The Relationship Of The Lateral Meniscus And The Anterolateral Ligament To Rotational Knee Laxity

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Anatomic Relationship of ALL and Lateral Meniscus

What is the Functional Relationship?
Study 1 – ALL vs. Posterior Root Lateral Meniscus

- Serial cutting study
- 16 fresh frozen knees
- Femur mounted into a Ball and Socket Hip Simulator
  - Allowed for rotational movement during PST
- Tibia mounted into a 6 dof load cell
- Optotrak markers

Methods

- Testing sequence
  - Intact knee
  - ACL –
  - LMPR- or ALL-
  - LMPR/ALL-
- 0-90° in 15° increments
- 5Nm IR torque
- Torque and position continuously recorded by computer

Results

- Extension
- At 45°
  - ALL has greater role at angles greater than 45 degrees
  - PRLM seems to have greater role closer to extension
- At 75°
Purpose
- To explore the supra-meniscal and infra-meniscal parts of the ALL and their connection to the meniscus to determine their gross anatomy, histology, and biomechanical properties.

Hypothesis
1. The infra-meniscal fibers would be stronger than the supra-meniscal fibers providing a robust meniscofemoral functional attachment
2. There would be no differences in the morphological appearance between the two sections as shown histologically

Methods - Biomechanics
- 14 fresh frozen cadaveric knees (n = 7) randomly assigned to Supra- or Infra-meniscal group
- Specimens placed in Instron machine
- Pulled to failure at 1mm/s – Failure force and stiffness calculated
- 1 specimen – histological analysis (H&E, Masson’s Trichrome)

Results - Biomechanics
- Infra-meniscal fibers resulted in greater forces compared to the supra-meniscal fibers (p=0.01; effect size = 1.38)
- Infra-meniscal fibers also significantly differ from the supra-meniscal fibers (p=0.01; effect size = 1.36)
Histological images of longitudinal sections showing:

- a) the supra-meniscal fibers of the ALL and
- b) the infra-meniscal fibers of the ALL.

The ALL revealed collagen running parallel to each other and they exhibited a cramped pattern that is characteristic of dense regular connective tissue.

The pattern of collagenous arrangement was relatively consistent between the supra-meniscal (a) and the infra-meniscal fibers (b).

Results - Histology

Discussion

- Studies demonstrate a strong mechanical/functional relationship between the anterolateral tibial plateau and the lateral meniscus.
- Lateral meniscus injury is commonly seen with ACL injury.
  - Posterior root tears of the lateral meniscus are found in approximately 8% of ACL reconstructions.
  - 14% prevalence of a radial tear of the middle third of the lateral meniscus in the ACL deficient knee during arthroscopy.
- In a study by Van Dyck et al. 43% of ACL deficient knees had an ALL abnormality.
  - Intact ALL – 31% Lateral Meniscus Injury
  - Abnormal ALL – 61% Lateral Meniscus Injury

Lateral Meniscus & Rotatory Laxity

- Medial meniscus functions as a critical secondary stabilizer to anteriorly directed forces during Lachman.
- Lateral meniscus appears to be a more important restraint to anterior tibial translation during pivot shift.

The Effect of Medial Versus Lateral Meniscectomy on the Stability of the Anterior Cruciate Ligament-Deficient Knee

- Medial meniscus functions as a critical secondary stabilizer to anteriorly directed forces during Lachman.
- Lateral meniscus appears to be a more important restraint to anterior tibial translation during pivot shift.
**Concomitant injury to the ALC, medial meniscus, or lateral meniscus is associated with increased knee rotatory laxity.**

**Discussion**

- High grade AL rotatory laxity not just about the ALL
  - ITB with Kaplan fibers
  - Lateral meniscus posterior root

- We hypothesize that it is the meniscobial ALL structure that exerts the majority of anterolateral control within the capsulo-meniscal complex

- The meniscobial attachment of the lateral meniscus by the ALL therefore may have some clinical implications to anterolateral rotatory laxity and should remain a focus of future work

**Thank You - The Fowler Team**