Meniscus Root Repair Scientific Update

Scientific Update

An increase in published orthopedic literature regarding meniscus function, pathology, and repair is leading to increased 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 conditions, such as direct trauma, overuse, previous injury, and increased age, can lead to meniscus damage.

Innovations and advancements in technology have resulted in better techniques and instrumentation for meniscus repair. This document summarizes published studies that describe the meniscal anatomy, biomechanical data, surgical techniques, and clinical data.

MENISCAL ANATOMY

Injury of the meniscus root.

Kennedy MI, Strauss M, LaPrade RF

- Medial posterior root tears are more common (52%) than lateral posterior root tears (41%).
- Disruption of root tears often leads to meniscal extrusion and failure of load distribution.
- The absence of a lateral posterior meniscus attachment results in greater strain placed on the ACL and increased anterior tibial translation and internal rotation.
- Proper anatomic root repairs restore knee stability and joint loading.
- Patients with no to mild osteoarthritis (OA) have significantly improved outcomes following posterior root repair and stalled OA progression.

> **Takeaway:** The proper identification and treatment of meniscal root tears has been proven to restore joint loading and improve patient outcomes.

Clin Sports Med. 2020;39(1):57-68. doi:10.1016/j.csm.2019.08.009

BIOMECHANICAL DATA

Biomechanical comparison of transtibial pull-out fixation versus suture anchor fixation for repair of medial meniscus posterior root tears.

Cinque ME, Hinz M, Sidrak J, Hollenbeck JFM, Buchalter WH, Kanakamedala A, Mitchell JJ, Godin JA, Provencher MT

- Human cadaveric study of 8 pairs of knees comparing extrusion and contact pressures of suture anchor repair techniques to transtibial repair techniques for meniscus posterior root repair.
- Each specimen underwent cyclic compressive loading and medial extrusion. Compartment contact pressures were evaluated after 0, 100, 500, and 1000 cycles.
- Suture anchor repair using the SutureLoc™ implant demonstrated lower medial meniscal extrusion and reduced medial compartment contact pressures after time-zero cyclic loading.

> **Takeaway:** Meniscus root repair with the SutureLoc implant demonstrated lower medial extrusion and reduced medial compartment contact pressures after time-zero loading, which may increase the likelihood of healing and improved long-term outcomes.

Am J Sports Med. 2025;53(9):2128-2135. doi:10.1177/03635465251342267

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Meniscal translation under loaded motion after posterior horn medial meniscal root repair: a cadaveric biomechanical evaluation.

Nuelle CW, Jackson GR, Bezold W, Smith BL, Cook JL

- Cadaveric model testing meniscal translation in 3 states: intact, posterior root released, and root repaired using adjustable suture anchor fixation with the SutureLoc™ implant.
- In each condition, the knees were axially loaded with 30 N through a range of motion to test meniscal excursion, extrusion, and hoop strain at 0°, 30°, 60°, 90°, and 100° of flexion for 10 cycles.
- Adjustable suture anchor fixation with the SutureLoc implant resulted in decreased excursion and extrusion compared to the meniscus root tear condition.

> **Takeaway:** The SutureLoc implant for posterior medial meniscus root repair demonstrated meniscal translation similar to that of the native meniscus under loading during knee motion, which could potentially enable more accelerated postsurgical rehabilitation.

Am J Sports Med. Published online January 29, 2026. doi:10.1177/03635465251405733

Biomechanical performance of transtibial pull-out posterior horn medial meniscus root repair is improved with knotless adjustable suture anchor-based fixation.

Bachmaier S, Krych AJ, Smith PA, Feucht MJ, LaPrade RF, Wijdicks CA

- Randomized, controlled porcine laboratory study comparing the time-zero biomechanical properties of 8 intact medial menisci to 6 groups with posterior medial meniscus root (PMMR) tears that were repaired using 6 different transtibial pull-out repair (TPOR) techniques, including the SutureLoc tensioning implant.
- Adjustable PMMR (SutureLoc implant) repair techniques showed higher initial repair loads and relief displacement than all 4 fixed repairs.
- During cyclic loading, adjustable PMMR (SutureLoc implant) repair techniques showed less displacement than fixed repair and comparable stiffness to the fixed Mason-Allen technique and returned the repaired meniscus back to its anatomic function.

> **Takeaway:** Only repairs using the SutureLoc adjustable-tensioning implant returned the repaired meniscus back to full anatomic function. Additionally, repairs using the SutureLoc implant for TPOR of PMMR tears improved the initial repair load and relief displacement after fixation and reduced cyclic displacement when compared to clinically reported, fixed-suture repair techniques.

Orthop J Sports Med. 2024;12(4):23259671241239575. doi:10.1177/23259671241239575

Repair of the lateral posterior meniscal root improves stability in an ACL-deficient knee.

Forkel P, von Deimling C, Lacheta L, Imhoff FB, Foehr P, Willinger L, Dyrna F, Petersen W, Imhoff AB, Burgkart R

- This human cadaveric study of 8 knees looks at 5 different scenarios: intact, ACL cut, ACL cut and lateral meniscus posterior root tear, ACL cut and lateral meniscus posterior root tear and transection of meniscal femoral ligament, and ACL cut with lateral meniscus posterior root tear.
- Lateral meniscus posterior root tears increased internal tibial instability compared to an ACL-insufficient knee.
- Lateral meniscus posterior root repair significantly decreased internal tibial rotation in an ACL-deficient knee.

> **Takeaway:** Repairing a lateral posterior meniscus root tear along with ACL reconstruction can improve rotational stability.

Knee Surg Sports Traumatol Arthrosc. 2018;26(8):2302-2309. doi:10.1007/s00167-018-4949-8

Cyclic displacement after meniscal root repair fixation: a human biomechanical evaluation.

LaPrade RF, LaPrade CM, Ellman MB, Turnbull TL, Cerminara AJ, Wijdicks CA

- This cadaveric study compares 4 different suture configurations for meniscal root repair.
- The authors evaluated root repairs using a 2 simple suture (TSS) technique, a modified Mason-Allen (MMA) suture technique, a single double-locking loop (S-DLL) technique, and a double double-locking loop (D-DLL) technique.
- Following 1000 cycles of each specimen, displacement was measured and revealed that the TSS technique displaced the least, followed by the MMA, D-DLL, and S-DLL techniques.

> **Takeaway:** The authors conclude that TSS fixation is sufficient at resisting displacement and demonstrates ultimate failure loads above currently accepted thresholds.

Am J Sports Med. 2015;43(4):892-898. doi:10.1177/0363546514562554

Biomechanical consequences of a nonanatomic posterior medial meniscal root repair.

LaPrade CM, Foad A, Smith SD, Turnbull TL, Dornan GJ, Engebretsen L, Wijdicks CA, LaPrade RF

- Nonanatomical posterior medial root repair did not restore contact area of mean contact pressures to that of the intact knee or when compared to an anatomical repair.
- Anatomic repair of the posterior medial meniscus horn decreased contact area by only 17% compared to a 44% decrease of contact area when nonanatomically repaired.
- Contact pressures of a nonanatomically repaired posterior medial root repair increased by 67% compared with an intact posterior medial meniscus root.

> **Takeaway:** Anatomic placement of the root is crucial for healing. Nonanatomic repair did not restore the contact area or mean contact pressures to that of the intact knee or anatomic repair.

Am J Sports Med. 2015;43(4):912-920. doi:10.1177/0363546514566191

Biomechanical consequences of a complete radial tear adjacent to the medial meniscus posterior root attachment site: in situ pull-out repair restores derangement of joint mechanics.

Padalecki JR, Jansson KS, Smith SD, Dornan GJ, Pierce CM, Wijdicks CA, Laprade RF

- Radial tears near the posterior root of the medial meniscus can compromise circumferential integrity, can result in extrusion, and are challenging to treat surgically.
- Repairing these radial tears with an in situ pull-out technique restores the loading profiles of the medial compartment.

> **Takeaway:** Reanchoring the posterior horn in patients with complete radial tears would have a favorable biomechanical effect.

Am J Sports Med. 2014;42(3):699-707. doi:10.1177/0363546513499314

Biomechanical consequences of a tear of the posterior root of the medial meniscus. surgical technique.

Harner CD, Mauro CS, Lesniak BP, Romanowski JR

- Human cadaveric study comparing an intact medial meniscus, a posterior root tear of the medial meniscus, a transtibially repaired posterior root tear, and total meniscectomy.
- An axial load of 1000 N was applied to the specimen and contact pressures measured at knee flexion angles of 0˚, 30˚, 60˚, and 90˚.
- Contact pressures increased 25% in the specimen with a medial meniscus posterior root tear.
- The transtibially repaired group demonstrated restored normal peak contact pressures and restored joint biomechanics.

> **Takeaway:** This study demonstrates that posterior root tears cause significant changes in contact pressure and knee joint kinematics. Root repair was successful in restoring joint biomechanics to within normal conditions.

J Bone Joint Surg Am. 2009;91 Suppl 2:257-270. doi:10.2106/JBJS.I.00500

CLINICAL DATA

Clinical, radiographic, and arthroscopic outcomes of surgical repair for radial and avulsed lesions on the lateral meniscus posterior root during ACL reconstruction: a systematic review.

Zheng T, Song G, Li Y, Zhang Z, Ni Q, Cao Y, Feng Z, Zhang H, Feng H

- Patients with tears of the lateral meniscus posterior root (LMPR) associated with ACL injuries obtained favorable functional scores after simultaneous ACL reconstruction (ACLR) and LMPR repairs.
- >90% of side-to-side radial tear repairs showed complete or partial healing upon second-look arthroscopy.
- Radiographical outcomes at 33.9 months post-op showed no significant progression of joint space narrowing or chondral lesions of the lateral meniscus.

> **Takeaway:** Complete or partial healing was found in 93.6% of the second-look arthroscopies after side-to-side repairs for radial tears of the posterior root.

Orthop J Sports Med. 2021;9(3):2325967121989678. Published 2021 Mar 17. doi:10.1177/2325967121989678

Midterm outcomes of posterior medial meniscus root tear repair: a systematic review.

Chang PS, Radtke L, Ward P, Brophy RH

- A systemic analysis of 28 studies demonstrated improved clinical outcomes (Lysholm, IKDC, Hospital for Special Surgery, and Tegner scores) associated with posterior medial meniscus root tear (PMMRT) repair.
- Some studies showed that PMMRT repair slowed the progression of OA but does not prevent it at midterm follow-up.

> **Takeaway:** Repairs of posterior medial meniscus root tears provide a functional benefit with consistent improvement in clinical outcome scores.

Am J Sports Med. 2022;50(2):545-553. doi:10.1177/0363546521998297

Medial meniscus posterior root tear treatment: a matched cohort comparison of nonoperative management, partial meniscectomy, and repair.

Bernard CD, Kennedy NI, Tagliero AJ, Camp CL, Saris DBF, Levy BA, Stuart MJ, Krych AJ

- Medial meniscus posterior horn root tears make up 10% to 21% of all meniscal tears.
- Meniscus root repair leads to less arthritis progression and subsequent knee arthroplasty compared with nonoperative management and partial meniscectomy.
- Meniscectomy for root tear leads to an increase need for knee arthroplasty.

> **Takeaway:** Meniscus root repair leads to significantly less arthritis progression and subsequent knee arthroplasty compared with nonoperative management and partial meniscectomy.

Am J Sports Med. 2020;48(1):128-132. doi:10.1177/0363546519888212

Medial versus lateral meniscus root tears: Is there a difference in injury presentation, treatment decisions, and surgical repair outcomes?

Krych AJ, Bernard CD, Kennedy NI, Tagliero AJ, Camp CL, Levy BA, Stuart MJ

- Authors used demographic characteristics, radiographic findings, treatment decisions, clinical outcomes, and risk factors to compare medial and lateral meniscus root tears.
- A retrospective review was performed to identify patients with symptomatic, medial, or lateral meniscus posterior root tears with a minimum 2-year follow-up.
- Of the 141 identified root tears, 109 were medial and 30 were lateral.

> **Takeaway:** The authors concluded that when compared to MMRTs, LMRTs occur in younger male patients with lower body mass index, less cartilage degeneration, less extrusion on MRI, and commonly with a ligament injury. The authors also concluded that LMRTs may have better results after repair, suggesting that differences in injury and patient characteristics may contribute to differences in these outcomes.

Arthroscopy. 2020;36(4):1135-1141. doi:10.1016/j.arthro.2019.11.098

Meniscus root repair vs meniscectomy or nonoperative management to prevent knee osteoarthritis after medial meniscus root tears: clinical and economic effectiveness.

Faucett SC, Geisler BP, Chahla J, Krych AJ, Kurzweil PR, Garner AM, Liu S, LaPrade RF, Pietzsch JB

- Patients who were treated with a meniscectomy or nonoperative treatment for a medial meniscus root tear showed 99.3% and 95.1% rates of OA respectively over a 10-year period.
- 53% of patients who received a medial meniscus root repair showed a progression of OA over 10 years.
- During the same 10-year period, only 33.5% of patients who received a medial meniscus root repair went on to knee arthroplasty compared to 51.5% and 45.5% of patients who received a meniscectomy or nonoperative treatment, respectively.

> **Takeaway:** Medial meniscus root repairs lead to less OA compared to total meniscectomy and nonsurgical treatment.

Am J Sports Med. 2019;47(3):762-769. doi:10.1177/0363546518755754

Non-operative management of medial meniscus posterior horn root tears is associated with worsening arthritis and poor clinical outcome at 5-year follow-up.

Krych AJ, Reardon PJ, Johnson NR, Mohan R, Peter L, Levy BA, Stuart MJ

- Nonoperative treatment of medial meniscus posterior horn root tears is associated with progression of arthritis and a relatively high rate of arthroplasty at 5-year follow-up.
- Nonoperative treatment resulted in 31% of patients progressing to knee arthroplasty within 30 months of the initial diagnosis.
- Overall, 87% of patients failed nonoperative treatment.

> **Takeaway:** Nonoperative treatment of medial meniscus posterior horn root tears is associated with poor clinical outcome, worsening arthritis, and a relatively high rate of arthroplasty at 5-year follow-up.

Knee Surg Sports Traumatol Arthrosc. 2017;25(2):383-389. doi:10.1007/s00167-016-4359-8

Comparison of clinical and radiologic results between partial meniscectomy and refixation of medial meniscus posterior root tears: a minimum 5-year follow-up.

Chung KS, Ha JK, Yeom CH, Ra HJ, Jang HS, Choi SH, Kim JG

- Authors followed 57 patients for a minimum of 5 years following partial meniscectomy and medial meniscus posterior horn repair.
- Radiological assessments were evaluated using Kellgren-Lawrence (K-L) grading and joint space evaluation.
- Repair group had significantly better clinical results when compared to meniscectomy group and showed less K-L grade progression and less joint narrowing. Of meniscectomized knees, 3% received a total knee arthroplasty within 5 years while none of the repair group received a total knee arthroplasty.

> **Takeaway:** Refixation of the meniscus root was more effective than partial meniscectomy and slowed the progression of arthritic changes.

Arthroscopy. 2015;31(10):1941-1950. doi:10.1016/j.arthro.2015.03.035

Prognostic factors of arthroscopic pull-out repair for a posterior root tear of the medial meniscus.

Moon HK, Koh YG, Kim YC, Park YS, Jo SB, Kwon SK

- Second-look arthroscopy of 10 patients following medial meniscus root tear repair showed complete healing of all 10 menisci without additional chondral lesions.
- Medial meniscal root tear repair alone failed to prevent the progression of meniscal extrusion.
- Patients with >5° of varus alignment experienced better medial meniscus root repair outcomes when combined with a correctional osteotomy.

> **Takeaway:** All clinical outcome measures significantly improved after a medial meniscus root repair, and the technique provided patients with a clinical benefit.

Am J Sports Med. 2012;40(5):1138-1143. doi:10.1177/0363546511435622

Arthroscopic pullout suture repair of posterior root tear of the medial meniscus: radiographic and clinical results with a 2-year follow-up.

Lee JH, Lim YJ, Kim KB, Kim KH, Song JH

- Arthroscopic PMMR was performed using a transtibial technique in 26 patients, all of whom had a minimum 2-year follow-up, including clinical and radiographic evaluation, along with 10 second-look arthroscopies.
- Upon second-look arthroscopies of 10 randomly selected patients, it was determined that all menisci had healed completely, and no additional chondral lesions were noted.
- Hospital for Special Surgery clinical scores improved from 61.1 preoperatively to 93.8 at final follow-up. Lysholm knee scores were 93.1 at final follow-up from 57 preoperatively.

> **Takeaway:** Arthroscopic transtibial repair technique of patients that are symptomatic is an effective treatment of posterior medial meniscus root tears.

Arthroscopy. 2009;25(9):951-958. doi:10.1016/j.arthro.2009.03.018