Deep Medial Collateral Ligament Reconstruction of the Knee Restores Rotational Stability Throughout Full Range of Motion While Contemporary MCL Reconstruction Only Does in Extension

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Background and Purpose

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- Injuries to the medial ligament complex result in valgus and anteromedial rotatory instability (AMRI).

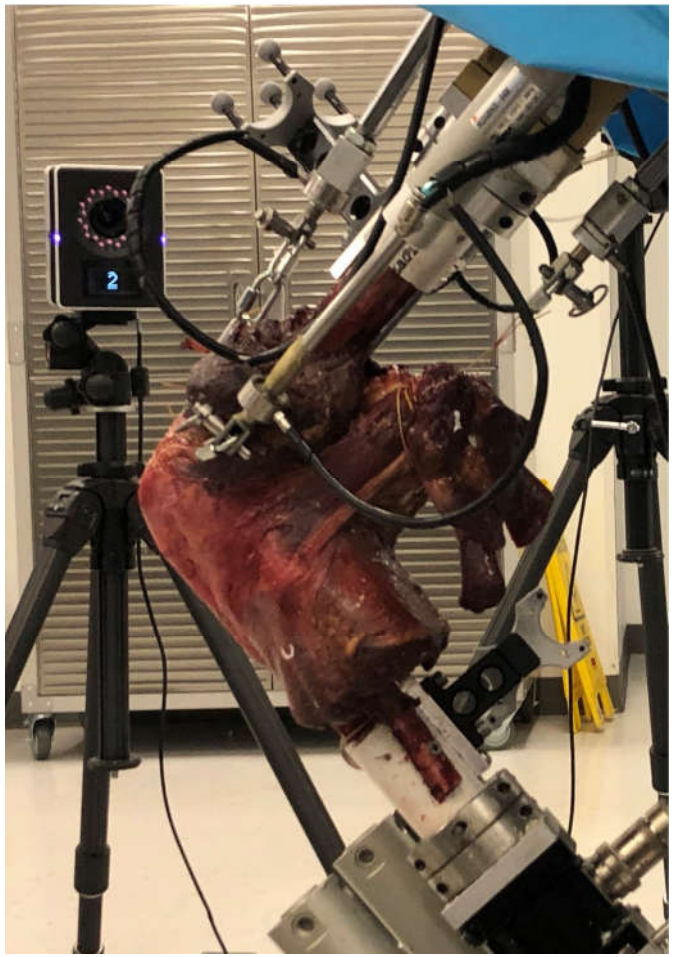
- Contemporary MCL reconstruction techniques focus on the superficial MCL to restore valgus stability while frequently ignoring the importance of the deep MCL in controlling tibial external rotation.

- The purpose of this study was to assess and compare the ability of a contemporary MCL reconstruction (single strand LaPrade) and a deep MCL (dMCL) reconstruction to restore rotational and valgus stability to the knee.

Methods

- Six pairs fresh-frozen cadaveric knee specimens with intact soft tissue envelopes

- Distal femur and tibia were potted in PVC pipes to facilitate biomechanical testing using a customized multi-axial knee activity simulator



Methods

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- Four states were tested:
  - 1) Intact
  - 2) After sectioning of the sMCL and dMCL
  - 3) Contemporary MCL reconstruction as described by LaPrade et al
  - 4) dMCL reconstruction
- Four loading conditions:
  - 1) 8 Nm valgus torque
  - 2) 5 Nm tibial external rotation torque
  - 3) 90N anterior drawer
  - 4) Combined 90 N anterior drawer plus 5 Nm tibial external rotation torque
- Multiple flexion angles 0°, 20°, 40°, 60° and 90°

Reconstruction Techniques

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Single Strand LaPrade (SSL)

- Femoral fixation posterior and proximal to medial epicondyle. Fixed on the tibia at the proximal tibial fixation point.

dMCL reconstruction

- Femoral fixation distal and posterior to medial epicondyle. Running antero-distally to tibial fixation point of the deep MCL.

SSL = white and green graft

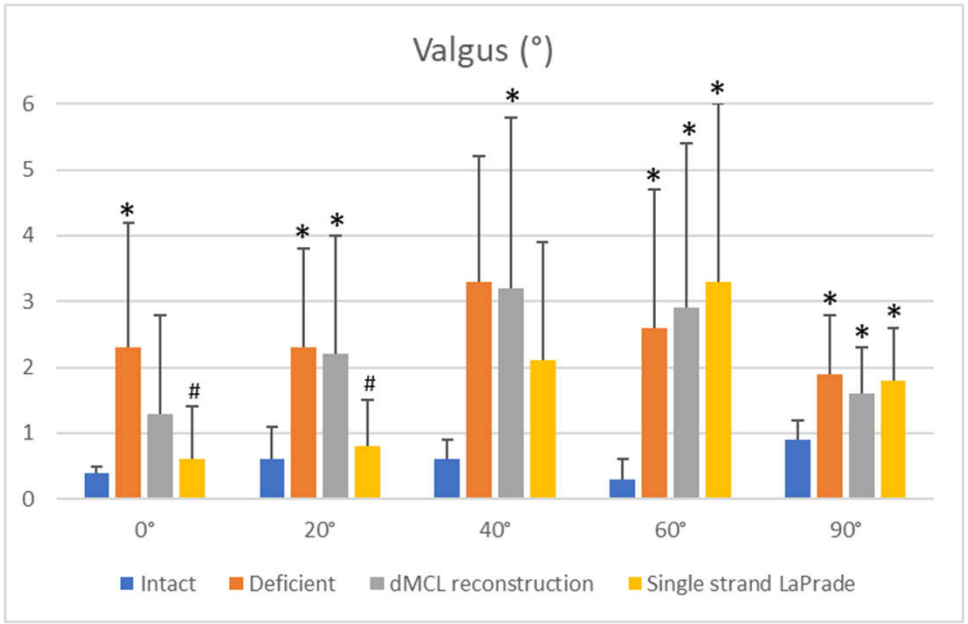
dMCL = solid white graft

Results

- Transection of the sMCL and dMCL resulted in increased laxity at all flexion angles for
  - Valgus torque
  - External rotation torque
  - Combined anterior drawer plus external rotation

Valgus

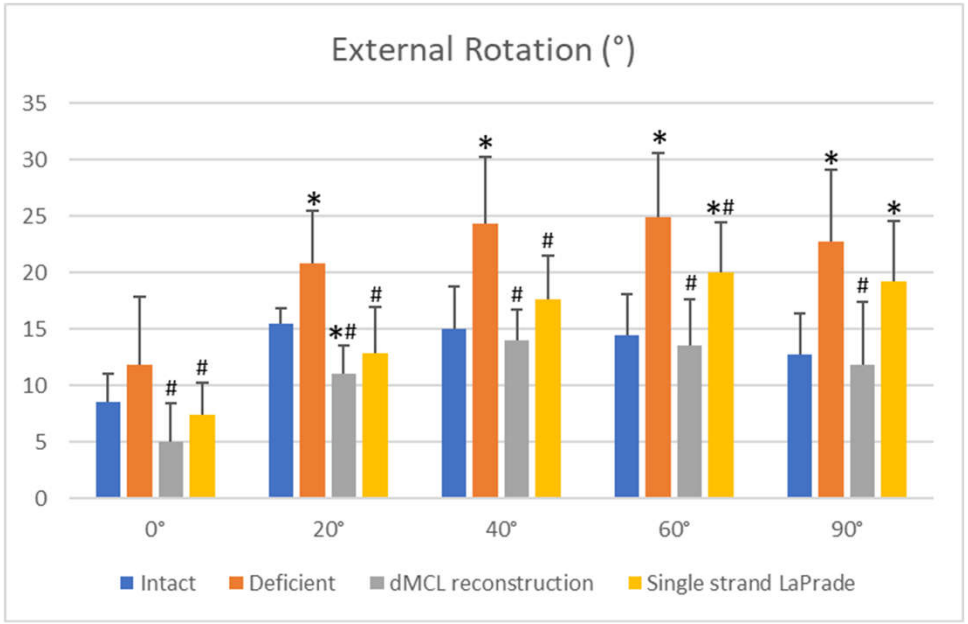
- SSL reconstruction restored valgus stability at 0°, 20°, and 40° ($p<0.01$)
- dMCL reconstruction did not restore valgus stability at any flexion angle



* Significantly different from intact; # Significantly different from deficient

External Rotation

- SSL reconstruction restored external rotation stability at 0° and 20° ($p<0.01$).
- dMCL reconstruction restored external rotation stability (all $p<0.05$) throughout all degrees of flexion.



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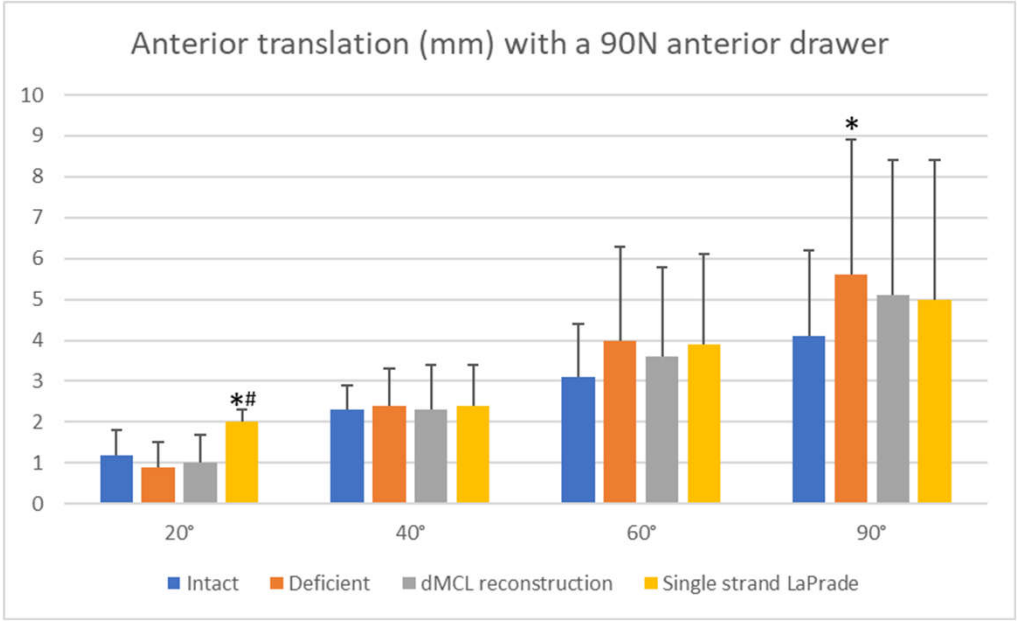
90N Anterior Drawer

- At 20° dMCL technique restored anterior translation to values observed in the intact state, whereas the SSL technique translation remained significantly larger ($p<0.05$).
- Comparing the dMCL and SSL reconstruction techniques showed no significant differences at 40° and 60° of flexion.



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Combined Anterior Drawer plus External Rotation

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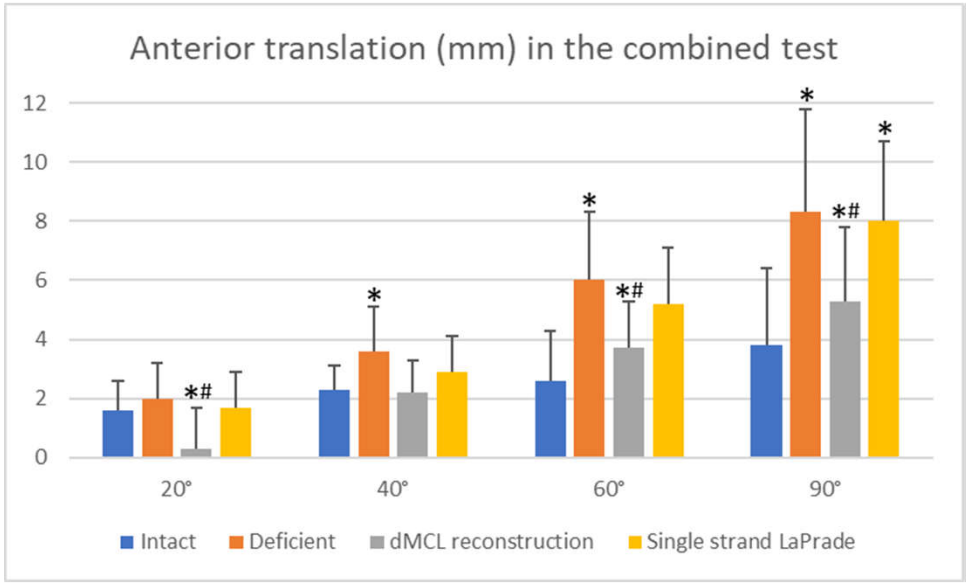
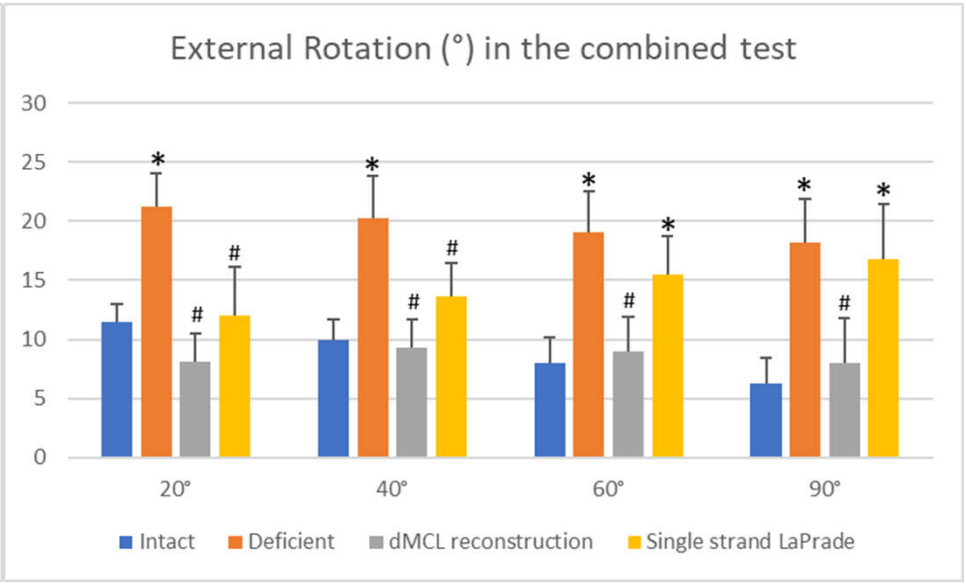
- SSL reconstruction did not restore stability at any degree of flexion ($p>0.05$).
- dMCL restored stability back to the intact level at 20° and improved stability between 40° and 90° flexion.





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Conclusion

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- Deep MCL reconstruction restored rotational stability to the knee throughout range of motion but did not restore valgus stability.

- Single Strand LaPrade reconstruction restored stability only near full extension (0° and 20°).

References

- Borque KA, Ball S, Sij E, Amis AA, Laughlin MS, Jones M, et al. A “Short Isometric Construct” reconstruction technique for the medial collateral ligament of the knee. Arthrosc Tech 2023;12:e167–71.
- LaPrade RF, Wijdicks CA. Development of an anatomic medial knee reconstruction. Clin Orthop Relat Res. 2012;470(3):806-814.
- Richter DL, McIver ND, Sapradit T, et al. A biomechanical comparison of the LaPrade technique versus a novel technique for reconstruction of medial-sided knee injuries. Am J Sports Med. 2022;50(8):2083-2092.
- Slocum DB, Larson RL. Rotatory Instability of the Knee: Its pathogenesis and a clinical test to demonstrate its presence. J Bone Jt Surg. 1968;50:211-225.