BS | Papers

BS Structured Summary



Article: Biomechanical Roles of the Popliteomeniscal Fascicles and Meniscofibular and Meniscotibial Ligaments in Stabilizing the Lateral Meniscus Posterior Horn

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. Educational summary independently prepared based on a published scientific article. The content of the original study belongs to its respective authors and publishers. For reference to the full work, please consult DOI: 10.1177/03635465261423213

Structured Summary: Biomechanical Roles of the Popliteomeniscal Fascicles and Meniscofibular and Meniscotibial Ligaments in Stabilizing the Lateral Meniscus Posterior Horn

Original Article: Biomechanical Roles of the Popliteomeniscal Fascicles and Meniscofibular and Meniscotibial Ligaments in Stabilizing the Lateral Meniscus Posterior Horn

Authors: Horita K, Kamiya T, Hamaoka K, Shiwaku K, Mori Y, Ikeda Y, Okada Y, Suzuki D, Emori M, Fujie H, Teramoto A

Journal: The American Journal of Sports Medicine

Ano: 2026;54(6):1423-1432

DOI: 10.1177/03635465261423213

INTRODUCTION / BACKGROUND

The lateral meniscus is mobile by nature — it glides roughly 10 mm anteroposteriorly during flexion, against only 2 mm for the medial one. That mobility depends almost entirely on the posterolateral corner restraints, the region LaPrade nicknamed the “dark side of the knee.” When those posterior restraints fail, hypermobility of the lateral meniscus follows, with lateral pain and mechanical locking symptoms.

Historical blame falls on the popliteomeniscal fascicles (PMFs). Simonian's classic 1990s work measured posterior horn displacement and suggested the anterior fascicle mattered more than the posterior. But there is a detail Simonian himself could not get around: for technical reasons, he tested only one protocol, in which the anterior PMF had to be cut first to access the posterior one. The hierarchy between the two fascicles was never truly isolated. Add to that the cases of hypermobility without obvious PMF injury and the repair techniques that never touch them yet work — all pointing to other structures at play.

Recent anatomists mapped this neighborhood more carefully. Aman described the posterior horn and posterolateral capsule attachments; Masferrer-Pino proposed the menisco-tibio-popliteus-fibular complex, an interconnected unit of PMF, lateral meniscotibial ligament (LMTL), popliteofibular ligament and meniscofibular ligament (MFibL). The anatomy grew richer, but the biomechanical proof of how much each piece actually holds the meniscus was missing.

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. Educational summary independently prepared based on a published scientific article. The content of the original study belongs to its respective authors and publishers. For reference to the full work, please consult DOI: 10.1177/03635465261423213

OBJECTIVE

To investigate, in a robotic cadaveric model, the biomechanical role of the anterior and posterior PMFs, the MFibL, the LMTL and the posterior meniscotibial ligament (PMTL) in stabilizing the lateral meniscus posterior horn. The hypotheses were that cutting either PMF would increase mobility regardless of order, that additional transection of the other posterolateral structures would worsen instability, and that these injuries would alter knee kinematics.

METHODS

Ten fresh-frozen cadaveric knees (mean age 83.1 years; 9 men, 1 woman) were mounted on a 6 degrees of freedom robotic system. The structures were sequentially transected under two protocols, to compare the effect of order between the anterior and posterior PMF: protocol A began with the anterior, protocol B with the posterior, both proceeding to the combination of the two, then MFibL, LMTL and PMTL.

Anterior displacement of the posterior horn was measured under a constant 10 N traction at 90° of flexion, with a capacitance-type strain sensor and a suture inserted into the posterior horn, simulating probing through the anteromedial arthroscopic portal — the same force and direction the surgeon applies at diagnostic arthroscopy. Tibial rotation was assessed during passive flexion-extension from 0° to 90°, and rotational laxity was tested under up to 5 Nm of torque in internal and external rotation, at 0°, 30°, 60° and 90°. Comparisons used linear mixed models with Tukey correction, significance set at P below 0.05.

It helps to understand why the MFibL enters the equation. First described by Haines, it arises from the lateral meniscus posterior horn, runs deep to the popliteus tendon and inserts onto the fibular head. Functionally, it tenses during tibial external rotation and is thought to coordinate with fibular rotation — as occurs in ankle dorsiflexion and plantarflexion — to pull the meniscus posteriorly and stabilize it. The PMTL, in turn, is a firm tibial attachment reinforcing the posterior horn against anterior displacement and against hyperextension. The study design isolates precisely these pieces that recent anatomy had been describing but that biomechanics had not yet weighed.

MAIN RESULTS

Anterior displacement of the posterior horn started at 6.3 mm in the intact state and rose to 8.1 to 8.4 mm after sectioning the anterior OR the posterior PMF — and here is the central finding: cutting order made no difference. Sectioning both fascicles together did not increase displacement beyond what a single cut already produced, a sign that other structures take over from there. Displacement rose again, significantly, to 10.2 mm after the MFibL and 11.4 mm after the PMTL.

Among the additional structures, MFibL and PMTL proved relevant stabilizers, while the LMTL played a minor role — probably because, located more anteriorly, it resists radial displacement more than posterior horn hypermobility. In internal rotation laxity, the angle grew from 32.6° intact to 36.4° after combined PMF cuts, 37.3° after the MFibL and 40.2° after the PMTL, most marked at 60° and 90° of flexion. External rotation laxity did not change

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. Educational summary independently prepared based on a published scientific article. The content of the original study belongs to its respective authors and publishers. For reference to the full work, please consult DOI: 10.1177/03635465261423213

significantly, which the authors attribute to preservation of the primary stabilizers: LCL, PCL and popliteofibular ligament. On passive flexion, transection shifted tibial rotation externally, consistent with loss of the posterior meniscal excursion that normally accompanies lateral condyle rollback.

AUTHORS' CONCLUSION

Anterior displacement of the lateral meniscus posterior horn occurred after sectioning either PMF, regardless of cutting order. The instability was worsened by concomitant injury to other posterolateral structures, particularly MFibL and PMTL. The results indicate that multiple posterolateral corner structures act together to maintain lateral meniscal stability, and that focusing solely on PMF repair may be insufficient in clinical practice.

💬 BS DISCUSSION

This paper pushes back on a habit many of us have carried since residency: treating lateral meniscus hypermobility as a synonym for popliteomeniscal fascicle injury. The choreography is more collective than that. The finding that stopped me was that cutting order did not matter — sectioning the anterior or the posterior first gave the same displacement. That elegantly dismantles Simonian's dominant reading, which by methodological limitation could only cut the anterior first and so seemed to crown it the chief villain. Once you can test both orders, the hierarchy vanishes.

And there is a subtlety worth the price of the paper: cutting both PMFs together did not increase displacement beyond a single cut. Think about what that means. If the fascicles owned stability outright, removing both should be worse than removing one. It was not. What held the difference were the other restraints — chiefly MFibL and PMTL. The PMFs form a sling around the popliteus tendon, and it seems that breaking one link already disarms the sling; the rest of the restraint comes from outside it. To me, that is the practice-changing message: the lateral meniscus does not hang from a nail, it hangs from a net.

What interests me most in clinic is the mismatch between biomechanics and MRI. Suganuma, in a clinical study, found that only the PMFs predicted hypermobility and that the MFibL did not associate — but he himself raised the hypothesis that the MFibL is too thin to show reliably on MRI. Now the bench shows the MFibL holds, and holds well. So the reading I take is this: when the MRI looks “clean” for the PMFs but the patient has classic lateral locking, do not rule out hypermobility. It may be MFibL or PMTL, which imaging is not seeing. Arthroscopy with the probe still outranks the report here.

Where I rein in the enthusiasm: mean age of 83 years. This is old tissue answering for a disease that is, mostly, of the young active knee. The authors are honest about it, but the overconstraint they cite as the risk of excessive repair has another side — in senile tissue,

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. Educational summary independently prepared based on a published scientific article. The content of the original study belongs to its respective authors and publishers. For reference to the full work, please consult DOI: 10.1177/03635465261423213

the reading of “important stabilizer” may be inflated by the specimen's own stiffness. And they tested only 10 N of traction, the standard probing force; under greater load the hierarchy among structures might reorganize. It is a time-zero snapshot, no muscle, no healing, none of the fibular rotation that gives the MFibL its functional meaning.

What I take to discuss with the resident is direct: faced with lateral hypermobility, stopping at PMF repair may be half the job. Assess MFibL and PMTL case by case, without falling into the excess of restoring everything and stiffening a meniscus that needs mobility to work. The question the paper leaves open is exactly where that balance point sits: how far to repair in order to stabilize, without crossing the line into overconstraint?

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. Educational summary independently prepared based on a published scientific article. The content of the original study belongs to its respective authors and publishers. For reference to the full work, please consult DOI: 10.1177/03635465261423213

BS Papers — is a division of the BS KNEE RESEARCH SERVIÇOS LTDA. group.

BS Knee Papers aims to facilitate access to the leading scientific evidence in knee surgery and sports medicine by translating relevant studies from the international literature into concise and accessible summaries for healthcare professionals.

This material is part of our initiative to disseminate scientific knowledge, bringing together structured summaries of articles published in leading peer-reviewed journals in the field.

Editorial production
BS KNEE RESEARCH SERVIÇOS LTDA.

Access more scientific content:
www.bspapers.com.br

Instagram: @bs_papers

@BS_PAPERS

This material is intended for educational purposes only and does not replace reading the original scientific article or the clinical judgment of healthcare professionals.

©2026 BS KNEE RESEARCH SERVIÇOS LTDA. All rights reserved.