CORONAL KNEE MOTION IN CHILDREN PERFORMING DROP LANDINGS IS NOT INFLUENCED BY GENDER

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INTRODUCTION

The incidence of knee ligament injuries is reported to be over 4-fold greater in women than in men (Arendt and Randall, 1995; Hewett, 1999). However, researchers to date have not conclusively determined why women are more likely to experience these debilitating injuries compared to men.

Currently, theories explaining the increased knee injury prevalence in women are based on differences in anatomy, hormones and biomechanics/neuromuscular control (Ford, 2003). While there are obvious differences in bony anatomy and hormones between men and women, knee injuries ultimately result from a failure of the supporting knee structures to withstand the applied forces that arise from the kinematics and kinetics of a task.

A majority of knee injuries occur from non-contact events such as landing or pivoting. Differences in knee kinematics have been reported between men and women performing landing activities. Specifically, valgus-directed bilateral knee motion measured in the coronal plane has been reported to be 2.0 and 3.7 cm greater in women compared to men when performing drop jumps from 31 cm and rebounds, respectively (Ford, 2003; Myer, 2002). Modifying landing biomechanics has been reported to decrease the incidence of knee injury 3.6-fold, eliminating gender differences in knee injury incidence (Hewett, 1999).

Pre-pubertal children provide an opportunity to study gender differences in knee joint kinematics independent of hormonal effects. While gender differences in sagittal-plane knee kinematics have been reported in adults performing drop jumps from three different heights, no gender differences were reported in sagittal-plane knee kinematics in pre-pubertal children performing drop landings from 61 cm (Huston, 2001; Owings, 2002). However, no studies have examined gender differences in coronal knee motion in pre-pubertal children.

Our aim was to determine whether gender differences in coronal knee motion during drop landings exist in pre-pubertal children. We hypothesized that pre-pubertal boys and girls would have similar coronal knee kinematics.

METHODS

Sixteen pre-pubertal children (8 girls, age = 8.2 ± 1.1 yrs, mass = 34.7 ± 8.4 kg; 8 boys, age = 8.4 ± 0.8 yrs, mass = 30.5 ± 3.1 kg; mean ± SD), untrained in drop landings, were instructed to step off of a 61 cm high platform and to land with one foot on each of two 40 x 60 cm force platforms (Bertec, Columbus, OH) mounted 5 mm apart. Ground reaction forces (GRF) were sampled at 1080 Hz. A six-camera motion capture system (Vicon Motion Systems, Lake

Forest, CA) sampling at 120 Hz and synchronized with the force platforms, recorded the position of two reflective markers placed on the lateral aspect of the left and right knee joint centers of each child, respectively.

The coronal (varus/valgus) motion of the knee during landing was quantified by the change in the coronal-plane inter-knee distance between two time points (TP): TP1) 3 frames (0.025s) before ground contact as determined from GRF data, and TP2) maximum inter-knee distance in cases of initial varus motion after ground contact or minimum inter-knee distance in cases of initial valgus knee motion. Coronal knee motion was calculated by subtracting the distance at TP2 from that at TP1. Therefore, varus motion is negative and valgus motion is positive. The mean of 10 trials was treated as the datum for each subject.

A two-tailed t-test assuming equal variance was used to determine whether gender differences in coronal knee motion were equal to 0. Statistical significance was set at $p < 0.01$ due to the small subject sample size.

RESULTS AND DISCUSSION

Coronal knee motion during landing did not differ between boys and girls ($p = 0.17$). Knee motion in boys and girls was 2.0 ± 3.3 cm and -1.0 ± 5.0 cm respectively. Mean knee motion of each girl ranged from -9.1 to 6.5 cm. Mean knee motion of each boy ranged from -2.9 to 7.3 cm. The lack of difference in coronal knee motion supports an earlier claim that gender differences in knee kinematics upon landing develop with age (Owings, 2002). However, it does appear as though there may be more variance in the pre-pubertal population compared to the high-school population. A strength of this study is the inclusion of 10 trials for each subject where previous studies in adults used the mean from only 3 trials. In addition, this study is unique in assessing gender differences in pre-pubertal children. The small subject sample size (n=16) is a limitation to the study.

SUMMARY

Knee kinematics upon landing do not appear to be gender specific in pre-pubertal children, suggesting that the neuromuscular control of the limbs also does not differ. Neuromuscular training has been shown to eliminate gender differences in knee injury incidence in a young high-school population (Hewett, 1999). Therefore, neuromuscular training of girls before and during puberty might potentially prevent the development of any gender differences in mechanics that place women at greater risk of knee injury.

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ACKNOWLEDGEMENTS

Supported by NIH AR 45655-01.