Original Article

Surgical Repair of Hypermobile Lateral Meniscus Secondary to Popliteomeniscal Fascicle Tears Improves Pain and Mechanical Symptoms

Malik E. Dancy, M.D., Adam J. Tagliero, M.D., Sara E. Till, M.S., Daniël B. Saris, M.D., Ph.D., Bruce A. Levy, M.D., Christopher L. Camp, M.D., and Aaron J. Krych, M.D.

Purpose: To describe the clinical and radiographic features associated with isolated hypermobile lateral meniscus (HLM), and report patient outcomes following surgically repaired isolated HLM. **Methods:** All patients diagnosed with HLM from 2000 to 2020 at a single academic institution were identified and reviewed. Patients were excluded if they had concomitant ligament injury or lacked 2-year follow-up. Preoperative and postoperative visual analog scale (VAS) pain scores were determined from clinical notes. Statistical analysis was performed in JMP, and statistical significance was determined with use of a paired *t*-test. **Results:** Eighteen knees in 17 patients met inclusion criteria. Mean patient age was 24.1 (range: 6-61) years. Mean follow-up was 73 months (25-151 months). All 18 knees reported pain at presentation; 94% (17/18) had mechanical symptoms. All 18 knees had preoperative MRIs, but only 1 (5.6%) knee was correctly diagnosed by a musculoskeletal trained radiologist. Most repairs were performed with an all-inside technique (61%, 11/18). VAS score improved significantly from 7.2 ± 2.9 preoperatively to 0.7 ± 1.9 postoperatively, with average improvement of VAS score of 6.5 ($P < .001$). Only one (5.6%) knee required revision meniscal surgery. **Conclusion:** Hypermobile lateral meniscus patients commonly see multiple providers, fail to have their HLM diagnosed on MRI, and undergo various treatments prior to a successful diagnosis. Localized lateral joint line pain, mechanical symptoms, and absence of distinct meniscus tear on MRI are the most frequent clinical presentations. Surgery with meniscus repair is a reliable solution to improve pain and mechanical symptoms. **Level of Evidence:** Level IV, therapeutic case series.

Introduction

The menisci serve an integral role in the biomechanics of the native knee. In addition to assisting with joint stability and congruity, the medial and lateral menisci support load transmission, shock absorption, proprioception, and joint lubrication.[1,2] Despite similar overall functions, there are key structural differences between the medial and lateral menisci—particularly, regarding their size, shape, and mobility. The lateral meniscus demonstrates greater mobility than the medial meniscus, with an average 10-mm anterior-posterior displacement during knee flexion versus only 2 mm[1] for the medial meniscus. However, pathologic hypermobility of the lateral meniscus (HLM) may occur following disruption of the popliteomeniscal fascicles (PMFs). This structure consists of the posterosuperior popliteomeniscal fascicle (sPMF) and anteroinferior popliteomeniscal fascicle (iPMF), and it functions as one of the primary stabilizers of the lateral meniscus posterior horn at 90° flexion.[3-9] Popliteomeniscal fascicle disruption subsequently enables excessive translation of the affected lateral meniscus into the joint space with provocative knee maneuvers—causing impingement with resultant pain, catching, locking, and/or limited range of motion.

Despite our understanding of its pathophysiology, HLM continues to pose a substantial diagnostic

From the Department of Orthopedic Surgery, Mayo Clinic, Rochester Minnesota, U.S.A.

The authors report the following potential conflicts of interest or sources of funding: C.L.C. and B.A.L. report consulting fees and non-financial support from Arthrex, outside the submitted work; B.A.L. reports nonfinancial support from Stryker, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received April 29, 2023; accepted August 17, 2023.

Address correspondence to Aaron J. Krych, M.D., Mayo Clinic, 200 1st St., SW, Rochester MN, 55905, U.S.A. E-mail: Krych.aaron@mayo.edu

2666-061X/23598

https://doi.org/10.1016/j.asmr.2023.100802

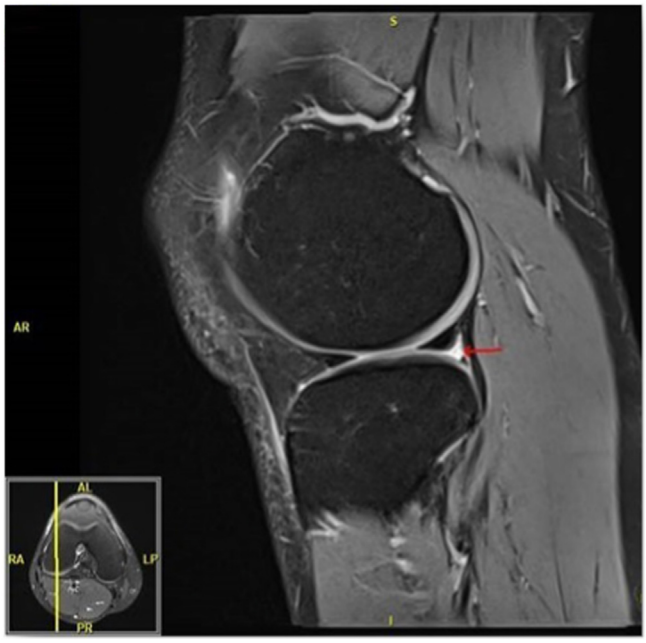

Fig 1. Sagittal T2 weighted knee MRI demonstrating tear of the popliteomeniscal fascicles of the posterior horn of the lateral meniscus (red arrow). All studies were performed at 3 Tesla, without intravenous gadolinium. Imaging was first interpreted by musculoskeletal fellowship-trained radiologists, and it was subsequently reviewed by senior orthopedic surgeon.

challenge. Patients often present without a distinct trauma history and report substantial symptoms despite negative or nonspecific MRI findings.[10-12] LaPrade et al. described the figure-4 test as a provocative maneuver to help identify affected patients, but the remainder of the physical exam is often negative or nonspecific.[11] Intraoperative diagnosis via arthroscopy remains the gold standard—achieved by probing the posterior aspect of lateral meniscus and demonstrating its abnormal anterior translation beyond the midpoint of the tibial articular surface.[5,11,12] Following diagnosis, surgical intervention is typically employed in symptomatic patients. Repair is usually arthroscopic and entails stabilization of the meniscus to the posterior capsule, but there remains significant variation in the repair techniques utilized.[6,11,13-15]

Currently, there remains a scarcity of studies investigating the clinical presentation, work-up, and management of popliteomeniscal fascicle tears resulting in hypermobile lateral menisci. The purposes of this study were to describe the clinical and radiographic features associated with isolated HLM and to report patient outcomes following surgically repaired isolated HLM. It is hypothesized that surgical management of hypermobile lateral meniscus results in a reduction in pain and mechanical symptoms for the majority of patients.

Methods

Study Population

The study was performed at the Mayo Clinic (Rochester, MN), and protocol approval was obtained from the Institutional Review Board (IRB #: 15-00601). Patient records were queried using two natural language processing tools: NLPTK ADVANCE MedTagger and Advanced Text Explorer (ATE). Search terms included "lateral meniscus", "hypermobile", and the latter's appropriate grammatical equivalents. Patients were limited to those diagnosed and operatively treated for HLM between January 2000 and January 2020. Diagnosis was either established preoperatively or intraoperatively and was confirmed at the time of knee arthroscopy via demonstration of excessive translation of the lateral meniscus into the joint space using a probe. Patients were excluded if they were found to have non-normal meniscal pathology (i.e., discoid), meniscal tear, concomitant ligamentous injuries, less than 2 years' follow-up, or lacked operative confirmation of the HLM diagnosis (Fig 1). After identification, retrospective chart review was performed to determine unique patient demographics (age, gender, height, weight, and sports participation), dates of clinical evaluation and subsequent surgery, preoperative pain via the 10-point Visual Analog Scale (VAS), surgical procedure and technique, postoperative outcomes (including VAS score at time of last follow-up), and any complications. All surgical procedures were performed by Sports Medicine fellowship-trained surgeons at a single academic institution.

Surgical Technique and Postoperative Care

Standard three-portal knee arthroscopy was performed by the three senior surgeons for each patient. Specific repair technique utilized for each meniscus varied on the basis of surgeon preference and tear morphology. All-inside, inside-out, and combination repair techniques were employed. Various suture patterns were likewise performed—namely, stacked vertical mattress, vertical mattress, horizontal mattress, or any combination of the aforementioned.

Postoperatively, patients were restricted to partial weight bearing with a hinged knee brace locked in full extension while walking, and knee flexion limited to 90° for the first 4 weeks (Fig 2). From weeks 4 to 8, patients were progressed to weight bearing, as tolerated, on the operative knee and allowed to perform full range of motion. Jogging and light activities were permitted at 3 months postoperatively. Knee loading at flexion angles greater than 90° was prohibited until 4 months postoperatively. Return to sport typically occurred at 4-6 months after surgery, per surgeon's discretion, and patients demonstrated clinical progress.

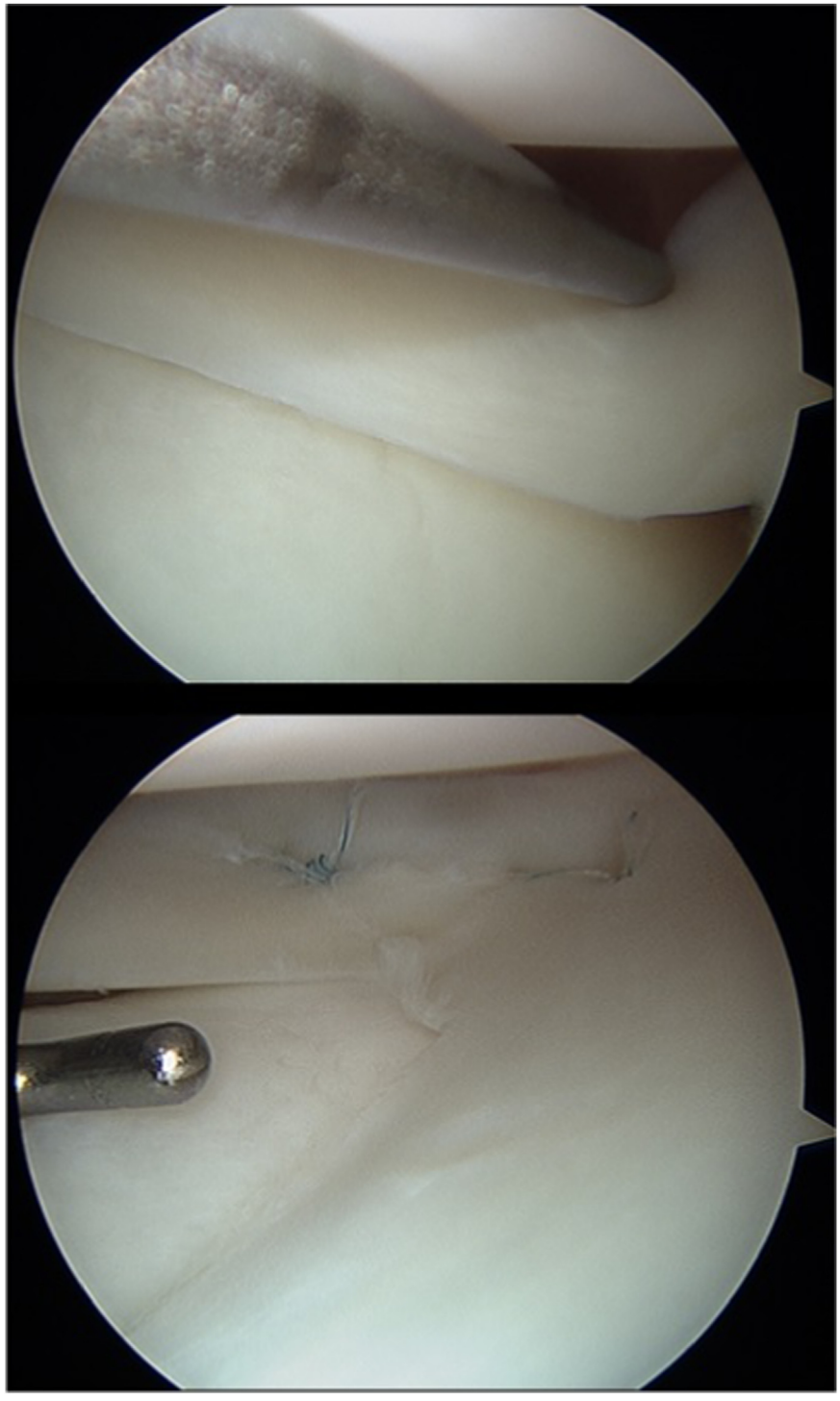

Fig 2. Arthroscopic image taken from an anterolateral knee viewing portal, demonstrating excessive translation of the lateral meniscus into the joint space with use of a probe, and the subsequent suture repair.

Statistical Analyses

Data collection occurred in Excel (2010; Microsoft Corp, Redmond, WA) and statistical analyses were completed in JMP (v14.1.0, SAS Institute, Cary, NC). Categorical variables are presented as *n* (%), while continuous variables are presented as mean or median with standard deviations and interquartile ranges, when appropriate. Statistical significance was determined with use of paired *t*-test and was achieved when the *P* value was less than .05.

Results

No patients identified with HLM subsequently underwent conservative management. A total of 18 knees

Table 1. Demographics

Sex (M, %)	55.6% (10/18)
Age (mean, median, range)	24.1 (17.5, 6-61)
BMI (mean, SD, range)	26.3 ± 4.9 (19.5-36.1)
Time from injury to first consult (days)	848.9 (321, 11-5557)
Sport (Yes)	72.2% (13/18)
Laterality	
Left	72.2% (13/18)
Right	27.8% (5/18)

Table 2. Injury and Initial Examination

Symptoms	Percentages
Swelling (Yes)	33.3% (6/18)
Effusion	5.6% (1/18)
Mechanical	94.4% (17/18)
Pain	100% (18/18); mean VAS 7.2 (SD 2.9)
VAS (mean, SD, range)	7.15 (2.85, 2-10)
History of surgery on affected knee	16.7% (3/18)
Previously seen by SPM provider	83.3% (15/18)
Previously seen by orthopedic surgeon	66.7%% (12/18)
Prior surgery (nonmeniscal)‡	16.7% (3/18)
Prior physical therapy	100% (18/18)
Initial Exam	
ROM (Mean, SD, Range, Median)	134.1 ± 14.7 (100-150, 140)
McMurray's Click	
Positive	33.3% (6/18)
Negative	50.0% (9/18)
Not reported	33.3% (3/18)
Figure of four	
Positive	50% (9/18)
Negative	5.6% (1/18)
Not reported	44.4% (8/18)
McMurray's pain	
Positive	66.6% (12/18)
Negative	16.7% (3/18)
Not reported	16.7% (3/18)
Imaging	
Baseline radiographs	94.4% (17/18)
Any radiographic findings*	0% (0/17)
MRI	100% (18/18)
Clear fascicle tear?	38.9% (7/18)
Dx by radiology?	5.6% (1/18)
Time from initial injury (mean, median, range [months])	84.7 (4, 0-1092)
Other pathology***	33.3% (6/18)
Previous MRI?	27.8% (5/18)
Preoperative interventions	
Physical therapy	11.1% (2/18)
Injection	11.1% (2/18)

MRI, magnetic resonance imaging; ROM, range of motion; SPM, sports medicine; VAS, visual analog scale.

‡All had prior diagnostic arthroscopies after symptom onset.

*One knee did not have baseline radiography.

***6 knees had chondromalacia identified on their preoperative MRI by an MSK-trained radiologist.

from 17 patients met inclusion criteria for analysis. The average age at time of diagnosis was 24.1 years (range: 6-61), and the average time from first symptoms to initial consultation was 850 days (median: 327). Over 70% of the cohort participated in some type of sport or regular athletic activity (Table 1). The average length of final follow-up was 73 months (range: 25 months to 151 months). Of these knees, 56% (10/18) belonged to male patients, and 72% were left knees (13/18) (Table 1).

Upon clinical evaluation, the most commonly reported symptom was pain, as 100% of knees experienced consistent pain symptoms, with mean preoperative VAS score of 7.2 (range: 2-10) (Table 2). An additional 94.4% experienced mechanical symptoms, such as catching or locking of the joint, and 33% reported swelling. Initial examination demonstrated an average knee flexion of 134° (range: 100-150) and overwhelmingly positive McMurray's test with pain (12/18, 66.7%). Only 6/18 knees demonstrated a click with McMurray's testing (Table 2). Although other maneuvers demonstrated high rates of positivity, the results were not consistently recorded in the patient encounter documentation (Table 2). All 18 knees underwent preoperative MRI, and although 7 were noted to have clear fascicle tear by senior orthopedic surgeons upon review of imaging, only 1 knee had HLM mentioned in the radiology report, which were generated by musculoskeletal fellowship-trained radiologists (Table 2). Over 80% of knees had been previously evaluated by another sports medicine specific provider; 67% of these knees had also been examined by other orthopedic surgeons prior to presentation. Only 2 knees underwent preoperative physical therapy or injection. Three knees had undergone previous surgery, all of which were diagnostic arthroscopies performed after symptom onset; none of their prior arthroscopies recognized or diagnosed the hypermobile lateral meniscus pathology (Table 2). All 18 knees had undergone preoperative physical therapy without resolution of pain and/or mechanical symptoms (Table 2).

In terms of operative treatment, most patients underwent surgery within a month of initial consultation (mean: 0.7 months, Table 3). All-inside repair and stacked vertical mattress were the most common approaches and suture patterns used (61% and 50%, respectively) during the repair. All menisci were repaired with a total of four sutures or less. All repairs were completed by 1 of 3 sports medicine fellowship-trained orthopedic surgeons. Three knees had additional pathology addressed intraoperatively, all of which were chondroplasty for chondromalacia that

Table 3. Operative Treatment

Parameter	Value
Time from initial injury (months)	31.1 (10.5, 0-184)
Time from consult to surgery (months)	0.7 (0, 0-6)
Other pathology at time of surgery?*	16.7% (3/18)
Repair	
All-inside	61.1% (11/18)
Inside-out	33.3% (6/18)
Combination	0.0% (0/18)
Other**	5.6% (1/18)
Suture Pattern	
Stacked vertical mattress	50.0% (9/18)
Vertical mattress	22.2% (4/18)
Stacked vertical and horizontal mattress	22.2% (4/18)
Not reported	5.6% (1/18)

*Other pathology: All 3 knees had chondromalacia addressed via chondroplasty.
**Other: Converted to open.

Table 4. Postoperative Outcomes

Exam	
McMurray's pain	
Positive	5.6% (1/18)
Negative	83.3% (15/18)
Not recorded	11.1% (2/18)
Figure of 4	
Positive	5.6% (1/18)
Negative	44.4% (8/18)
Not recorded	50% (9/18)
ROM (mean, range, median)	138.7 ± 6.3 (125-150, 140)
Mechanical symptoms	
Resolved	66.7% (12/18)
Continued*	33.3% (6/18)
Pain symptoms	
Resolved	77.8% (14/18)
Continued**	22.2% (4/18)
VAS (mean, SD, range)	0.7 (1.9, 0-7)
Mean Δ VAS	6.5
Effusion	
Resolved	88.9% (16/18)
Not reported	11.1% (2/18)
Recurrent injury	16.7% (3/18)
Reoperation	
For meniscus***	5.6% (1/18)
For non-meniscal pathology‡	11.1% (2/18)
Follow-up (months)	73 (25-151, 79)

*4 knees with all-inside repair, 2 with inside-out repair.
**2 knees with all-inside repair, 2 knees with inside-out repair.
***Sports re-injury with subsequent partial lateral meniscectomy for new radial tear. Previously asymptomatic.
‡One knee underwent wide-local excision for liposarcoma; the other underwent arthroscopic loose body removal.

involved the lateral compartment. Further surgical details are presented in Table 3.

At final follow-up (mean 73 months), there were substantial reductions in symptoms, as 78% and 67% of the cohort reported resolution of all pain and mechanical symptoms, respectively (Table 4). VAS score decreased significantly from preoperatively to postoperatively—with a mean postoperative VAS score of 0.7 (range: 0-7), and an average change in VAS score of 6.5 ($P < .001$). Four knees had recurrent pain symptoms at a mean of 24 months (range: 8-53); three of which sustained an ipsilateral acute or traumatic event following index surgery. A total of 3 knees underwent reoperation, only one of which was for a meniscus injury; the remaining 2 underwent surgery for nonmeniscal pathology and were found to have satisfactory meniscus stability and healing intraoperatively.

Discussion

The most important finding of this study was that pain and mechanical symptoms were the predominant presenting complaints of HLM patients. Preoperative advanced imaging studies inconsistently identified HLM. Surgical repair with stabilization of the hypermobile menisci reliably improved pain and mechanical symptoms.

The most consistently reported complaints at the time of initial clinical evaluation were persistent pain and mechanical symptoms (i.e., locking, catching, and clicking), which were endorsed by nearly all patients within the present study (100% and 94.4%, respectively). Other symptoms such as knee swelling or effusion were less consistently reported. McMurray's testing elicited pain in 66.6% (12/18) of knees, Fig 4 testing elicited pain in 50% (9/18) of knees, and 33.3% (6/18) of affected knees demonstrated a click with McMurray's testing. Of note, a significant portion of patients (3/18 knees for McMurray's, 8/18 knees for Fig 4) did not have these maneuvers documented, but when specifically performed and recorded, the tests were overwhelmingly positive for pain within these HLM patients (80% and 90% knees, respectively). These findings are consistent with those of Laprade et al., who reported that while all 6 HLM patients in their 2005 series had no evidence of abnormality on standard provocative knee examinations, 100% experienced pain with the Figure-4 test.[11] Later, Kamiya et al. investigated the midterm outcomes of arthroscopic fixation of HLM in 20 patients, and they reported that 100% of patients endorsed frequent locking of the affected knee prior to surgical intervention— particularly, with deep flexion maneuvers.[14] At the time of arthroscopy, the researchers were able to reproduce anterior translation of the posterolateral aspect of the lateral meniscus with deep knee flexion—so-called "paradoxical motion"—which led to entrapment within the lateral compartment joint space, and ultimately restricted ability to extend the knee ("locking"). Altogether, these findings suggest that inquiring about history of pain and deep flexion-exacerbated locking episodes, in conjunction with performing McMurray's and Fig 4 testing, may be useful clinical strategies for identifying patients with HLM at the time of initial evaluation.

All 18 knees within the present investigation underwent preoperative MRI, and only 1 knee was correctly diagnosed by MSK-trained radiologists at a tertiary care center. A recent study by Toyooka et al. investigated the diagnostic accuracy of MRI for isolated hypermobile lateral meniscus.[16] With a cohort of 66 patients—22 HLM patients matched 2:1 to controls—researchers demonstrated that upon MRI assessment of the integrity of the sPMF, iPMF, and popliteal hiatus in each knee by 2 blinded orthopedic surgeons, there was a statistically significant odds ratio for a diagnosis of HLM in the setting of worse preoperative MRI findings within each structure (sPMF OR 5.50 [$P = .036$]; iPMF 12.20 [$P = .002$]; popliteal hiatus 5.00 [$P = .034$]). Although investigators ultimately reported that there was insufficient diagnostic accuracy for identifying HLM via MRI alone, their findings indicate a strong role for MRI in the setting of high clinical suspicion for HLM. Similarly, the work described here did not find a universal connection between preoperative MRI findings and HLM presence; however, it suggests a significant role for MRI as a diagnostic adjunct in the identification of patients with this condition.

All-inside repair was the most employed technique for this investigation, utilized in 61% of repairs; inside-out and open repairs were also performed (33% and 6%, respectively). Suture pattern varied, with stacked vertical mattress (50%), standard vertical mattress (22%), and a combination of stacked vertical and horizontal mattress (22%) repairs being performed. Despite variation in HLM repair technique, postoperative outcomes were overall very satisfactory—with a statistically significant decrease in reported pain from preoperatively to postoperatively (mean VAS 7.2 vs 0.7; $P < .001$), 83.3% (15/18) knees achieving resolution of pain with McMurray's test at time of follow-up, and 66.7% (12/18) having complete resolution of mechanical symptoms. Only 4/18 (22.2%) knees had recurrent functional pain at mean follow-up of 24 months; however, 3 of these had sustained ipsilateral leg trauma after the index surgery. Overall, there were 3 reoperations, but only 1 was for meniscal pathology; the remaining two reoperations occurred for nonmeniscal pathology, and both demonstrated healed lateral menisci intraoperatively. In 2005, Laprade et al. described their preferred HLM repair technique, with an open approach after initial diagnostic arthroscopy, and placement of horizontal mattress sutures to secure the disrupted popliteomeniscal fascicles to the popliteus tendon complex.[11]

Alternatively, Kamiya et al. used an inside-out repair technique after diagnostic arthroscopy and recreated the meniscotibial attachments with a double-stacked vertical suture pattern.[14] Both investigators reported substantial improvement in patient symptoms postoperatively. Hence, the findings of preceding studies corroborate those of the present investigation, in that pain and mechanical symptoms reliably resolve following surgical stabilization of hypermobile lateral menisci, even within the setting of multiple different repair strategies.[5,6,11,12,14,15,17-19]

Limitations

This study is not without limitations. Only 2 time points were considered—preoperative assessment and the last documented follow-up appointment. Hence, potential time-dependent clinical deterioration was not accounted for. The retrospective nature of the study relied upon the historical documentation of several providers across nearly two decades—as such, there was a lack of standardization in the reporting of patients' subjective accounts, exam findings, and outcomes both preoperatively and at follow-up. Furthermore, aside from subjective pain, patient-reported outcome measures (PROMs) were not readily documented within patients' records, and therefore, functional outcomes were not able to be compared preoperatively to postoperatively in a standardized fashion. Although all repairs were performed by sports medicine fellowship-trained surgeons, there were differences between the repair techniques employed, and postoperative care protocols were not standardized. Lastly, because of the rarity of HLM pathology, this is a small case series, and therefore, the generalizability of the conclusions is limited. Despite these limitations, however, the present investigation contributes to the current body of literature regarding HLM, adding much-needed clarity and insight into this complex and rare pathology.

Conclusions

Hypermobile lateral meniscus patients commonly see multiple providers, fail to have their HLM diagnosed on MRI, and undergo various treatments prior to a successful diagnosis. Localized lateral joint line pain, mechanical symptoms, and absence of distinct meniscus tear on MRI are the most frequent clinical presentations. Surgery with meniscus repair is a reliable solution to improve pain and mechanical symptoms.

References

1. Fox AJS, Bedi A, Rodeo SA. The basic science of human knee menisci: Structure, composition, and function. *Sports Health* 2012;4:340-351.
2. Mohamadi A, Momenzadeh K, Masoudi A, et al. Evolution of knowledge on meniscal biomechanics: A 40-year perspective. *BMC Musculoskelet Disord* 2021;22:625.
3. Aman ZS, DePhillipo NN, Storaci HW, et al. Quantitative and qualitative assessment of posterolateral meniscal anatomy: Defining the popliteal hiatus, popliteomeniscal fascicles, and the lateral meniscotibial ligament. *Am J Sports Med* 2019;47:1797-1803.

4. Cohn AK, Mains DB. Popliteal hiatus of the lateral meniscus. Anatomy and measurement at dissection of 10 specimens. *Am J Sports Med* 1979;7:221-226.
5. Shin HK, Lee HS, Lee YK, Bae KC, Cho CH, Lee KJ. Popliteomeniscal fascicle tear: Diagnosis and operative technique. *Arthrosc Tech* 2012;1:e101-e106.
6. Simonian PT, Sussmann PS, Wickiewicz TL, et al. Popliteomeniscal fasciculi and the unstable lateral meniscus: Clinical correlation and magnetic resonance diagnosis. *Arthroscopy* 1997;13:590-596.
7. Stäubli HU, Birrer S. The popliteus tendon and its fascicles at the popliteal hiatus: Gross anatomy and functional arthroscopic evaluation with and without anterior cruciate ligament deficiency. *Arthroscopy* 1990;6:209-220.
8. Suganuma J, Mochizuki R, Inoue Y, Yamabe E, Ueda Y, Kanauchi T. Magnetic resonance imaging and arthroscopic findings of the popliteomeniscal fascicles with and without recurrent subluxation of the lateral meniscus. *Arthroscopy* 2012;28:507-516.
9. Sussmann PS, Simonian PT, Wickiewicz TL, Warren RF. Development of the popliteomeniscal fasciculi in the fetal human knee joint. *Arthroscopy* 2001;17:14-18.
10. Beel W, Macchiarola L, Mouton C, Laver L, Seil R. The hypermobile and unstable lateral meniscus: A narrative review of the anatomy, biomechanics, diagnosis and treatment options:14-14. *Ann Jt* 2022;7.
11. LaPrade RF, Konowalchuk BK. Popliteomeniscal fascicle tears causing symptomatic lateral compartment knee pain: Diagnosis by the figure-4 test and treatment by open repair. *Am J Sports Med* 2005;33:1231-1236.
12. Van Steyn MO, Mariscalco MW, Pedroza AD, Smerek J, Kaeding CC, Flanigan DC. The hypermobile lateral meniscus: A retrospective review of presentation, imaging, treatment, and results. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1555-1559.
13. D'Addona A, Izzo A, Di Vico G, Rosa D, Maffulli N. The popliteomeniscal fascicles: From diagnosis to surgical repair: a systematic review of current literature. *J Orthop Surg Res* 2021;16:148.
14. Kamiya T, Suzuki T, Otsubo H, et al. Midterm outcomes after arthroscopic surgery for hypermobile lateral meniscus in adults: Restriction of paradoxical motion. *J Orthop Sci* 2018;23:1000-1004.
15. Steinbacher G, Alentorn-Geli E, Alvarado-Calderón M, Barastegui D, Álvarez-Díaz P, Cugat R. Meniscal fixation is a successful treatment for hypermobile lateral meniscus in soccer players. *Knee Surg Sports Traumatol Arthrosc* 2019;27:354-360.
16. Toyooka S, Shimazaki N, Masuda H, et al. Preoperative magnetic resonance imaging as a diagnostic aid for hypermobile lateral meniscus. *Diagnostics (Basel)* 2021;11:2276.
17. Ahn JH, Lee SH, Kim KI, Nam J. Arthroscopic meniscus repair for recurrent subluxation of the lateral meniscus. *Knee Surg Sports Traumatol Arthrosc* 2018;26:787-792.
18. Keyhani S, Movahedinia M, Soleymanha M, Verdonk R, Kazemi M, Qoreishy M. Repair of popliteomeniscal fascicles tear using a posterior transseptal portal fixes hypermobile lateral meniscus. *J Exp Orthop* 2021;8:93.
19. Simonetta R, Di Vico G, Papalia R, Vasta S, Denaro V. Arthroscopic all-inside treatment of popliteomeniscal fascicles tears: Surgical technique and results from the first 6 consecutive patients. *J Biol Regul Homeost Agents* 2016;30:91-97 (4 Suppl 1).