Grant Information Summary:

Neuromuscular Response Characteristics in Males and Females Following Knee Perturbations in a Single Leg Weight-Bearing Stance

Practical Implications:

Females activate their quadriceps earlier than males in response to a sudden, lower extremity perturbation in a functional weight-bearing stance.

Background

While gender differences in neuromuscular / biomechanical function are thought to be the most compelling factors to explain the gender bias in injury rates, researchers have failed to conclusively demonstrate the relationship of any one variable to ACL injury risk. Little research to date has evaluated protective neuromuscular responses at the knee joint in a functional environment. However, previous research indicates factors such as muscle pre-activity, weight-bearing status, joint angle, and trunk position can significantly influence the timing and relative contribution of a particular muscle to knee joint stabilization. To evaluate gender differences in neuromuscular response characteristics under more functionally relevant conditions, we developed a research model to impose a rotational perturbation at the knee with the subject in a single leg, weight-bearing stance.

Objective

We examined whether muscle response times and activation patterns in lower extremity muscles differ between males and females in response to a rotational knee perturbation while standing in a single leg weight-bearing stance.

Design and Setting

We designed a lower extremity perturbation device to produce a sudden, forward and either internal (IR) or external (ER) rotation moment of the trunk and femur relative to the weight-bearing tibia. Each subject completed 10 trials of both IR and ER perturbation and the first 5 acceptable trials were averaged and used for data analysis. Two separate repeated measures ANOVAs compared myoelectric response times and muscle recruitment patterns in males and females for both internal and external rotation perturbation.

Subjects

Thirty-two female (19 lacrosse, 13 soccer) and thirty-two male (lacrosse) healthy intercollegiate athletes participated in the study.

Measurements

Surface electromyography recorded long latency reflex response times in the medial and lateral quadriceps, hamstring and calf muscles in response to the perturbation.

Results

Females responded faster than males following an unexpected knee perturbation (ER, $p = .026$; IR, $p = .012$). This difference was primarily due to earlier quadriceps activation, with reaction times being similar in the hamstring and calf muscles. We found no difference in the order in which males and females recruited their muscles (ER, $p = .104$; IR, $p = .464$).

Conclusions

Our findings indicate that while males and females demonstrate similar muscle recruitment patterns to an imposed lower extremity perturbation, females activate their quadriceps earlier than males. Whether this earlier quadriceps activation diminishes the ability of the hamstrings to adequately stabilize the knee joint or subjects the ACL to greater risk of injury is still unknown and requires further study. Furthermore, our results confirm that neuromuscular activation patterns in response to a functional, weight-bearing perturbation are quite different from those previously reported using non/partial weight-bearing or uni-planar perturbations. In order to fully appreciate the neuromuscular contribution to joint stability during functional activities when knee injury is most likely to occur, more studies using similar functional testing environments are needed. ■

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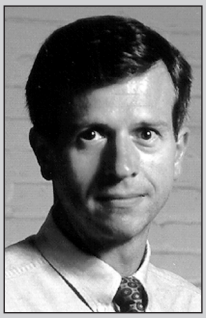

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Shultz S.J., Perrin D.H., Adams J.M., Arnold B.L., Gansneder B.M. & Granata K.P. Neuromuscular Response Characteristics in Males and Females Following Knee Perturbation in a Single Leg Weight Bearing Stance. *Journal of Athletic Training*. (In Press)

Shultz S.J., Perrin D.H., Adams J.M., Arnold B.L., Gansneder B.M. & Granata K.P. Assessment of Neuromuscular Response Characteristics at the Knee Following a Functional Perturbation. *Journal of Electromyography and Kinesiology*. 10 (3): 159-170, 2000

Shultz S.J. & Perrin D.H. Using Surface Electromyography to Assess Gender Differences in Neuromuscular Response Characteristics. *Journal of Athletic Training*. 1999, 34 (2): 165-176

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