Abstract:

Objectives: Anterior cruciate ligament (ACL) tears are one of the most common injuries among athletes. However, the ability to fully restore rotational stability with ACL reconstruction (ACLR) remains a challenge because up to 25% of patients may present with a residual pivot shift following surgery. Advocacy for reconstruction of the anterolateral ligament (ALL) is rapidly increasing because biomechanical studies have reported that the ALL is a significant contributor to internal rotational stability of the knee. Although several graft fixation angles for the anatomic ALL reconstruction (ALLR) have been reported in literature, none have been biomechanically validated. Therefore, the purpose of this study was to assess the effect of ALLR graft fixation angle on knee joint kinematics in the clinically relevant setting of a concomitant ACLR. The goal was to find the optimal knee flexion angle for fixation of the ALLR graft that would most accurately restore native knee kinematics without introducing overconstraint to the knee. It was hypothesized that all fixation angles would significantly reduce rotational laxity compared to the sectioned ALL state and that fixation at 30° would best reproduce native joint kinematics.

Methods: Eight non-paired fresh-frozen human cadaveric knees with no prior injury, surgical history, or gross anatomic abnormality were evaluated with a 6 degree-of-freedom robotic system. Each specimen underwent a full kinematic assessment in each of the following states: 1) intact, 2) anatomic single-bundle (SB) ACLR with intact ALL, 3) anatomic SB ACLR with sectioned ALL, 4) 7 anatomic SB ACLR and ALLR states utilizing ALL graft fixation knee flexion angles of 0°, 15°, 30°, 45°, 60°, 75° and 90°, and 5) sectioned ACL and ALL. Internal rotation during a 5 N-m internal rotation torque and anterior displacement during an 88 N anterior load were recorded at 15° intervals between 0° and 120° of knee flexion. Axial plane displacement and internal rotation during a simulated pivot shift (combined 5 N-m internal rotation and 10 N-m valgus torques) were recorded between 0° and 60°. Kinematic changes were measured and compared to the native state for all reconstructed and sectioned states.

Results: Anterolateral ligament reconstruction at all graft fixation angles significantly reduced internal rotation of the knee with respect to the ACLR with sectioned ALL state at all knee flexion angles beyond 30° (Figure 1). However, ALLR overconstrained the knee joint at each tested ALL graft fixation angle and through all tested knee flexion angles beyond 15° during simulated internal rotation torque and pivot shift tests (Figure 1). Furthermore, no significant difference was observed between the different graft fixation angles on the kinematics of the knee with respect to anterior drawer, pivot shift and internal
Conclusion: Anatomic ALLR in conjunction with an ACLR overconstrained internal rotation of the knee joint at flexion angles beyond 15° regardless of graft fixation angle. The surgical technique and indications for this procedure should be investigated further and it is recommended that ALLR be used with caution.