INTRODUCTION:
The recent surge of interest in double bundle Anterior Cruciate Ligament reconstruction techniques has arisen from the biomechanical theory that the technique allows better postoperative tolerance of complex knee activity because it recreates both a posterolateral and anteromedial bundle of the ACL while traditional transtibial single bundle techniques recreate only the anteromedial bundle. This theory remains indecisively tested. Biomechanical studies examining the individual contributions of the native ACL bundles to the kinematics of the knee under complex loads are scarce with conflicting results when knee kinematics were evaluated after selective sectioning of the native ACL bundles. The purpose of this study is to assess for differences in knee kinematics with selective sectioning of the individual native bundles of the ACL under simulated Lachman and Pivot Shift testing.

METHODS:
After obtaining Investigational Review Board approval fourteen fresh, frozen, cadaveric knees were studied with two specimens excluded due to concomitant intraarticular pathology. Femurs were potted and mounted on a 6-DOF motion platform. The tibia was attached to a 6-component load cell and standard bone coordinate systems established with a coordinate measuring device. Specimens were tested in three conditions: intact, one ACL bundle sectioned, and complete ACL sectioning. Specimens were randomized to have either the AMB sectioned or the PLB sectioned. ACL bundles were sectioned at their tibial origins from which they were named. In each condition specimens were subjected to a simulated Lachman test of 100 N anterior force at 0, 15, and 30 degrees flexion. Specimens were then subjected to a simulated pivot shift test (5 Nm internal torque and 10 Nm valgus moment) at flexion angles of 0, 15, 30 and 45 degrees. Anterior tibial translation (ATT) and internal rotation (IR) of the tibia were measured and analysis of variance used to test for statistically significant differences (p<0.05) between bundle sectioning conditions.

RESULTS:
Seven specimens underwent AMB sectioning and five underwent PLB sectioning. Selective sectioning of the ACL bundles produced small ATT findings relative to intact ACL states with isolated sectioning of the AMB yielding statistically significant larger ATT than sectioning of the PLB during both simulated Lachman testing and simulated Pivot Shift testing (p<0.001). When analyzed at each individual flexion angle, selective sectioning of the AMB yielded statistically significant larger ATT during both the simulated Lachman and simulated Pivot Shift testing at all measured angles except full extension. No significant difference in ATT was found between isolated sectioning of the two bundles at full extension for both the simulated Lachman and Pivot Shift tests (p = 0.785 and p = 0.816).

DISCUSSION:
Our results show that isolated sectioning of the ACL bundles at their tibial footprints yield small ATT and IR changes during simulated Lachman and Pivot Shift testing. When evaluating for differences in ATT after selective sectioning of the ACL bundles the AMB yields statistically significant larger ATT than selective sectioning of the PLB for both the simulated Lachman and simulated Pivot Shift tests. It is unclear whether the small but statistically significant changes seen with selective sectioning of the native ACL bundles are clinically significant. When evaluating for differences in IR kinematics during the simulated pivot shift test, isolated sectioning of the PLB showed statistically significant changes compared to AMB sectioning only at full extension. It is unclear whether the small but statistically significant IR change with selective sectioning of the PLB at full extension (2.24 +/- 2.08 degrees) is clinically significant. Our results suggest that reconstructing the ACL via a two graft/four tunnel technique may not be necessary to restore adequate post-reconstruction kinematics in all cases of ACL deficient knees. Furthermore, our results suggest that a single bundle reconstruction, placed in the center of the respective ACL footprints may be sufficient to restore appropriate post reconstruction knee kinematics and should be further evaluated.

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