

Research Article

Retrospective Outcomes of Augmented Medial Patellofemoral Ligament Repair with a Reinforced Bioinductive Implant: A Short-Term Follow-up Analysis

Sean McMillan, DO¹ , Elizabeth Ford, DO² 

¹ Orthopedics, Virtua Health System, ² Orthopedics, Allegheny Health Network

Keywords: reinforced bioinductive implant, MPFL, Patella dislocation, medial patellofemoral ligament, knee

<https://doi.org/10.60118/001c.159385>

Journal of Orthopaedic Experience & Innovation

Vol. 7, Issue 1, 2026

Background

Patellar instability is commonly associated with disruption of the medial patellofemoral ligament (MPFL). Although MPFL reconstruction (MPFLR) is the current standard of care, complication rates remain notable, particularly in young and high-risk patients. Reinforced bioinductive implants (RBI) have recently emerged as a biologically supportive alternative. Augmented MPFL repair (AMPFLr) using an RBI aims to combine anatomic reconstruction principles with biologic repair augmentation. The purpose of this study is to retrospectively evaluate patient reported outcomes and re-dislocation rates after undergoing AMPFLr using an RBI for patella instability. It is hypothesized that patients who underwent this procedure demonstrate clinical improvement over baseline in patient reported outcomes metrics (PROMs) and range of motion. A secondary hypothesis is AMPFLr would be non-inferior compared to historical data at early time points.

Methods

A retrospective review was performed for all patients undergoing AMPFLr between May 2021 and September 2024 at a single institution. Inclusion criteria were primary MPFL surgery, age ≥ 14 years, preoperative MRI confirming MPFL tear, RBI augmentation, and ≥ 1 -year follow-up. Exclusion criteria included allograft/autograft use, inadequate imaging, derotational osteotomies, and concomitant ACL reconstruction. Outcomes included range of motion (ROM), visual analog scale (VAS) pain scores, and BANFF Patella Instability Instrument (BPII2.0) scores collected preoperatively and at 6 and 12 months. Complications and reoperations were recorded. Paired t-tests compared postoperative values to baseline ($\alpha = 0.05$).

^a Dr. McMillan is a board certified orthopedic surgeon with specialty certification in orthopedic sports medicine (CAQ). He is the Chief of Orthopedics at the Virtua Health Mount Holly, Willingboro and Camden Campuses. Additionally he serves as the Director of Orthopedic Sports Medicine Fellowship at Virtua Health. Dr. McMillan lectures and teaches nationally and internationally on a variety of orthopedic sports medicine topics and did his sub-specialty training at the University of Massachusetts. During this time he helped serve as a team physician within the Boston Red Sox organization. Dr. McMillan is affiliated with the Rowan School of Osteopathic Medicine and Inspira Health orthopedic residencies and has a passion for teaching and conducting research in a real world setting that will impact the lives of his patients for the better. In particular, Dr. McMillan has a focus on orthopedic biologic solutions and innovation. Dr. McMillan was recently appointed to associate professor at the Rowan department of biomedical engineering, as well as the new combined Institute for Regenerative Medicine and Transplantation within the Rowan-Virtua School of Translational Biomedical Engineering and Sciences. Dr. McMillan currently serves on the Board of Directors for the American Osteopathic Academy of Orthopedics (AOAO) as the Immediate Past President and is a past recipient of the AOAO Emerging Leader Award. In May 2025 he was inaugurated as the new President of the New Jersey Orthopedic Society.

[Visit Dr. McMillan](#)

[Connect with Dr. McMillan on LinkedIn](#)

[Conflicts of Interest Statement for Dr. McMillan](#)

[Visit the Open Payments Data Page for Dr. McMillan](#)

Results

Forty-seven patients met inclusion criteria (mean age, 23.9 ± 8.5 years; 61.7% female) with a mean clinical follow-up of 12.7 ± 2.6 months. Three patients (6.4%) underwent reoperation: two for arthrofibrosis requiring manipulation under anesthesia and one for tibial tubercle osteotomy hardware failure after trauma. 1 patient suffered complete re-dislocation, 3 patients (6%) reported subjective instability during pivoting. Significant improvement was observed across all outcome measures. VAS pain decreased from 4.4 ± 1.4 to 0.5 ± 0.8 at 12 months ($p < 0.001$). BPII2.0 scores improved from 36.7 ± 7.8 to 73.9 ± 5.3 at 12 months ($p < 0.001$). Flexion increased from $106.8^\circ \pm 17.2^\circ$ to $128.6^\circ \pm 5.0^\circ$ ($p < 0.001$), and extension normalized by 12 months ($p = 0.004$).

Conclusion

AMPFLr with RBI augmentation resulted in significant improvements in pain, function, and knee ROM within 12 months, with no cases of recurrent dislocation and a low reoperation rate. PROM improvements were comparable to historically reported MPFL reconstruction outcomes, supporting the non-inferiority of AMPFLr at early follow-up. These findings suggest that AMPFLr is a safe and effective option for treating patellar instability, though longer-term and comparative studies are needed to determine durability and optimize indications.

Level of Evidence

Level IV, retrospective case series.

INTRODUCTION

Patellar dislocation commonly results in injury to the medial patellofemoral ligament (MPFL), which serves as the primary passive soft-tissue restraint preventing lateral translation of the patella. The ligament primarily engages between 0° and 30° of knee flexion, when bony constraints are minimal (Conlan et al. 1993; Hautamaa et al. 1998). Biomechanically, the MPFL contributes approximately 50–60% of the total medial soft-tissue restraint across this early arc of motion. Disruption of the ligament significantly alters patellofemoral joint kinematics and stability. Through cadaveric studies, the native MPFL's tensile strength has been identified as relatively low at approximately 200 ± 50 N, highlighting its function as a checkrein translational or rotational forces such as pivoting (Calvo Rodríguez et al. 2015).

The MPFL commonly tears at one of 3 sites, the femoral origin, the patellar insertion, or mid-substance. The location of the tear can have important implications for recurrence risk following a first-time dislocation, with femoral-sided tears often correlating with higher recurrent instability rates (Hautamaa et al. 1998). Additionally, the presence of anatomic risk factors such as trochlear dysplasia, patella alta, increased tibial tubercle–trochlear groove (TT-TG) distance, or rotational malalignment further predisposes patients to recurrent instability despite conservative management.

Recurrent patellar dislocations are frequently treated surgically, with procedure selection tailored to each patient's underlying pathology and risk profile. Although the understanding of patellofemoral biomechanics and surgical strategy has advanced, each treatment option carries inherent limitations and potential complications (Mountney et al. 2005). Historically, primary MPFL repair (MPFLr) was used to restore stability; however, high rates of recurrent

instability, particularly in patients with high-risk anatomy, have shifted clinical practice toward MPFL reconstruction (MPFLR) (Kruckeberg et al., n.d.; Puzzitiello et al. 2019). Multiple clinical series and biomechanical studies have demonstrated that MPFLR provides improved stability, restores near-physiologic restraint, and reduces re-dislocation rates (Arendt et al. 2011; Buckens and Saris 2010; Fisher et al. 2010; Mikashima et al. 2006; Smith et al. 2007). Nevertheless, even with precise anatomic tunnel placement and improved graft tensioning techniques, complication rates remain significant, particularly in pediatric and adolescent populations where rates approach 25% (Clark et al. 2017).

Recent attention has turned to biologically supportive technologies as an adjunct in restoration of patellofemoral stability while decreasing the risk of known complications associated with historical treatment options. Reinforced bioinductive implants (RBI) (BioBrace®, ConMed Corporation; Largo, FL) have been shown to be biomechanically non-inferior to the native MPFL in terms of strength and stiffness profile, while not as rigid as semitendinosus (Semi-T) grafts (McMillan et al. 2024). This RBI is composed of highly porous type I collagen integrated with bioresorbable poly(L-lactide) microfilaments, creating a three-dimensional scaffold optimized for both mechanical support and cellular integration. The implant offers a time-zero tensile strength of approximately 141 N, providing immediate strength while functioning as a biologically active matrix that recruits host cells, supports neovascularization, and promotes organized collagen deposition (Wetzler et al. 2024; McMillan et al. 2021). RBIs are indicated as an augment and not a stand-alone structure. As such, the concept of utilizing a RBI in the setting of MPFL surgery has led to the term augmented medial patellofemoral ligament repair (AMPFLr) which denotes using the RBI in a traditional reconstruction technique combined with imbrication of the

implant to the native MPFL at the tear location based upon MRI findings.

The purpose of this study is to retrospectively evaluate patient reported outcomes and re-dislocation rates after undergoing AMPFLr using an RBI for patella instability. It is hypothesized that patients who underwent this procedure demonstrate improvement over baseline in patient reported outcomes metrics (PROMs) and motion. A secondary hypothesis is AMPFLr would be non-inferiority compared to historical data at early time points.

METHODS

Institutional Review Board (IRB) approval was obtained and using CPT codes 27418, 27420, 27422, and 24727, a retrospective chart review was undertaken to identify all patients at a single institution who underwent surgery for patella instability between May 2021 and September 2024. Once identified, patients were screened based upon inclusion and exclusion criterion. Inclusion criterion included: primary surgery for the MPFL, age greater than 14 years, the use of a RBI for AMPFLr, pre-operative MRI confirming MPFL tear, follow-up for a minimum of 1-year. Exclusion criterion included: revision procedures for MPFL, the use of allograft or autograft, lack of pre-operative imaging, patients undergoing de-rotational osteotomies, and combined anterior cruciate ligament reconstruction (ACLR).

Patients were assessed pre-operatively via physical examination and MRI to identify MPFL disruption. Range of motion (ROM), visual analog scale (VAS) scores, and BANFF Patella Instability Instrument (BPII2.0) scores were obtained at pre-op, 6 months, and 12 months postoperatively. Medical co-morbidity data was collected including diabetes, hypertension, smoking, and neuromuscular disorders. Additional postoperative data collected included: re-dislocation, infection, stiffness/arthrofibrosis, and the need for further surgical intervention.

STATISTICAL ANALYSIS

All patient data was de-identified and analyzed by an independent statistician. Continuous variables, including patient-reported outcome measures (VAS and BANFF2 scores) and knee range of motion (flexion and extension), were summarized using means and standard deviations. Categorical variables, such as gender, comorbidities, and procedure type, were summarized using counts and percentages. Changes in continuous outcomes over time were assessed using paired two-tailed Student's t-tests comparing each postoperative time point (3, 6, and 12 months) to baseline values. A p-value of less than 0.05 was considered statistically significant. All analyses were performed assuming equal variances, and no adjustments were made for multiple comparisons. Reoperation rates and complication frequencies were reported descriptively. Due to the small number of reoperation events, no inferential statistical analyses were performed for categorical outcomes.

RESULTS

Forty-seven patients met inclusion criteria and were analyzed (Table 1). 46/47 (97.9%) patients underwent primary surgery for their instability, while the only revision was for a patient who had a previous tibial tubercle osteotomy without intervention to the MPFL. All surgeries were performed on an outpatient basis. The cohort included 29 females (61.7%) and 18 males (38.3%), with a mean age of 23.9 ± 8.5 years (range, 14–41). Medical comorbidities were uncommon, with no patients reporting diabetes or smoking, and only one patient each reporting hypertension (2.1%) or involuntary spasms/Asperger's syndrome (2.1%). Mean clinical follow-up was 12.7 ± 2.6 months (range, 10–25).

Three patients (6.4%) required reoperation (Table 2). Two developed postoperative arthrofibrosis requiring manipulation under anesthesia (MUA) at approximately 3–4 months, and one experienced tibial tubercle osteotomy hardware failure following a traumatic hyperflexion event shortly in their post-operative course which was further complicated by a subsequent deep vein thrombosis (DVT). One patient suffered complete patella dislocation at 13 months post-procedure while playing kickball. Three patients (6%) reported subjective instability events with pivoting at least once after returning to sport.

Pain outcomes improved across all time points from pre-operative evaluation (Table 3). The mean preoperative VAS score of 4.4 ± 1.4 decreased to 1.3 ± 1.4 at three months ($p < 0.001$), to 0.7 ± 1.2 at six months ($p < 0.001$), and to 0.5 ± 0.8 at twelve months, representing a statistically significant reduction of 3.9 points from baseline ($p < 0.001$).

PROMs in the form of BPII2.0 scores increased from a preoperative mean of 36.7 ± 7.8 to 64.8 ± 7.7 at six months ($p < 0.001$) and to 73.9 ± 5.3 at twelve months, reflecting a total improvement of 37.1 points ($p < 0.001$).

Similarly, ROM improved in both flexion and extension across postoperative time points (Table 4). Knee extension improved from $2.3^\circ \pm 5.2^\circ$ preoperatively to $0.3^\circ \pm 1.1^\circ$ at both three and six months, and ultimately to full extension by twelve months ($p = 0.004$). Knee flexion increased from $106.8^\circ \pm 17.2^\circ$ preoperatively to $119.1^\circ \pm 11.7^\circ$ at three months, $125.4^\circ \pm 7.1^\circ$ at six months, and $128.6^\circ \pm 5.0^\circ$ at twelve months, yielding an overall improvement of 21.8° ($p < 0.001$).

DISCUSSION

The primary findings of this study demonstrate that AMPFLr a RBI resulted in statistically significant improvements in pain, function, and knee ROM within the first postoperative year, with a low overall reoperation rate. The secondary hypothesis was also confirmed, with the PROM from the BPII2.0 score demonstrating non-inferiority compared to the historical literature at 1 year postoperative. Patients experienced rapid and sustained reductions in VAS pain scores, marked functional gains as reflected by BPII2.0 improvements, and progressive normalization of both knee extension and flexion. These outcomes are consistent with

Table 1. Patient demographics, comorbidities, and follow-up for those who underwent AMPFLr are reported.

Summary	AMPFLr (N=47)
Procedure Type, n (%)	
n	47
Primary	46 (97.9%)
Reoperation	0 (0%)
Revision	1 (2.1%)
Setting, n (%)	
n	47
Inpatient	0 (0%)
Outpatient	47 (100%)
Gender, n (%)	
n	47
Female	29 (61.7%)
Male	18 (38.3%)
Age (Years)	
n	47
Mean (SD)	23.9 (8.5)
Median	21.0
Min, Max	14.0, 41.0
Comorbidities	
Diabetes, n/N (%)	0/47 (0%)
Any Smoking, n/N (%)	0/47 (0%)
High Blood Pressure, n/N (%)	1/47 (2.1%)
Involuntary Spasms/Aspergers, n/N (%)	1/47 (2.1%)
Duration of Follow-up (Months)	
n	47
Mean (SD)	12.7 (2.6)
Median	12.1
Min, Max	(10.0, 25.0)

Of note, 46 of the 47 patients underwent a primary procedure.

Table 2. Reoperation Reasons

Patient ID	Surgery Date	Reoperation Date	Reoperation Reason
1	2/16/2024	5/14/2024	Arthrofibrosis, Joint Stiffness
2	1/16/2024	2/14/2024	Failed TTO Screw Due to Hyperflexion, Deep Vein Thrombosis
3	8/23/2023	12/6/2023	Arthrofibrosis, Joint Stiffness

3 of the 47 patients were identified as needing reoperation for intervention status post AMPFLr. None of the reoperations were for recurrent dislocation, however 2 patients did develop postoperative arthrofibrosis.

previously published literature supporting MPFLR as a reliable procedure for restoring patellar stability and improving PROMs (Hiemstra et al. 2021; 2017).

The magnitude of pain reduction observed in this cohort aligns with prior studies reporting substantial early postoperative improvements following MPFLR. Earlier investigations have noted VAS decreases ranging from 2 to 4 points within the first year, a range comparable to the 3.9-point reduction seen in the present study. Similarly, functional

scores demonstrated large, clinically meaningful gains, with BPFI2.0 improvements exceeding 35 points at final follow-up. This degree of functional recovery is consistent with results from other series of both isolated and combined MPFL procedures which have reported to improve from a baseline approximately 26.1-46.5 points to 66.1 points at one-year postoperative (Hiemstra et al. 2021; 2017).

Table 3. Patient VAS and BPII2.0 scores at baseline and at regular follow-up intervals

MPFL Subjects (N=47): VAS Scores										
Pre-Op		3 Months			6 Months			12 Months		
Mean (SD)	n	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)
4.4 (1.4)	47	1.3 (1.4)	46	-3.0 (<0.001)	0.7 (1.2)	39	-3.7 (<0.001)	0.5 (0.8)	47	-3.9 (<0.001)
MPFL Subjects (N=47): BPII2.0 Scores										
Pre-Op					6 Months			12 Months		
Mean (SD)	n				Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)
36.7 (7.8)	47				64.8 (7.7)	32	27.7 (<0.001)	73.9 (5.3)	47	37.1 (<0.001)

Patients were evaluated via PROM's at baseline and across standard postoperative intervals for pain scores and function. Across all time points there was significant improvement in VAS and BPII2.0 scores compared to baseline.

Table 4. Knee ROM at baseline and at regular follow-up intervals

MPFL Subjects (N=47): Knee Extension										
Pre-Op		3 Months			6 Months			12 Months		
Mean (SD)	n	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)
2.3 (5.2)	47	0.3 (1.1)	46	-2.0 (0.019)	0.3 (1.1)	39	-2.0 (0.034)	0 (0)	47	-2.3 (0.004)
MPFL Subjects (N=47): Knee Flexion										
Pre-Op		3 Months			6 Months			12 Months		
Mean (SD)	n	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)	Mean (SD)	n	Change (p-value)
106.8 (17.2)	47	119.1 (11.7)	46	12.5 (<0.001)	125.4 (7.1)	39	18.3 (<0.001)	128.6 (5.0)	47	21.8 (<0.001)

ROM data for all patients were collected at baseline and across standard postoperative intervals. Across all time points there was significant improvement in both flexion and extension compared to baseline.

ROM outcomes followed an expected recovery pattern, with rapid early improvements in flexion and a more gradual return to full extension. The approximate 22° of flexion from baseline is an indicator that graft tensioning and tunnel placement likely avoided over-constraint, an important consideration given the risk of postoperative stiffness reported in the literature.

The overall reoperation rate of 6.4% in this cohort compares favorably with previously published rates, which often range from 5% to 25% depending on patient age, surgical technique, and concomitant procedures (Razick et al. 2025). Notably, arthrofibrosis requiring manipulation under anesthesia remains one of the most frequently cited complications following MPFL reconstruction, particularly in younger and high-risk populations (Clark et al. 2017; Razick et al. 2025). The two patients requiring MUA in this study reflect this trend. The additional case involving TTO hardware failure and subsequent deep vein thrombosis underscores the known risks associated with combined procedures, though this was not directly attributable to the AMPFLr itself. One patient was found to have suffered complete patella re-dislocation post-procedure. The patient stated their cleat got caught on the turf field and the knee

twisted traumatically. The patient chose to treat the repeat dislocation with physical therapy. The 3 patients who reported subjective instability without re-dislocation were found to have this sensation with a pivoting movement after returning to sport. Two of these patients report they continue to wear a protective patella brace during sports. None of these patients report symptoms severe enough to warrant re-MRI or consideration of further surgical discussion.

The demographic characteristics of this cohort may also have influenced outcomes. The young mean age, low comorbidity burden, and absence of smokers likely contributed to the favorable recoveries observed. Prior literature has demonstrated that older age, elevated BMI, and complex anatomic risk factors correlate with higher recurrence and complication rates (Clark et al. 2017; Razick et al. 2025; Huddleston et al. 2025). The uniform use of outpatient surgical settings further suggests that patients were appropriately selected and optimized for the procedure.

Despite the reported findings, this study has several limitations that must be acknowledged. First, the follow-up period was limited to an average of approximately 12 months, which may not fully capture longer-term recur-

rence rates, implant durability, or the development of patellofemoral cartilage changes. Second, the absence of a comparison group matched cohort limits the ability to draw comparative effective conclusions outside of historical literature statistics. Third, although PROMs and ROM data were thoroughly collected, radiographic and advanced imaging (MRI) were not routinely collected, which could have provided additional insight into the healing and restoration process. Additionally, data on patients with a diagnosis of joint hypermobility and documentation of levels of trochlear dysplasia were not uniformly collected or reported. Finally, the sample size, while consistent with many MPFL studies, limits the statistical power to evaluate predictors of complications or subgroup differences.

Despite these limitations, the results of this study reinforce the effectiveness of AMPFLr in improving pain, function, and knee motion in patients with patellar instability. The low complication and reoperation rates further support the safety of the procedure when performed with appropriate technique and postoperative management, albeit with the results being at an early timepoint. Future research involving longer-term follow-up, larger multicenter cohorts, and direct cohort comparisons may help refine surgical indications and further optimize patient outcomes.

Submitted: March 22, 2026 EDT. Accepted: March 22, 2026 EDT. Published: March 24, 2026 EDT.



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-NC-ND-4.0). View this license's legal deed at <https://creativecommons.org/licenses/by-nc-nd/4.0> and legal code at <https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode> for more information.

REFERENCES

- Arendt, E. A., A. Moeller, and J. Agel. 2011. "Clinical Outcomes of Medial Patellofemoral Ligament Repair in Recurrent (Chronic) Lateral Patella Dislocations." *Knee Surg Sports Traumatol Arthrosc* 19: 1909–14. <https://doi.org/10.1007/s00167-011-1516-y>.
- Buckens, C. F., and D. B. Saris. 2010. "Reconstruction of the Medial Patellofemoral Ligament for Treatment of Patellofemoral Instability: A Systematic Review." *Am J Sports Med* 38: 181–88. <https://doi.org/10.1177/0363546509353132>.
- Calvo Rodríguez, R., D. Figueroa Poblete, Z. Anastasiadis Le Roy, et al. 2015. "Reconstruction of the Medial Patellofemoral Ligament: Evaluation of the Clinical Results of Autografts versus Allografts." *Rev Esp Cir Ortop Traumatol* 59: 348–53. <https://doi.org/10.1016/j.recot.2014.10.006>.
- Clark, D., A. Metcalfe, C. Wogan, V. Mandalia, and J. Eldridge. 2017. "Adolescent Patellar Instability: Current Concepts Review." *Bone Joint J Br* 99: 159–70. <https://doi.org/10.1302/0301-620X.99B2.BJJ-2016-0256.R1>.
- Conlan, T., W. P. Garth Jr., and J. E. Lemons. 1993. "Evaluation of the Medial Soft-Tissue Restraints of the Extensor Mechanism of the Knee." *J Bone Joint Surg* 75: 682–93. <https://doi.org/10.2106/00004623-199305000-00007>.
- Fisher, B., J. Nyland, E. Brand, and B. Curtin. 2010. "Medial Patellofemoral Ligament Reconstruction for Recurrent Patellar Dislocation: A Systematic Review Including Rehabilitation and Return-to-Sports Efficacy." *Arthroscopy* 26: 1384–94. <https://doi.org/10.1016/j.arthro.2010.04.005>.
- Hautamaa, P. V., D. C. Fithian, K. R. Kaufman, D. M. Daniel, and A. M. Pohlmeier. 1998. "Medial Soft Tissue Restraints in Lateral Patellar Instability and Repair." *Clin Orthop* 349: 174–82. <https://doi.org/10.1097/00003086-199804000-00021>.
- Hiemstra, L. A., S. Kerslake, and M. R. Lafave. 2017. "Quality-of-Life Outcomes of Patients Following Patellofemoral Stabilization Surgery: The Influence of Trochlear Dysplasia." *J Knee Surg* 30 (9): 887–93. <https://doi.org/10.1055/s-0037-1598038>.
- Hiemstra, L. A., S. Kerslake, M. R. Lafave, and A. Tucker. 2021. "Patella Alta Is Reduced Following MPFL Reconstruction but Has No Effect on Quality-of-Life Outcomes in Patients with Patellofemoral Instability." *Knee Surg Sports Traumatol Arthrosc* 29 (2): 546–52. <https://doi.org/10.1007/s00167-020-05977-8>.
- Huddleston, H., E. W. James, R. Davie, et al. 2025. "Revision Medial Patellofemoral Ligament Reconstruction: Prevalence of Anatomic Risk Factors and Early Outcomes." *J Knee Surg*, Epub ahead of print November 18. <https://doi.org/10.1055/a-2712-4022>.
- Kruckeberg, B. M., R. R. Wilbur, B. M. Song, et al. n.d. "Comparison of Failure Rates at Long-Term Follow-up between MPFL Repair and Reconstruction for Recurrent Lateral Patellar Instability." *Orthop J Sports Med* 2024: 12. <https://doi.org/10.1177/23259671231221239>.
- McMillan, S., R. Arciero, and E. Ford. 2021. "The next Frontier for Rotator Cuff Augmentation? Strength + Bio-Induction." *J Orthop Exp Innovat* 2: 1–7. <https://doi.org/10.60118/001c.28081>.
- McMillan, S., S. Sherman, Z.R. Brown, E. Brewer, and E. Ford. 2024. "Medial Patellofemoral Ligament Augmented With a Reinforced Bioinductive Implant Is Biomechanically Similar to the Native Medial Patellofemoral Ligament at Time Zero in a Cadaveric Model." *Arthrosc Sports Med Rehabil* 6 (5): 100975. <https://doi.org/10.1016/j.asmr.2024.100975>.
- Mikashima, Y., M. Kimura, Y. Kobayashi, M. Miyawaki, and T. Tomatsu. 2006. "Clinical Results of Isolated Reconstruction of the Medial Patellofemoral Ligament for Recurrent Dislocation and Subluxation of the Patella." *Acta Orthop Belg* 72: 65–71.
- Mountney, J., W. Senavongse, A. A. Amis, and N. P. Thomas. 2005. "Tensile Strength of the Medial Patellofemoral Ligament before and after Repair or Reconstruction." *J Bone Joint Surg Br* 87: 36–40. <https://doi.org/10.1302/0301-620X.87B1.14924>.
- Puzzitiello, R. N., B. Waterman, A. Agarwalla, et al. 2019. "Primary Medial Patellofemoral Ligament Repair versus Reconstruction: Rates and Risk Factors for Instability Recurrence in a Young, Active Patient Population." *Arthroscopy* 35: 2909–15. <https://doi.org/10.1016/j.arthro.2019.05.007>.
- Razick, D. I., M. Akhtar, F. Sumandea, et al. 2025. "Patient-Reported Favorable Outcomes of a Minimum Five-Year Follow-Up After Medial Patellofemoral Ligament (MPFL) Reconstruction: A Systematic Review and Meta-Analysis." *Cureus* 17 (3): e80160. <https://doi.org/10.7759/cureus.80160>.
- Smith, T. O., J. Walker, and N. Russell. 2007. "Outcomes of Medial Patellofemoral Ligament Reconstruction for Patellar Instability: A Systematic Review." *Knee Surg Sports Traumatol Arthrosc* 15: 1301–14. <https://doi.org/10.1007/s00167-007-0390-0>.
- Wetzler, A., S. McMillan, E. Brewer, A. Patel, S. Handy, and M. Wetzler. 2024. "No Difference in Pullout Strength between a Bio-Inductive Implant and a Semitendinosus Tendon Graft in a Biomechanical Study of Medial Patellofemoral Ligament Repair Augmentation." *Arthrosc Sports Med Rehabil* 6. <https://doi.org/10.1016/j.asmr.2023.100827>.