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Paper #207

The Anterolateral Ligament Carries Load and Provides Stability in the ACL-Deficient Knee but Bears Minimal Load when the ACL is Intact

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Summary:
The ALL may act as a secondary stabilizer in the ACL-deficient knee however, the role of the ALL in the ACL-competent knee appears limited

Abstract:
INTRODUCTION
The recently-named anterolateral ligament (ALL) has received attention as a potential knee stabilizer1. However, limited biomechanical data exist supporting this assertion. Thus, the purpose of this study is: 1) to quantify the contributions of the ALL to knee stability compared to the ACL; and 2) to measure the load carried by ALL in response to clinically relevant tests of anterior and rotational stability.

METHODS
Clinical exams including the pivot shift, Lachman, and anterior drawer were simulated using a six degree of freedom robot that was equipped with a universal force-moment sensor on eleven fresh-frozen cadaveric knees (mean age, 43 years; range, 20-64; 8 male)2. Kinematics was measured in nine knees with the ACL intact, after isolated sectioning of the ACL, and after sectioning both the ACL and ALL. The load carried by the ALL with the ACL intact and sectioned was calculated in all knees using the superposition principle. ALL load and tibiofemoral kinematics were compared across knee conditions using repeated measures ANOVA and Tukey post-hoc test ($P<0.05$).

RESULTS
In response to the simulated pivot shift, sectioning the ACL caused coupled anterior translation to increase by 4.5 mm (204.5%) and 1.5° (6.5%) in anterior translation and internal rotation, respectively. Subsequent sectioning of the ALL caused an additional increase in coupled anterior translation and internal rotation of 2.9 mm (43.4%) and of 3.6° (14.6%), respectively. In response to the simulated Lachman and anterior drawer, sectioning the ACL increased tibial anterior translation by 12.5 mm (181.2%) and 7.8 mm (159.2%), respectively. Subsequent sectioning of the ALL yielded an additional 3.0 mm (15.5%) and 2.6 mm (20.5%) of anterior displacement, respectively.

With the ACL intact, the ALL carried 19.8% of the load borne by the ACL in response to the simulated pivot shift. After sectioning the ACL, ALL load increased to 58.3% of that carried by the ACL. In response to the simulated Lachman and drawer, the ALL carried 6.5% and 8.1% of the load borne by the ACL, respectively, in the intact knee. Sectioning the ACL caused ALL load to increase to 38.2% and 41.9% of that carried by the ACL during the Lachman and drawer exams, respectively.

DISCUSSION

Paper #207

The ALL may act as a secondary stabilizer in the ACL-deficient knee. The ALL bears minimal load when the ACL is intact, but does bear load after the ACL is sectioned. These data reinforce that the ACL is the dominant load bearing structure against anterior loads and combined moments simulating the pivot shift. The role of the ALL in the ACL-competent knee appears limited; however, the role of the ALL in the setting of ACL reconstruction should be investigated.