neurovascular damage and skin and soft-tissue complications.

Arthrosc Tech. 2019;8(2):e131-e139. doi:10.1016/j.eats.2018.10.009

All-inside suture repair for isolated radial tears at the midbody of the lateral meniscus.

Uchida R, Horibe S, Shiozaki Y, Shino K

- › In young athletes, radial tears of the midbody on the lateral meniscus are most common.
- › Meniscectomy has been considered a first-line treatment for this type of tear; however, a meniscectomy may lead to degenerative changes.
- › An easier and less invasive treatment option is a meniscocapsular suture technique or an all-inside suture repair technique.

Takeaway: All-inside meniscal repair has many benefits, including a straightforward approach, the use of standard anterior portals, an easy approximation of the gap without traction of stumps toward the periphery, and less posterior neurovascular damage.

Arthrosc Tech. 2019;8(12):e1451-e1456. doi:10.1016/j.eats.2019.07.032

Meniscus repair with simultaneous ACL reconstruction demonstrated similar clinical outcomes as isolated ACL repair: a result not seen with meniscus resection.

Phillips M, Rönnblad E, Lopez-Rengstig L, Svantesson E, Stålmán A, Eriksson K, Ayeni OR, Samuelsson K

- › This retrospective study compared knee injury and osteoarthritis outcome scores and EuroQoL-5D subscale scores at 2-year follow-up for patients who had an ACL reconstruction and a simultaneous meniscal treatment.
- › ACL reconstruction with meniscus resection resulted in worse clinical outcomes when compared to ACL reconstruction with meniscus repair.

Takeaway: Meniscus repair may provide greater clinical outcomes compared to meniscus resection when treating a reparable meniscal tear that presents along with an ACL tear.

Knee Surg Sports Traumatol Arthrosc. 2018;26(8):2270-2277. doi:10.1007/s00167-018-4862-1

Are outcomes after meniscal repair age dependent? a systematic review.

Rothermel SD, Smuin D, Dhawan A

- › An analysis of previously published data compared patients both younger and older than 40 years undergoing meniscus repair.

Takeaway: Results reveal that no significant difference exists when evaluating the failure rate for meniscus repair.

Arthroscopy. 2018;34(3):979-987. doi:10.1016/j.arthro.2017.08.287

A contact pressure analysis comparing an all-inside and inside-out surgical repair technique for bucket-handle medial meniscus tears.

Marchetti DC, Phelps BM, Dahl KD, Slette EL, Mikula JD, Dornan GJ, Bucci G, Turnbull TL, Singleton SB

- › Meniscal tears are the most commonly treated knee injury.
- › No significant differences were observed between the inside-out and all-inside repair techniques at any flexion angle for contact area, mean contact pressure, and peak contact pressure.

Takeaway: Both all-inside and inside-out repair techniques may adequately decrease the likelihood of cartilage degeneration.

Arthroscopy. 2017;33(10):1840-1848. doi:10.1016/j.arthro.2017.04.013

Comparable outcomes after bucket-handle meniscal repair and vertical meniscal repair can be achieved at a minimum 2 years' follow-up.

Moatshe G, Cinque ME, Godin JA, Vap AR, Chahla J, LaPrade RF

- › Study compared outcomes following bucket-handle repairs and vertical meniscal repairs using a stacked vertical suturing technique.
- › Patients had improved results and low failure rates with the repair of bucket-handle tears using a stacked vertical suture technique.

Takeaway: Improved results and low failure rates were achieved using the same surgical technique to address vertical meniscus tears.

Am J Sports Med. 2017;45(13):3104-3110. doi:10.1177/0363546517719244

Changes in contact area in meniscus horizontal cleavage tears subjected to repair and resection.

Beamer BS, Walley KC, Okajima S, Manoukian OS, Perez-Viloria M, DeAngelis JP, Ramappa AJ, Nazarian A, Rothe

- › Study compared tibiofemoral contact pressure and contact area with a horizontal cleavage tear versus meniscal repair, partial meniscectomy, and subtotal meniscectomy.
- › Horizontal cleavage tears increased contact pressure 70%.
- › Circumferential suture repair restored peak contact pressures and areas to within 15% of baseline.

Takeaway: Partial and subtotal meniscectomy significantly reduced contact area and increased contact pressure. These changes may accelerate joint degeneration. A suture-based repair of these horizontal cleavage tears returns the contact area and contact pressure to nearly normal.

Arthroscopy. 2017;33(3):617-624. doi:10.1016/j.arthro.2016.09.004

Meniscus suture repair: minimum 10-year outcomes in patients younger than 40 years compared with patients 40 and older.

Steadman JR, Matheny LM, Singleton SB, Johnson NS, Rodkey WG, Crespo B, Briggs KK

- › Study compared meniscus repair failure rates and functional outcomes between patients under 40 years of age and those who were older than 40 years at the time of the procedure.
- › Repair failure rate was not different between the 2 groups.
- › Lysholm, Tegner, and patient satisfaction scores were evaluated and demonstrated patients in both groups had high function and high patient satisfaction an average of 16 years following meniscus repair.

Takeaway: Age did not appear to be a factor in meniscus repair failure rate, including for long-term outcomes that showed high function and patient satisfaction in patients both under and over 40 years of age.

Am J Sports Med. 2015;43(9):2222-2227. doi:10.1177/0363546515591260

Analysis of a new all-inside versus inside-out technique for repairing radial meniscal tears.

Beamer BS, Masoudi A, Walley KC, Harlow ER, Manoukian OS, Hertz B, Haeussler C, Olson JJ, Deangelis JP, Nazarian A, Ramappa AJ

- › Study compared gap formation, strength, and stiffness for all-inside compared to inside-out suturing techniques.
- › All-inside repairs resulted in significantly lower displacement and higher load-to-failure strength.
- › The failure mode for all-inside repairs was suture breakage (suture failure) compared to tissue pull-through (tissue failure) in inside-out repairs.

Takeaway: Biomechanical properties of a vertical all-inside technique are superior to those of a horizontal inside-out technique.

Arthroscopy. 2015;31(2):293-298. doi:10.1016/j.arthro.2014.08.011

Repair of horizontal meniscus tears: a systematic review.

Kurzweil PR, Lynch NM, Coleman S, Kearney B

- › Study reviewed published outcomes of repaired horizontal cleavage tears and tested the hypothesis that surgically repaired horizontal cleavage tears have an unacceptably low rate of success.
- › Nine previously published articles totaling 98 repairs of horizontal tears met inclusion criteria.
- › The 76% success rate for horizontal repairs does not support the hypothesis and supports repair of horizontal cleavage tears.
- › There was a 68% success rate for vertical tears.
- › There was an 84% success rate for bucket-handle tears.

Takeaway: Studies of horizontal cleavage repair tears showed an overall success rate of 77.8%, comparable to repairs of other tear types, which does not support the idea that horizontal cleavage tear repairs have a low success rate.

Arthroscopy. 2014;30(11):1513-1519. doi:10.1016/j.arthro.2014.05.038

Success of meniscal repair at anterior cruciate ligament reconstruction.

Toman CV, Dunn WR, Spindler KP, Amendola A, Andrish JT, Bergfeld JA, Flanigan D, Jones MH, Kaeding CC, Marx RG, Matava MJ, McCarty EC, Parker RD, Wolcott M, Vidal A, Wolf BR, Huston LJ, Harrell FE Jr, Wright RW

- › This was a MOON (Multicenter Orthopedic Outcomes Network) case study examining meniscal repair with ACL reconstruction success at 2-year follow-up.
- › There is an estimated 90% clinical success rate of meniscal repair at 2-year follow-up when the meniscus is repaired at the time of an ACL reconstruction.

Takeaway: When combined with ACL reconstruction, meniscal repair is a successful procedure. Repairable meniscus tears completed at the time of these repairs had a >90% clinical success rate at 2-year follow-up.

Am J Sports Med. 2009;37(6):1111-1115. doi:10.1177/0363546509337010