



Grant Information Summary:

The Moderating Effect of Tibialis Anterior Fatigue Protocol on the Relationships between Rearfoot Eversion, Thigh Muscle Activation, and Knee Internal Rotation During a Single Leg Forward Jump Stop Task

Practical Significance Statement

During single-leg forward jump-stops, the tibialis anterior muscle may not be a primary determinant for rearfoot eversion and knee internal rotation, and eventual increased anterior cruciate ligament (ACL) strain. Alternative biomechanical adaptations may partially explain the higher ACL injury rates that have been shown to accompany individuals who tend to pronate excessively.

Study Background

Excessive pronation is thought to lead to excessive knee internal rotation (KIR), as it may be associated with excessive rear-foot eversion (EV). This link may possibly place more strain on the ACL, predisposing the ligament to greater injury risk. The musculature surrounding the ankle joint that controls EV may be essential in controlling KIR when the lower extremity is in a closed kinetic chain. Specifically, it is thought that the tibialis anterior muscle (TA) may be most important in controlling EV, especially

during heel-toe landings (e.g. a jump stop task). Therefore, fatiguing the TA muscle may provide greater insight into its potential influences on EV and KIR, and ultimately ACL injury risk, during a dynamic activity.

Objective

The primary purpose of this work was to examine the relationships between EV and KIR when controlling for thigh muscle activation levels. Secondly, this work also sought to investigate the effects of TA fatigue on EV and KIR during single-leg forward jump stops.

Design And Setting

A repeated measures design was used in the study with the single within-subjects factor being time (pre and post). This study took place in the Applied Neuromechanics Research Laboratory at UNC Greensboro.

Subjects

Seventy-two healthy, recreationally active university students (age 23.8 ± 4.0 yrs, height 168.9 ± 14.2 cm, weight 70.9 ± 15.0 kg) participated in this study.

Measurements

All subjects performed single-leg forward jump-stops before and after the TA muscle fatiguing protocol. During the single-leg forward jump stop task, joint kinematic and surface electromyographic data of selected thigh musculature were obtained. TA muscle fatigue was induced via dorsiflexion / inversion submaximal exercise until subjects could no longer complete the task. Pre- and post root-mean-square amplitudes (MVIC%) of the vastus lateralis, biceps femoris, and semitendinosus were obtained 150ms prior to foot contact. Partial correlation coefficients between total KIR excursion (KIR_{exc}) and EV excursion at peak KIR (EV_{KIR_{exc}}) were evaluated while controlling for thigh muscle activation. Additionally, paired t-tests were used to compare KIR_{exc} and total EV excursions (EV_{exc}) before and after TA muscle fatigue.

Results

Partial correlation coefficients between EV_{KIR_{exc}} and KIR_{exc} were not significant either pre- ($r=0.155$, $P=0.203$) or post-TA muscle fatigue ($r=0.220$, $P=0.069$). No differences existed in EV_{exc} ($t_{71}=-.756$, $P=0.452$) or KIR_{exc} ($t_{71}=1.348$, $P=0.182$) following the induction of TA muscle fatigue.

Conclusions

EV was not associated with KIR during single-leg forward jump-stops. Moreover, TA muscle fatigue did not cause a change in EV and KIR. In this heel-to-toe or flat-foot landing, it does not appear that the TA muscle is a primary determinant of EV. Furthermore, theoretical connections between excessive EV, increased KIR, and ACL strain were not supported.

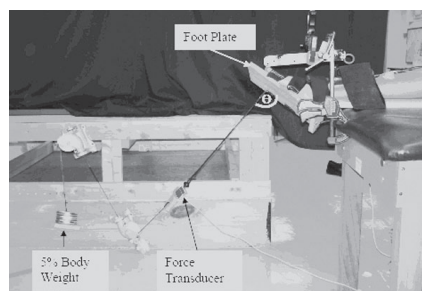


Figure 1. Sagittal Plane View of Pulley System to Fatigue the Tibialis Anterior Muscle

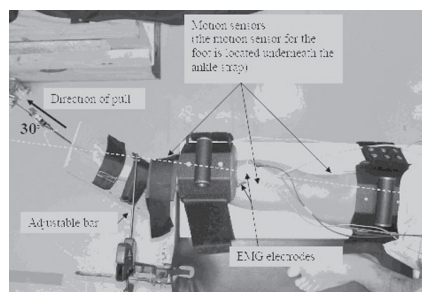


Figure 2. Superior View of Pulley System to Fatigue the Tibialis Anterior Muscle

Principal Investigator:



Yohei Shimokochi,
PhD, ATC

Yohei Shimokochi, BA degree in Physical Education, MA degree in Education (1999) from Nihon University Japan; B.S. degree in Athletic Training from Minnesota State University, Mankato, and PhD in Exercise and Sport Science (Sport Medicine/Athletic Training Concentration) from the University of North Carolina at Greensboro. Currently, Dr. Shimokochi serves as NIH Postdoctoral Research Associate, University of North Carolina at Greensboro. In September, 2007, he will join the faculty of Osaka University of Health and Sport Science as an Assistant Professor in Department of Health and Sport Management - Athletic Training Course.

Publication & Presentation List

Rearfoot Eversion and Tibialis Anterior Muscle Fatigue Are Not Associated with Knee Internal Rotation during a Single-Leg Forward Jump Stop, NATA Annual Meeting and Clinical Symposium. 2007. Anaheim, CA.

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