

Evaluation of the Knee Stability Under One Bundle Tear in Anterior Cruciate Ligament: A Human Cadaveric Study

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Summary:

The purpose of this study is to assess the simulated Lachman test and PS for the one bundle ACL tears using the biomechanical testing. Lachman test and PS test may be sometime positive under pure AMB partial tear. If any manual testing is positive, PLB will not be pure partial tear. When the augmentation method is applied to partial ACL tear, surgeons should take this result into consideration.

Abstract:

PURPOSE

A partial tear of ACL is a frequent pattern of ACL injury, observed in 10 to 27% of isolated ACL lesions. Bak et al showed in the natural history of partial ACL tear, only 62% had a good or excellent knee function, and significant decline in activity was seen. In recent years, ACL augmentation, which reproduces an AM bundle or a PL bundle selectively, has been performed in patients with partial ACL ruptures and good clinical results have been reported. The augmentation of AM or PL bundle is "standard" operation for partial tear of ACL. However, it is still unclear whether the remnant observed in partial ACL tears has a certain function in knee stability. The purpose of this study is to assess the simulated lachman test and PS for the pure one bundle ACL tears using the biomechanical testing.

METHODS

Fourteen human cadaveric knees were divided to two groups and tested using a robotic system with two external loadings: (1) an 89-N anterior tibial load(ATL) at full extension (FE), 15°, 30°, 45°, 60°, and 90° (2) a combined 7-Nm valgus torque and 5-Nm internal tibial rotation torque (Simulated pivot-shift test; SPS) at FE, 15°, 30°. Using the robotic/UFS testing system, the 6- degrees of freedom (dof) knee kinematics and the in-situ forces in the intact ACL and the ACL graft, as well as the in ISF in the AM and PL bundles and their respective replacement grafts, were measured. Three knee states were used in each knee: (1) Intact (2) AM bundle deficient or PL bundle deficient (3) ACL deficient. As for the method to make one bundle deficient state, AM bundle was decided as the fiber with tightness during flexion position of the knee. On the other hand, PL bundle was decided as the fiber with tightness during extension position of the knee. Statistical analysis of the ATT and in-situ forces was performed using a 2-factor repeated measures analysis of variance (ANOVA) with knee state and knee angle as the factor. Statistical significance was set at $P < .05$.

RESULT

As for Antero Tibial Translation (ATT) under ATL, AM bundle deficient state at 15° and 30° showed statistically difference from intact state. However, PL bundle deficient state had no difference from intact state. As for Coupled ATT under SPS, PL bundle deficient state had no difference from intact state at all angles. However, as for Coupled ATT at 15° and 30°, AM bundle deficient state had significant difference from intact states and no significant difference from ACL deficient state. In addition, the difference of ATT between intact state and each deficient state were assessed. As for difference of ATT during low flexion angle, difference between both bundle deficient state and

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intact ACL didn't show larger difference than 3mm.

CONCLUSION

Lachman test and Pivot shift test may be sometime positive under pure AMB partial tear. If any manual testing is positive, PLB will not be pure partial tear. When the augmentation method is applied to partial ACL tear, surgeons should take this result into consideration.