EXTERNAL HIP ABDUCTOR SUPPORT AUGMENTS SINGLE-LEG LANDING STABILITY

Michael Decker, Casey Myers, Kevin Shelburne, Bradley Davidson
University of Denver, Human Dynamics Laboratory, Denver, CO USA
email: michael.decker@du.edu

INTRODUCTION

Authors studying biomechanical and neuromuscular risk factors for lower extremity injury have suggested that weakness of muscles that abduct the hip, such as the gluteus medius, may promote aberrant movement patterns that predispose an individual to greater injury risk [1]. For example, individuals with diminished hip muscle strength demonstrate decreased postural stability and exhibit increased reliance on the ankle to reposition the body center of mass during athletic activities [2]. These authors demonstrated hip abductor weakness to reduce both static and dynamic postural stability thus it is plausible to suggest that external devices that augment hip abductor function may promote postural stability. The purpose of this paper was to determine the effects of external hip abductor support on postural stability during a single-leg landing.

METHODS

Thirteen healthy participants (8 male, 5 female) performed 3 single-leg landings followed by single-leg static balance onto a force platform from a horizontal distance equal to greater trochanter height while wearing form-fitting shorts with hip abductor support (HS) and shorts without hip abductor support (NHS). The ground reaction forces and moments were measured during landing with a force plate and were used to calculate three center of pressure (COP) variables: COP velocity, maximum COP displacement, and COP area. These variables were measured over 5 epochs based on the anterior-posterior ground reaction force (A-P GRF, **Figure 1**) and contrasted with a repeated measures ANOVA (hip support x epoch) with the peak hip abductor torque, body mass and height as covariates. Hip abductor torque was measured with a hand-held dynamometer placed on the lateral femoral condyle while the subject was standing with the hip abducted approximately 5 deg. The greatest of three-three second maximum hip abduction isometric contractions was used to represent peak hip abductor torque. Peak vertical and medial GRFs, maximum knee flexion and the time to maximum knee flexion were contrasted with paired t-tests.

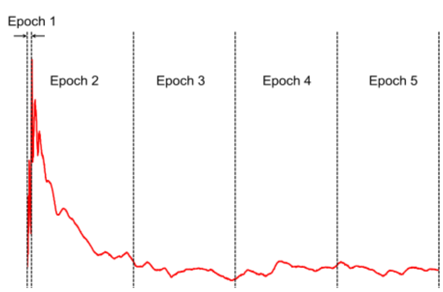

Figure 1: The A-P GRF for a single-leg landing followed by single-leg static balance (beginning at Epoch 3) was used to divide the analysis into 5 epochs starting from initial ground contact. Epochs 2 to 5 were equal in length (≈500 ms).

RESULTS AND DISCUSSION

The peak vertical GRF was on average 6.5% lower during the HS condition (p=.033); whereas a trend was found for lower peak medial GRF (p=.098). Despite these differences, additional analyses revealed approach velocity, maximum knee flexion and the time to maximum knee flexion were identical between hip abductor support conditions (all p>.05) indicating similar landing styles. The COP velocity was not different between hip abductor support conditions (p=.406). Maximum COP displacement values were progressively lower with HS compared to NHS as the task progressed. Maximum COP displacement was on average lower when landing with HS but this difference was dependent upon the epoch (p=.009). The COP area was on average 2.5% lower across all epochs while landing with HS (p=.045; **Figure 2**).

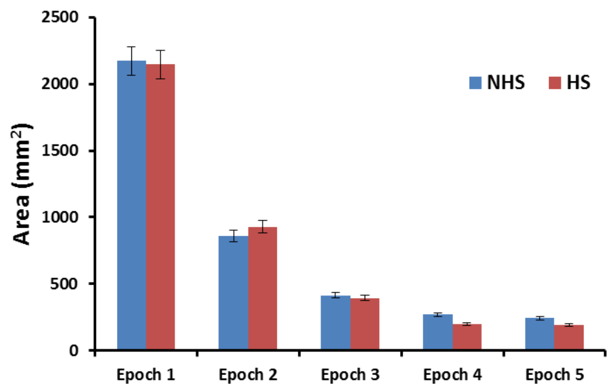

Figure 2: COP Area during a single-leg landing followed by single-leg static balance performed with (HS, red bars) and without (NHS, blue bars) external hip abductor support. Single-leg static balance started at the beginning of Epoch 3 and finished at the end of Epoch 5. COP area was on average lower for the HS condition (p=.045).

CONCLUSIONS

Several COP variables were examined during single-leg landings followed by single-leg static balance with and without external hip abductor muscle support. Landing and balancing with augmented hip abductor support was found to re-direct external forces, without changing the landing style, and improve the control of postural stability. These improvements were emphasized during the epochs where enhanced proprioceptive information may be useful in helping to predict and control the flexion strategy of the kinetic chain near ground contact as well as transitioning from dynamic to static postural stability near the middle of the task (epoch 3).

REFERENCES

1. Willson JD et al. *J Am Acad Orthop Surg* **13**, 316-325, 2005.
2. Lee, S-P, et al. *Gait Posture*, **In press**, 2013.