

Posterior Meniscal Root Repairs

Outcomes of an Anatomic Transtibial Pull-Out Technique

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Background: Outcomes after transtibial pull-out repair for posterior meniscal root tears remain underreported, and factors that may affect outcomes are unknown.

Purpose/Hypothesis: The purpose of this study was to compare patient-centered outcomes after transtibial pull-out repair for posterior root tears in patients <50 and ≥50 years of age. We hypothesized that improvement in function and activity level at minimum 2-year follow-up would be similar among patients <50 years of age compared with patients ≥50 years and among patients undergoing medial versus lateral root repairs.

Study Design: Cohort study; Level of evidence, 3.

Methods: Inclusion criteria were patients aged 18 years or older who underwent anatomic transtibial pull-out repair of the medial or lateral posterior meniscus root by a single surgeon. All patients were identified from a data registry consisting of prospectively collected data in a consecutive series. Cohorts were analyzed by age (<50 years [n = 35] vs ≥50 years [n = 15]) and laterality (lateral [n = 15] vs medial [n = 35]). Patients completed a subjective questionnaire preoperatively and at minimum of 2 years postoperatively (Lysholm, Tegner, Western Ontario and McMaster Universities Osteoarthritis Index [WOMAC], 12-Item Short Form Health Survey [SF-12], and patient satisfaction with outcome). Failure was defined as revision meniscal root repair or partial meniscectomy.

Results: The analysis included 50 knees in 49 patients (16 females, 33 males; mean age, 38.3 years; mean body mass index, 26.6). Of the 50 knees, 45 were available for analysis. Three of 45 (6.7%) required revision surgery. All failures were in patients <50 years old, and all failures underwent medial root repair. No significant difference in failure was found based on age ($P = .541$) or laterality ($P = .544$). For age cohorts, Lysholm and WOMAC scores demonstrated significant postoperative improvement. For laterality cohorts, all functional scores significantly improved postoperatively. No significant difference was noted in postoperative Lysholm, WOMAC, SF-12, Tegner, or patient satisfaction scores for the age cohort or the laterality cohort.

Conclusion: Outcomes after posterior meniscal root repair significantly improved postoperatively and patient satisfaction was high, regardless of age or meniscal laterality. Patients <50 years had outcomes similar to those of patients ≥50 years, as did patients who underwent medial versus lateral root repair. Transtibial double-tunnel pull-out meniscal root repair provided improvement in function, pain, and activity level, which may aid in delayed progression of knee osteoarthritis.

Keywords: posterior meniscus root; root repair; transtibial pull-out repair; medial meniscus; lateral meniscus; outcomes

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The anterior and posterior meniscus roots anchor the medial and lateral menisci to the tibial plateau, allowing the meniscus to disperse axial loads into hoop stresses.^{4,8,10} Posterior meniscal root tears lead to altered tibiofemoral contact pressures and contact areas, which have been reported to be functionally similar to a total meniscectomy.^{2,16,21,25} If left untreated, patients may experience increased pain and dysfunction due to progressive degenerative changes, which could lead to early degenerative joint disease.^{7,27} Over the years, treatment algorithms have shifted toward meniscal preservation.⁴ Due to an increased understanding of the consequences of injury at or near the meniscal root attachments, greater emphasis has been placed on restoring meniscal integrity, particularly when injury occurs at the root attachment.⁴



Figure 1. Illustration of a transtibial pull-out repair for a posterior medial meniscal root tear. Reproduced with permission from LaPrade CM, LaPrade MD, Turnbull TL, Wijdicks CA, LaPrade RF. Biomechanical evaluation of the transtibial pull-out technique for posterior medial meniscus root repairs using 1 and 2 transtibial bone tunnels. *Am J Sports Med.* 2015;43(4):899-904.

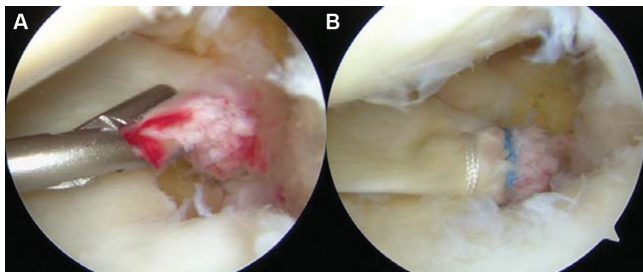


Figure 2. Arthroscopic images demonstrating (A) a posterior medial meniscal root tear and (B) final fixation of the root repair after the sutures have been pulled through the transtibial tunnels, tensioned, and secured to the tibia with a cortical fixation device (left knee).

With a shift toward meniscal preservation for meniscal root tears,⁴ various techniques have been developed.¹⁷ Specifically, the transtibial pull-out repair technique for posterior medial and lateral meniscal root tears strives to restore meniscal function and has been biomechanically validated to restore tibiofemoral joint contact mechanics.^{16,25} Preliminary studies have reported improvement in function, pain, and objective measures.^{11,15,19} While early results suggest an improvement in outcomes, the majority of studies have focused on repairs of the posterior medial meniscus root, limiting the complete

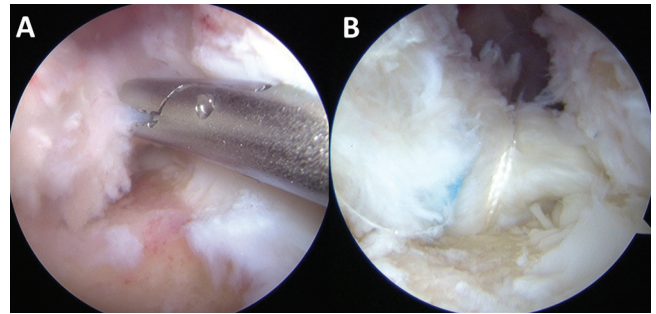


Figure 3. Arthroscopic images demonstrating (A) a posterior lateral meniscal root tear and (B) final fixation of the root repair after the sutures have been pulled through the transtibial tunnels and secured to the tibia with a cortical fixation device (right knee).

assessment of posterior root tears.^{1,11,19} Of the outcomes studies that have reported on lateral root repairs, techniques have varied widely, including no treatment, all-inside repair, inside-out repair, and a modified transtibial pull-out repair.^{1,15,26,28} Outcomes after both medial and lateral meniscal root repair using a transtibial pull-out technique remain unclear, emphasizing the need for additional patient-centered outcomes studies.

The purpose of this study was to report patient-centered outcomes in patients who underwent transtibial pull-out repair for posterior meniscal root tears. The primary focus of this study was to compare outcomes in patients younger than 50 years versus patients 50 years and older. Outcomes were also assessed in patients with medial versus lateral meniscal root repairs. We hypothesized that improvement in function and activity level at a minimum 2-year follow-up would be no different among patients younger than 50 compared with those 50 and older and among patients undergoing posterior lateral versus posterior medial meniscal root repairs.

METHODS

This study was approved by the institutional review board at Steadman Philippon Research Institute. This was a retrospective study performed on prospectively collected data. Inclusion criteria were all patients 18 years or older who underwent an anatomic transtibial pull-out repair (Figure 1) of either the medial (Figure 2) or lateral (Figure 3) posterior meniscus root between January 2011 and March 2014 by a single orthopaedic surgeon.

Exclusion criteria were age less than 18 years or a meniscal repair in a region other than the posterior root attachment (ie, anterior root or body of meniscus). All patients were identified from a data registry consisting of prospectively collected data in a consecutive series.

To assess knee alignment before meniscal repair, the mechanical axis of the knee was measured at initial clinical evaluation by use of long-leg standing radiographs. To assess the mechanical axis, a line was drawn from the

center of the femoral head to the center of the tibial plafond. A second line was drawn from the medial border to the lateral border of the tibial plateau. A third line was drawn from the medial border of the tibial plateau to the intersection of the first line along the tibial plateau. The mechanical axis was calculated by dividing the length of Line 3 by the Length of Line 2; this intersection was reported as a percentage, with 0% being the medial border of the tibial plateau and 100% being the lateral border.

Patients completed a subjective questionnaire preoperatively and at a minimum of 2 years postoperatively, which included the Lysholm score,²⁰ the Tegner activity scale,²⁹ the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC),³ the 12-Item Short Form Health Survey (SF-12) Physical Component Summary (PCS) and Mental Component Summary (MCS), and patient satisfaction with outcome. Patient satisfaction with outcome was rated on a 10-point scale, with 1 equal to highly unsatisfied and 10 equal to highly satisfied. All patients were administered a questionnaire on a tablet at the time of the office visit or via email. Failure was defined as any patient who underwent a revision meniscal root repair or partial meniscectomy of the previously repaired meniscus root following the index surgery.

Surgical Technique

An anatomic transtibial double-tunnel pull-out meniscal root repair was performed using the following technique (Figure 1). The patient was positioned supine with the surgical leg in 70° of knee flexion, the thigh secured in a leg holder, and the foot of the operating table folded down. The nonsurgical leg was abducted at the hip and secured in a well-padded leg-holder device. Standard medial and lateral parapatellar arthroscopic portals were created. The posterior medial and lateral meniscus root attachments were identified, and a calibrated arthroscopic probe was used to assess root stability and, in the event that a tear was identified, to characterize the root tear type.¹⁴

With a curved curette, the tibial attachment site of the torn meniscus root was debrided of soft tissues down to a bleeding bone bed to improve healing of the repair. A 3-cm incision was created adjacent to the tibial tubercle on the ipsilateral side of the root tear. Two transtibial tunnels were drilled 5 mm apart, exiting intra-articularly at the posterior root attachment site. An aiming device with a cannulated sleeve was used to position a drill pin. A tibial tunnel guide was used to ream the first tunnel (along the posterior aspect of the posterior root attachment site). The second tunnel was placed approximately 5 mm anterior to the first tunnel by use of an offset guide. The tunnels were visualized arthroscopically to verify appropriate tunnel positioning and the drill pins were removed, leaving the 2 cannulas in place for passing the sutures (2-0 Fiberwire; Arthrex Inc). An accessory anteromedial or anterolateral portal was formed to pass the sutures through the torn meniscus root. A self-passing suture device (Sharpshooter, Ivy Medical) was placed in the

accessory portal to pass a suture through the posterior portion of the torn meniscus root, which was then shuttled down the posterior transtibial tunnel. The steps were repeated with a second suture passed through the midportion of the torn meniscus root and shuttled down the second transtibial tunnel. The sutures were tensioned to reduce the meniscus root to its native anatomic attachment site. An anatomic repair was performed because non-anatomic root repair fails to restore the contact area and mean contact pressures to those of the intact knee or those achieved with anatomic repair.¹³ Once the reduction of the root repair was verified under direct arthroscopic visualization, the sutures were tied over a surgical cortical fixation device on the anterior tibia. Meniscal root repair sutures were secured after ligament fixation in cases requiring combined cruciate or collateral ligament repair or reconstruction. When a meniscal root repair was performed concurrent with a cruciate ligament reconstruction, the femoral tunnels for the cruciate ligaments were reamed first and passing sutures were placed in the tunnels. For cases with an anterior cruciate ligament (ACL) reconstruction, the root repair was performed next and the ACL tibial tunnel was then reamed, the graft passing suture was pulled down the tibial tunnel, and the ACL graft was passed into the femoral tunnel and secured. The knee was then cycled to remove any slack in the ACL graft, and the graft was secured in the tibial tunnel in full extension. For patients with a concurrent posterior cruciate ligament (PCL) reconstruction, the PCL tibial guide pin was placed and its position verified with intraoperative fluoroscopy. Once the pin was verified to be in the proper position, the root repair was performed and the root repair sutures were passed down the tibial tunnels. The PCL tibial tunnel was then reamed, and the 2 PCL grafts were passed and secured into the PCL femoral tunnels and then passed down the tibial tunnel. Both grafts were then secured to the tibia (anterolateral bundle at 90°, and then the posteromedial bundle at 0°) before fixation of the root repair sutures over the tibia.

Contraindications for root repair surgery were Kellgren-Lawrence grade 3 to 4⁹ or diffuse grade 3 to 4 chondromalacia²⁴ of the ipsilateral compartment and patients deemed unable to meet the postoperative rehabilitation protocol requirement of being nonweightbearing for 6 weeks.

Rehabilitation

Patients remained nonweightbearing in a straight leg brace for the first 6 weeks after surgery to prevent isolated hamstring activation, which could impart stress on the meniscal root repair. On postoperative day 1, passive knee range of motion exercises from 0° to 90° and quadriceps strength training exercises were initiated. Increased range of motion was allowed as tolerated after 2 weeks. Partial weightbearing began at week 7 and gradually increased to full weightbearing as tolerated without pain or swelling. Patients focused on endurance and strength exercises starting at 2 months postoperatively and gradually progressed to normal

TABLE 1
Patient Demographics by Cohort^a

	Age Cohort			Meniscal Laterality Cohort		
	<50 y (n = 35)	≥50 y (n = 15)	<i>P</i>	Lateral (n = 15)	Medial (n = 35)	<i>P</i>
Sex, female/male, n	10/25	6/9	.427	6/9	10/25	.427
Age, y	29.9 (18.2-49.1)	58.0 (51.3-65.7)	<.001	32.2 (19.7-52.7)	41.0 (18.2-65.7)	.055
Body mass index	25.5 (19.5-34.1)	29.2 (18.5-49.2)	.068	24.3 (20.2-30.0)	27.6 (18.5-49.2)	.008

^aData are reported as mean (range) unless otherwise indicated; n refers to the number of knees.

activities with an average return to full activities at 5 to 7 months postoperatively.²³

Statistical Data Analysis

Data were tested for normal distribution by use of the Kolmogorov-Smirnov test. Parametric methods were used for comparisons among meniscal tear cohorts for the SF-12 PCS, knee alignment, age at time of surgery, and follow-up years. For comparisons of normally distributed continuous variables between cohorts, an independent *t* test was used. Nonparametric methods were used for comparisons among groups for the Lysholm score, the Tegner activity scale, WOMAC, SF-12 MCS, patient satisfaction with outcome, and body mass index (BMI). For comparisons of non-normally distributed continuous variables between cohorts, the Mann-Whitney *U* test was used. For preoperative and postoperative comparisons of dependent variables, the paired-samples *t* test was used for normally distributed data and the Wilcoxon signed rank test was used for nonnormally distributed data. Comparisons of 2 categorical data values were performed by use of chi-square tests and Fisher exact tests. All *P* values were 2-tailed, and *P* < .05 was considered statistically significant. All statistical analyses were performed by use of SAS (version 9.4; SAS Institute).

RESULTS

Demographics

Fifty-two patients met the inclusion criteria for this study. One male patient underwent bilateral knee surgery with a medial root repair on the left knee and a lateral root repair on the right knee. One patient refused to participate, and 1 patient did not speak English, leaving 50 knees in 49 patients (16 females, 33 males) with a mean age of 38.3 years (range, 18.2-65.7 years) and a mean BMI of 26.6 (range, 18.5-49.2) included in this study. No significant difference was found in gender or BMI between the age cohorts (Table 1). No significant difference was noted in age (Figure 4) or sex between the meniscal root tear laterality cohorts. However, patients with medial meniscal root tears had a significantly higher BMI than patients with lateral root tears (Table 1).

For the first analysis, patients were categorized into 2 cohorts based on age, with patients younger than 50 years in one cohort and patients 50 years or older in the other cohort. There were 34 patients (35 knees) younger than 50 years and 15 patients (15 knees) 50 years or older. For the second analysis, patients were categorized into 2 cohorts based on lateral versus medial meniscal root tear laterality. There were 15 patients (15 knees) in the lateral cohort and 35 patients (35 knees) in the medial cohort.

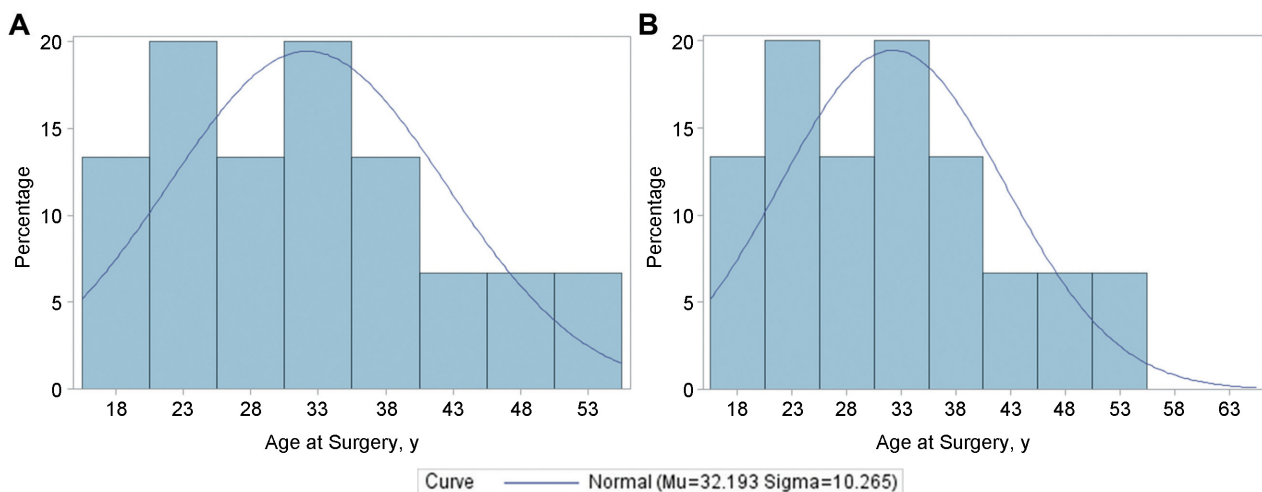


Figure 4. Histogram of the age distribution for the (A) lateral and (B) medial meniscal root repair cohorts.

TABLE 2
Concurrent Treatments and Intraoperative Findings Documented at Index Surgery^a

Condition	Lateral Meniscal Root Tear	Medial Meniscal Root Tear
Anterior cruciate ligament reconstruction	10 (67)	7 (20)
Medial collateral ligament reconstruction	5 (33)	5 (14)
Fibular collateral ligament reconstruction	2 (13)	4 (11)
Posterior cruciate ligament reconstruction	1 (7)	4 (11)
Grade 3 or 4 chondral defects	4 (27)	20 (57)
Medial	1 (7)	9 (26)
Lateral	3 (20)	2 (6)
Medial and lateral	—	1 (3)
Medial and patellofemoral	—	7 (20)

^aData are reported as n (%). A dash indicates no concomitant treatments performed.

TABLE 3
Patient Outcomes Categorized by Root Tear Classification as Observed Arthroscopically

Tear Type	n
Type 2A (complete radial 0 to <3 mm)	18
Type 2B (complete radial 3 to <6 mm)	13
Type 2C (complete radial 6 to 9 mm)	11
Type 3 (bucket handle with root detachment)	3
Type 4 (complex oblique or longitudinal)	4
Type 5 (root avulsion fracture)	1

Demographic data were documented at the initial clinical evaluation (Table 1). Detailed concurrent operative data and intraoperative findings were documented at the time of surgery (Table 2). In addition, each patient's root tear was classified at the time of surgery according to a previously described classification scheme¹⁴ (Table 3).

Concomitant Treatments and Clinical Evaluation

A significant difference was noted in the number of patients who underwent concomitant ACL reconstruction between medial and lateral cohorts. Patients who underwent a lateral meniscal root repair had 8 times the odds (95% CI, 2.1-31.0) of having a concomitant ACL reconstruction compared with patients who underwent a medial meniscal root repair ($P = .003$) (Table 2). No significant difference was noted in varus or valgus knee alignment. The mechanical axis for the lateral cohort was an average of 47% (range, 27%-67%), while the mechanical axis for the medial cohort was 41% (range, 19%-75%) ($P = .203$) of the medial to lateral width of the tibial plateau.¹⁸

Failures

Of the 50 knees, 45 knees (14 lateral, 31 medial) had a minimum 2-year follow-up. Of the 45 knees, 3 (6.7%) required revision meniscal root repair surgery. All 3 failures were in patients younger than 50 years who had a medial meniscal root repair. The mean time to failure was 11.0 months (range, 4.0-17.5 months). The average age of patients who experienced failure was 24 years (range, 18.9-27.9 years).

Of the medial meniscal tear cohort, 3 of 31 knees (9.7%) required revision surgery, while in the lateral cohort no patients required revision surgery; however, the difference in revision surgeries was not significant ($P = .544$). Although all patients who required revision surgery were younger than 50 years, no significant difference was noted in failure based on age cohort ($P = .541$). No significant difference was found in alignment for failures versus nonfailures. Patients who required revision surgery had an average mechanical axis of 45% (range, 26%-57%; SD, $\pm 16\%$), and patients who did not require revision surgery had an average mechanical axis of 42% (range, 19%-72%; SD, $\pm 14\%$) ($P = .758$).

Outcomes

Preoperative Versus Postoperative Outcome Scores. The total follow-up rate was 90% (45/50 knees), with 5 patients lost to follow-up (1 lateral, 4 medial). Average length of follow-up was 2.5 years (range, 2.0-4.3 years). For the age cohorts, functional scores including the Lysholm, Tegner activity scale, and the WOMAC score demonstrated significant postoperative improvement. However, the SF-12 PCS demonstrated a significant improvement only for patients younger than 50 years, while the SF-12 MCS demonstrated significant improvement only in patients 50 years and older (Table 4).

For the laterality cohorts, all functional outcome scores and activity levels demonstrated significant postoperative improvement (Table 5).

Age Younger Than 50 Versus 50 Years and Older. No significant differences were found in Lysholm score, WOMAC score, SF-12 PCS, SF-12 MCS, Tegner activity scale, or patient satisfaction with outcome in patients less than 50 years of age compared with patients 50 years of age and older (Table 6).

Medial Versus Lateral Root Repair Cohorts. No significant difference was noted in any outcome measures between the 2 root repair cohorts (Table 7).

DISCUSSION

The most important finding of this study was that patients who underwent posterior meniscal root repairs with an

TABLE 4
Improvement From Preoperative to Postoperative Outcome Scores by Age Cohort^a

Outcome Score	Age <50 y (n = 15 Follow-up)			Age ≥50 y (n = 30 Follow-up)			
	Pre	Post	P	Pre	Post	P	P
Lysholm	43	82	<.001	63	79		.006
WOMAC total	42	5	<.001	33	15		.007
SF-12 PCS	36.7	53.0	<.001	43.7	47.9		.293
SF-12 MCS	54.7	53.0	.550	47.0	53.9		.034
Tegner activity scale	2	4	.001	2	3.5		.078

^aPre, preoperative; Post, postoperative; SF-12 MCS, 12-Item Short Form Health Survey Mental Component Summary; SF-12 PCS, 12-Item Short Form Health Survey Physical Component Summary; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

TABLE 5
Improvement From Preoperative to Postoperative Outcome Scores by Laterality Cohort^a

Outcome Score	Lateral (n = 14 Follow-up)			Medial (n = 31 Follow-up)			
	Pre	Post	P	Pre	Post	P	P
Lysholm	35	75	.002	54	84		<.001
WOMAC total	52	10	.001	34	8		<.001
SF-12 PCS	33.6	49.8	<.001	41.0	52.0		<.001
SF-12 MCS	54.4	55.2	.791	51.6	52.4		.601
Tegner activity scale	2	4	.023	2	4		.008

^aPre, preoperative; Post, postoperative; SF-12 MCS, 12-Item Short Form Health Survey Mental Component Summary; SF-12 PCS, 12-Item Short Form Health Survey Physical Component Summary; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

TABLE 6
Average Postoperative Outcomes Measures by Age Cohort^a

Outcome Score	Age <50 y (n = 15 Follow-up)	Age ≥50 y (n = 30 Follow-up)	P
Lysholm	82 (45-95)	79 (26-100)	.520
WOMAC total	5 (0-25)	15 (0-57)	.098
SF-12 PCS	53.0 (36.4-65.4)	47.9 (29.9-63.1)	.107
SF-12 MCS	53.0 (26.1-64.9)	53.9 (32.5-63.8)	.173
Tegner activity scale ^b	4 (1-10)	3.5 (0-8)	.062
Patient satisfaction with outcome ^b	9 (1-10)	8 (2-10)	.897

^aData are reported as mean (range) unless otherwise indicated. SF-12 MCS, 12-Item Short Form Health Survey Mental Component Summary; SF-12 PCS, 12-Item Short Form Health Survey Physical Component Summary; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

^bScores are reported as median values.

TABLE 7
Average Postoperative Outcomes Measures by Laterality Cohort^a

Outcome Score	Lateral (n = 14 Follow-up)	Medial (n = 31 Follow-up)	P
Lysholm	75 (26-95)	84 (51-100)	.350
WOMAC Total	10 (0-57)	8 (0-40)	.960
SF-12 PCS	49.8 (29.9-58.3)	52.0 (34.5-65.4)	.433
SF-12 MCS	55.2 (36.5-64.9)	52.4 (26.1-63.8)	.893
Tegner activity scale ^b	4 (1-10)	4 (0-8)	.310
Patient satisfaction with outcome ^b	9 (2-10)	8.5 (1-10)	.898

^aData are reported as mean (range) unless otherwise indicated. SF-12 MCS, 12-Item Short Form Health Survey Mental Component Summary; SF-12 PCS, 12-Item Short Form Health Survey Physical Component Summary; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

^bScores are reported as median values.

anatomic transtibial double-tunnel pull-out technique had significantly improved outcomes and a high level of patient satisfaction with outcome at follow-up. Our findings suggest that anatomic transtibial double-tunnel pull-out repair is a successful surgical technique for patients who were treated for a posterior medial or posterior lateral meniscal root tear regardless of age.

One of the biggest debates about whether to repair posterior meniscal root tears is whether the procedure is beneficial for older patients. In the present study, no significant difference was found in functional outcome scores between patients younger than 50 years of age compared with patients 50 years and older. In addition, the average differences in outcome scores between age cohorts were within the minimal detectable change of the score.⁵ Whether older patients should undergo meniscectomy or root repair continues to be debated among surgeons.⁷ In the present study, findings suggest that patients 50 years and older should not be excluded purely based on age. Other factors such as osteoarthritis (Kellgren-Lawrence) grade, high BMI, or the ability to comply with the postoperative rehabilitation protocol may be more useful in guiding the management of meniscal root tears, rather than age as a sole factor.²² Additionally, in a comparative cohort study that reported outcomes for patients with an average age of 55 years who underwent posterior medial root meniscectomy versus root repair, the repair cohort had a 32-point improvement in Lysholm score, whereas the meniscectomy cohort had only a 12-point improvement from preoperative to postoperative status.⁶

In the present study, patients who underwent posterior meniscal root repairs reported significantly improved outcomes at a minimum of 2 years postoperatively regardless of which meniscus was repaired. Significant improvements in function and pain after medial meniscal root repair surgery have been documented; however, outcomes after lateral root repair are limited.^{11,15,19} Thus, our study further supports that there is no difference in outcomes between a medial or lateral meniscal root repair.

One of the goals of meniscal root repair surgery is to slow or ultimately arrest the progression of ipsilateral compartment arthritis. The present study did not assess arthritis progression, but Chung et al⁶ compared the results of posterior medial root repair and partial medial root meniscectomy, in patients with Kellgren-Lawrence grade 0 to 2, at a minimum of 5 years postoperatively. The investigators found that while repair did not prevent the progression of knee osteoarthritis completely, osteoarthritic changes were decelerated as compared with partial meniscectomy.⁶ This finding is also supported by other literature. Kim et al¹² investigated medial meniscal root tears that were treated with repair or meniscectomy. At second-look MRI and radiography, the repair cohort had significantly less joint space narrowing than the meniscectomy cohort, indicating a slower progression of knee osteoarthritis.¹² Another study reported on 2 medial meniscal root repair techniques. At a minimum of 2 years after arthroscopy, radiographic evaluation revealed no significant change in Kellgren-Lawrence grade from preoperative assessment to postoperative assessment for either cohort.¹¹ Overall, the evidence found within the current literature

supports the efficacy of meniscal root repair. With repair of meniscal root tears, patient outcomes have been reported to significantly improve and future degeneration of the knee joint may be delayed.

We recognize some limitations with this study. Data were reviewed retrospectively; however, all data were collected prospectively. All patients included in this study were seen at a tertiary referral clinic, which may not be representative of the general population. Additionally, no imaging was performed postoperatively; therefore, the rate and completeness of healing could not be assessed. The size of each comparison cohort may have limited the statistical power of the study; however, this study examined a consecutive series of patients treated by 1 surgeon. Additionally, a large number of the patients required concomitant ligament reconstructions, creating some heterogeneity within our samples, which may be a factor in the improvement in short-term outcomes. Furthermore, no debridement cohort was included to serve as a comparison; therefore, in cases of concomitant ligament reconstruction, it is difficult to determine the amount of improvement attributed to the ligament reconstruction and the amount of improvement due to the root repair.

CONCLUSION

In this study, outcomes after posterior meniscal root repair significantly improved postoperatively and patient satisfaction was high, regardless of age and meniscal laterality. Patients age 50 years or older had outcomes similar to those of patients younger than 50 years, as did patients who underwent medial versus lateral meniscal root repair. Overall, transtibial double-tunnel pull-out meniscal root repair resulted in significant improvements in function, symptoms of pain, and activity level. Further long-term studies are recommended.

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