Grant Information Summary:

A Comparison of Muscle Activation and Knee Joint Stiffness between Female Dancers and Basketball Players during Drop Jumps

Practical Significance Statement

Compared to basketball players, dancers showed non-significant trends towards higher hamstrings and lower quadriceps muscle activity during drop landings. Continued research examining other possible ACL protective movement strategies employed by dancers is necessary.

Study Background

Anterior cruciate ligament (ACL) injuries of the knee do occur during a drop landing movement pattern. Although both dancers and athletes regularly perform landings during their activities, dancers reportedly have lower rates of ACL injury than athletes. During activity, greater knee muscle co-activation can increase knee joint stiffness and can be protective by minimizing extreme joint range of motion. Dancers have been reported to demonstrate diminished H-reflexes (indicating higher muscle co-activation levels) than active controls. Whether dancers, who undergo years of disciplined jump training, use different neuromuscular strategies than traditional athletes that may modify knee joint stiffness and allow for ACL injury protection during activity remains unknown.

Objective

The focus of this work was to compare knee muscle activation, knee joint stiffness (KJS), and ground reaction forces (GRFs) between female dancers (D) and basketball players (B) during double-leg drop jumps (DJ).

Design And Setting

This study utilized a descriptive cohort design and took place in the Applied Neuromechanics Laboratory on the campus at UNC Greensboro.

Subjects

Thirty-five dancers (age 20.7±2.3yrs, height 164.3±6.7cm, mass 62.2±1.9kg), and 20 female basketball players (age 20.1±2.0yrs, height 170.5±6.1cm, mass 72.6±11.4kg) participated in this investigation.

Measurements

All participants performed five DJs from an established height of 45 cm. Surface electromyography was used to measure the muscle onset times (ms) and mean amplitudes (%MVIC) before (*pre=150 ms*) and after (*post=50 ms*) ground contact in the following muscles: lateral gastrocnemius (LG), medial and lateral hamstring (MH, LH) and lateral quadriceps (LQ). A 3D electromagnetic sensor tracking system and forceplatform was used to measure peak GRFs (BW) and sagittal KJS (knee moment change/ flexion angle change from ground contact to maximum knee flexion; Nm/kg°) during landing.

Results

In this study, no group differences existed between onset times (D=133.4±53.2ms, B = 121.6±50.2ms; *P=.22*) and amplitudes (*pre:* D=28.1±8.7%MVIC, B=27.7±10.5%MVIC; *P=.60*; *post:* D=51+17.3%MVIC, B = 49.6 ± 21.4%MVIC; *P=.78*) for all muscles and for KJS (D=.016±.01Nm/kg°, B = .018 ±.01 Nm/kg°; *P=.44*). Dancers exhibited higher GRFs than basketball athletes (D = 4.26 ± .9BW; B = 3.68 ± .6BW; *P=.01*). Moderate effect sizes for the dancers indicated trends towards higher activation levels in the medial hamstrings *pre* and *post* landing, and in the lateral gastrocnemius muscle post landing. However, the dancers also demonstrated lower lateral quadriceps activity observed after ground contact.

Conclusions

Although muscle activation amplitudes and onsets did not differ statistically, the moderate effect sizes observed does suggest a meaningful difference may exist between these groups. While KJS did not differ between the groups, higher GRFs noted in the dancers may potentially indicate neuromechanical differences exist across other joints. Further research is needed to conclusively determine if dancers possess different neuromuscular characteristics during a landing activity compared to traditional athletes.

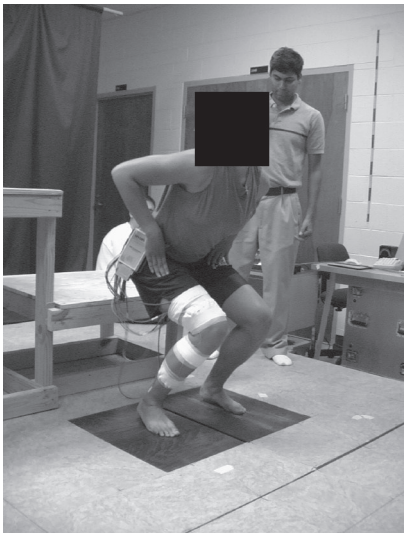

Figure. Performance of the drop jump task from 45 cm box onto forceplate with position sensors and sEMG electrodes attached on a study participant.

Principal Investigator:

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Jatin P. Ambegaonkar recently completed his Doctorate in Exercise and Sport Science from the University of North Carolina at Greensboro in May 2007. Prior to completing his PhD, he earned his M.S. degree in Sport Injury Prevention & Management from Spring College, and his B.S. degree in Occupational Therapy from the University of Mumbai in India. Currently, Dr. Ambegaonkar is an Assistant Professor and Coordinator of Clinical Education at George Mason University. Additionally, he also serves as the Co-Director of the Sports Medicine Assessment, Research and Testing Laboratory.

Publication & Presentation List

Ground Reaction Forces, but not Knee Muscle Activation, or Sagittal Knee Joint Stiffness Differ between Female Dancers and Basketball Players during Drop Jumps, *MAATA Annual Meeting*, Free Communications Presentation, Virginia Beach, VA, May 2007.

Ground Reaction Forces, but not Knee Muscle Activation, or Sagittal Knee Joint Stiffness Differ between Female Dancers and Basketball Players during Drop Jumps, *NATA Annual Meeting*, Free Communications Presentation, Anaheim, CA, June 2007.

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