CORRELATION BETWEEN KT ARTHROMETER DATA AND ACL STRAIN SUGGESTS DIAGNOSTIC IMPORTANCE

1Ata M. Kiapour, 2Carmen E. Quatman, 2Samuel C. Wordeman, 1Jason W. Levine, 1Richard C. Ditto, 2,3Mark V. Paterno, 1Vijay K. Goel, 1Constantine K. Demetropoulos, 2,3Timothy E. Hewett

1University of Toledo, Engineering Center for Orthopaedic Excellence (ECORE) Toledo, OH
2The Ohio State University, Sports Health and Performance Institute, Columbus, OH,
3Cincinnati Children’s Hospital Medical Center, Sports Medicine Biodynamics Center, Cincinnati, OH

INTRODUCTION

The CompuKT knee arthrometer is used to quantify AP tibial translation relative to the femur and demonstrates good to excellent intra-rater reliability [1,2,3]. The CompuKT is used diagnostically to generate load-displacement data to evaluate ACL integrity [2,3], and as a research tool to evaluate ACL stiffness in healthy and pathologic subjects [4]. Little data has been generated to correlate these measurements with ACL strain. The purpose of this study was to evaluate the relationships between ACL strain and CompuKT force-displacement curves.

METHODS

20 cadaveric lower limbs (46±6 yrs) were tested using a CompuKT to evaluate ACL integrity and generate load-displacement curves. In all tests, AP loads were cycled (±30 lbs) using standard protocol by a single tester. This test is conducted at 20-35° of knee flexion. As the ACL provides approximately 87% of the restraint to anterior tibial translation (ATT) at this flexion angle range [5,6,7], it is likely that the load-displacement curve is a good representation of ACL integrity. Subsequently, two parapatellar incisions were used to arthroscopically place a DVRT displacement transducer on the ACL (AM bundle), and specimens were retested. The relationship between peak ACL strain and CompuKT force-displacement data at 30 lb were evaluated using a general regression model and an ANOVA with post hoc Bonferroni correction.

RESULTS

No significant difference in ATT was observed between testing sessions (2.8±1.4 mm prior and 3.0±1.1 mm after DVRT insertion). Peak ACL strain during knee arthrometry was 4.9±4.3%. Both ACL strain (p=0.02) and ATT (p<0.0005) were significantly related to anterior shear load. Linear regression analysis (Figure 1) with the assumption that 0 mm ATT corresponds with 0% ACL strain (y-intercept = 0) demonstrated a Pearson’s correlation coefficient (r) of 0.78 (P<0.0005).

DISCUSSION

Anterior shear load (30 lb) during knee arthrometry is significantly related to both ACL strain and ATT. Arthroscopic DVRT insertion did not affect ATT. A significant linear relationship was demonstrated between ATT and ACL strain. This relationship indicates that the knee arthrometry is a good indicator of ACL strain at 20-35° of flexion, and therefore, has intrinsic value in the evaluation of ACL loading characteristics and the diagnosis of a
functionally compromised ACL. Development of more quantifiable methods to utilize knee arthrometry data may help improve prevention strategies and ACL injury mechanism studies.

ACKNOWLEDGEMENTS

The authors would like to thank Laura Buckenmeyer for assistance with data analysis. The authors also acknowledge funding support from the National Institutes of Health Grants RO1-AR049735 and R01-AR056259.

REFERENCES:
1-Myer et al, AJSM, 2008
2-Daniel et al, JBJS, 1985
3-Myrer et al, AJSM, 1996
4-Romani et al, J Womens Health, 2003
5-Markolf et al, JBJS, 1976
6-Fukubayashi et al, JBJS, 1982
7-Markolf et al, JBJS, 1978