



Grant Information Summary:

Biomechanical and Neuromuscular Aspects of Non-Contact ACL Injuries: The Influence of Gender, Experience and Training

Practical Implications:

This study provides evidence that females perform athletic tasks in a way that may predispose them to ACL injuries, and that participation in a training program may prevent the emergence of potentially injurious movement patterns.

Background

Non-contact ACL injuries are one of the most common knee injuries sustained by individuals who engage in athletics. Comparison of injury rates between male and female athletes participating in similar sports show that there is a greater incidence of ACL injuries in females. Numerous theories have been proposed to explain the higher incidence of ACL injuries in females, however exact mechanisms and risk factors have not been adequately defined. One area that has received little attention is whether females perform specific sports maneuvers that may predispose them to ACL injuries.

Objective

Three studies were performed to meet the following objectives: 1) identify aspects of performance that may predispose female athletes to non-contact ACL injuries, 2) evaluate the effects of experience on the performance of athletic activities, and 3) assess the effectiveness of a training program in altering potentially injurious lower extremity mechanics.

Design and Setting

Studies I and II were cross-sectional designs. Study III was a controlled trial that incorporated a repeated measures design. All three studies were performed in a laboratory setting.

Subjects

Study I compared experienced male (n=15) and female (n=15) collegiate soccer players, while study II compared novice (n=15) and experienced (n=15) female high-school soccer players. Study III evaluated female high-school soccer players (n=20) before and after an intervention program and female high-school soccer players (n=19) not participating in the intervention program.

Measurements

Dependent variables analyzed in all three studies included 3D knee kinematics, 3D knee kinetics, and normalized EMG activity of quadriceps and hamstrings. All data were obtained during a side-step cutting maneuver. (Figure 1)

Results

Results from Study I found that during early deceleration, females experienced greater frontal plane moments (0.43 ± 0.5 vs. 0.006 ± 0.3 N/m kg; $p < 0.01$), smaller sagittal plane moments (2.1 ± 0.84 vs. 1.4 ± 0.77 N/m kg; $p < 0.05$) and

greater quadriceps activation (191 vs. 151% MVIC, $p < 0.02$) than males. Contrary to our original hypothesis, Study II found that novice females demonstrated significantly smaller knee moments in the sagittal, frontal and transverse planes and 58% greater muscle co-contraction than experienced females. In Study III, significant post-season increases in frontal and transverse plane knee force impulses were seen in the control group (17.5% and 19.0% respectively), while no changes were observed in the group participating in the intervention program.

Conclusions

The results of this study provide evidence that female athletes perform a side-step cutting maneuver differently than males and that the biomechanical pattern demonstrated by females is suggestive of increased risk for ACL injury. Furthermore, it appears that the "at risk" patterns in females increases with athletic experience. Participation in an injury intervention program may act to prevent the emergence of potentially injurious movement patterns.

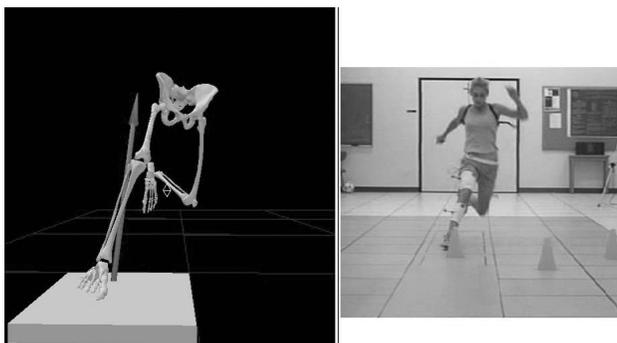
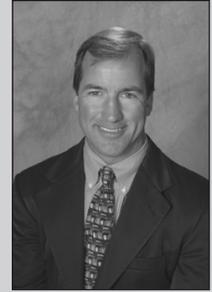


Figure 1:
Motion Capture Model and Data Collection Picture

Principal Investigator:



Christopher Powers, PhD, PT

Publication & Presentation List

NATA Annual Meeting,
Baltimore, MD, June 15-19, 2004

Powers CM, Sigward SM, Ota S, Pelley K. The influence of gender on knee kinematics, kinetics and muscle activation patterns during side-step cutting. *Journal of Athletic Training* 39(2):S14, 2004

Sigward SM, Ota S, Pelley K, Powers CM. The influence of experience on knee kinematics, kinetics and muscle activation patterns in young female athletes. *Journal of Athletic Training* 39(2):S27, 2004

Powers CM, Sigward SM, Ota S, Pelley K. The influence of an ACL injury training program on knee mechanics during a side-step cutting maneuver. *Journal of Athletic Training* 39(2):S27, 2004

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