Sex Differences in Unconstrained Transverse Plane Kinematic Response Under Compression and Simulated Muscle Forces

Samuel C. Wordemana, Carmen E. Quatmanc, Ata M. Kiapourc, Richard C. Dittoa, Vijay K. Goela, Constantine K. Demetropoulosf, Timothy E. Hewettd

aSports Health and Performance Institute (SHPI); bDepartment of Biomedical Engineering; cDepartment of Orthopaedic Surgery; dDepartments of Physiology and Cell Biology, and Family Medicine, The Ohio State University; eThe Engineering Center for Orthopaedic Research Excellence (ECORE), The University of Toledo

BACKGROUND

- Anterior cruciate ligament (ACL) injury affects nearly 250,000 Americans annually
- In vitro studies provide insight into tissue mechanics
- It is postulated that sex differences in tibial geometry alters biomechanics1,2
  - Few studies consider sex when interpreting in vitro biomechanical results and populating cadaveric studies

PURPOSE: To examine sex differences in unconstrained kinematic response to simulated muscle forces and compressive loads

HYPOTHESIS: Transverse plane kinematic response differs between male and female cadavers when a compressive load is applied across the knee joint

RESULTS

- Simulated muscle forces applied to stripped tendons via muscle clamps:
  - 400 Newton Quadriceps
  - 200 Newton Hamstrings
- Rigid body tibiofemoral kinematic measured at 100 Hz (Optotrak 3020 System, Northern Digital, Waterloo, Canada)
- Limbs cycled from 0°-90° of flexion using servo-electric actuators
- Compressive load of 134 Newton added, tests repeated
- Repeated measures mixed-model analysis of covariance (ANCOVA) used to assess differences in transverse plane knee alignment

- Significant sex-by-flexion angle differences
- Simulated muscle force condition (p=0.024)
- Simulated muscle force + compression (p=0.007)
- Within specimen effect of knee flexion angle (p=0.000)

Figure 2 shows transverse plane alignment by knee flexion angle

Female specimens experienced internal rotation through a greater range of flexion angles for both conditions
- Under compression, males decrease the magnitude of internal rotation at flexion angles greater than 20°
- Females progressively increase internal rotation to 35°
- This study demonstrates that significant differences in unconstrained kinematics exist between the sexes
- Under identical loading conditions, soft tissue strains may differ significantly
- Biomechanical studies should consider these differences when populating specimens and interpreting results

REFERENCES:

[3] Chandrashekar et al., 2006 J Biomech

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