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

• 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

• 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

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.

* Significantly different from intact; # Significantly different from deficient
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.

* Significantly different from intact; # Significantly different from deficient
Combined Anterior Drawer plus External Rotation

- 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.

* Significantly different from intact; # Significantly different from deficient
Conclusion

• 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°).

