Grant Information Summary:

EMG & Kinematic Analysis of Drop Jumps from an Unknown Height: A Mechanism for Non-Contact Injuries

Practical Implications:

These results provide experimental evidence for the importance of contracting muscles prior to ground during function exercises. When forces at the knee occur earlier than anticipated, preparatory thigh muscle contraction and stiffness were decreased. This reduces dynamic support and exposes ligaments to injury. Furthermore, these results demonstrate gender differences in overall movement patterns that may explain the increased incidence of non-contact ACL injuries in females.

Background

During athletic competition, high velocity movements and joint loads must be anticipated, and then integrated into complex preprogrammed muscle activation strategies. Unanticipated events, such as the premature onset of joint forces, not only affects performance but may disrupt the capacity of muscle to act as a load compensating mechanism, thereby exposing capsuloligamentous structures to failure. Many studies have identified gender differences with respect to lower extremity biomechanical variables that may predispose females to these injuries. However, limited data exists describing the influence of unknown conditions on thigh muscle activity and knee joint kinematics between males and females. Previous research mod-

els have not replicated the neuromechanical events associated with sudden, unexpected loads that may lead to a non-contact injury.

Objective

The purpose of this study was to compare female and male dynamic restraint mechanisms during unanticipated functional joint loading.

Design and Setting

Data were analyzed using multiple 2 (knowledge) x 2 (height) and 2 (gender) x 2 (knowledge) x 2 (height) ANOVA tests with repeated measures. Testing was conducted at the Biokinetics Research Laboratory within the Department of Kinesiology at Temple University.

Subjects

Forty healthy subjects (20 male, 20 female) participated in the study (age: male = 22.25 $\pm$ 2.40 yrs; female = 21.65 $\pm$ 2.06 yrs, height: male = 179.90 $\pm$ 8.83 cm; female = 166.50 $\pm$ 5.56 cm, mass: male = 80.27 $\pm$ 11.40 kg; female = 61.32 $\pm$ 9.11 kg).

Measurements

Subjects performed thirty-six drop jumps from boxes of different heights (35 cm and 50 cm) under conditions that varied vision and knowledge of the drop jump height (6 drop jumps/condition). Surface electromyography (EMG) of the quadriceps and hamstring muscles was measured during these jumps (preparatory and reactive periods). Kinematic data included hip and knee angular displacement, velocity, and acceleration.

Results

Results showed that when subjects landed early (35 cm drop) without knowledge of the drop height, there was significantly (P<.05) less (mean = 19%) preparatory activity in the quadriceps and hamstring muscles. No significant gender differences were observed in preparatory or reactive muscle activity. Kinematic differences showed significantly (P<.05) greater (mean = 21%) hip and knee angular acceleration compared to the other drop conditions in all subjects. Furthermore, females had significantly (P<.05) less hip and knee ROM, smaller maximum flexion angles, and achieved maximum flexion angles in less time when compared to males. Females also landed with the hips significantly (P<.05) more extended.

Conclusions

These data demonstrated that thigh muscle activation patterns and corresponding knee joint kinematic variations are similar to those that occur with traumatic non-contact injuries. Implementation of this model affirmed that females generally employ a stiffer landing strategy, but without a corresponding increase in thigh muscle activity. However, females do not anticipate or react differently when confronted with a sequence of events simulating non-contact injuries. Further use of this test model may help identify aberrations in hip muscle activation strategies or frontal plane kinematics that compromise dynamic restraint and knee joint stability.

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Publication & Presentation List

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

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