Title: Internal and External Rotation Stabilizers of the Knee with Intact Cruciate and Collateral Ligaments: A Biomechanical Study

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Objectives: The purpose of this study was to assess the effect of sequentially cutting the posterolateral, anterolateral, posteromedial and anteromedial structures of the knee on rotational kinematics in the setting of intact cruciate and collateral ligaments. It was hypothesized that cutting of the iliotibial band (ITB), anterolateral ligament and lateral capsule (ALL/LC), the posterior oblique ligament (POL), and the posteromedial capsule (PMC) would significantly increase internal rotation and that the anteromedial capsule (AMC), and the popliteus tendon and popliteofibular ligament (PLT/PFL) when sectioned would lead to a significant increase in external rotation of the knee.

Methods: Ten pairs (\(n = 20\)) of cadaveric knees were assigned to two sequential cutting groups (posterolateral-to-posteromedial and posteromedial-to-posterolateral). Specimen were subjected to 5 N-m of internal and external rotation torque at knee flexion angles 0° through 90° in the intact and after each cut state. Rotational changes were measured and compared to the intact and previous states following each cut.

Results: Sectioning of the ITB significantly increased internal rotation at 60° and 90° by 5.4° and 6.2°, respectively (after ALL/LC cut) and 3.5° and 3.8° (prior to ALL/LC cut) (Figure 1). At 60° and 90°, section of the ALL/LC produced significant increases in internal rotation of 3.1° and 3.5°, respectively (after ITB cut) and of 0.5° (prior to ITB cut) (Figure 1). At 0°, section of the POL produced significant increases in internal rotation of 2.0° (ITB intact) and 1.8° (after ITB cut) (Figure 1). Sectioning the PLT/PFL complex significantly increased external rotation at 60° and 90° by 2.7° and 2.9°, respectively (prior to sectioning medial structures) and 2.2° and 2.7° (after sectioning medial structures) (Figure 2). Sectioning the AMC produced significant increases in external rotation at 30°- 90° of flexion, however the magnitude of change was < 1° (Figure 2).
Figure 1. Changes in internal rotation from the intact state during a 5 N-m internal rotation torque when sequentially cutting structures from lateral to medial (above) and medial to lateral (below).
Figure 2. Changes in external rotation from the intact state during a 5 N-m external rotation torque when sequentially cutting structures from lateral to medial (above) and medial to lateral (below).

**Conclusion**: Collectively the anterolateral corner structures had a primary role in internal rotational control of the knee from 60° to 90° of knee flexion. The ITB was the most significant primary stabilizer for internal rotation in ACL intact knees. The POL contributed to internal rotational control at full extension, while the PLT/PFL complex controlled external rotation of the knee at higher flexion angles (60° and 90°). Internal rotation control of the knee has been mainly attributed to the cruciate and collateral ligaments. This study delineates the primary and secondary roles of the ITB, the ALL/LC, POL and PLT/PFL to rotatory stability of the knee. As such, it provides new information about the understanding of rotational instabilities of the knee.