The effects of trunk and lower extremity strength on optimal landing mechanics during a one-legged drop landing task in Air Force Special Tactics Operators

Rafferty DM*, Simonson AJ*, Wohleber MF*, Heebner NR†, Sell TC†, Abt JA†, Lephart SM†. University of Pittsburgh Warrior Human Performance Research Laboratory, Hurlburt Field, FL*; Neuromuscular Research Laboratory, Warrior Human Performance Research Center, Department of Sports Medicine and Nutrition, University of Pittsburgh, Pittsburgh, PA†

**Context:** Air Force Special Tactics Operators perform missions that require operational tasks such as maneuvering over obstacles, traversing uneven terrain, and dismounting vehicles. Operators often land from such tasks with one leg instead of two and with a tactical load, potentially compounding injury risk. Suboptimal trunk and lower extremity strength measures may lead to improper landing mechanics, particularly with single leg strategies. **Objective:** To determine the relationship between lower-extremity and trunk isokinetic strength and landing mechanics in healthy male Operators. **Design:** Descriptive correlational study. **Setting:** University-operated, Special Operations Forces human performance research laboratory **Participants:** A total of 128 male Air Force Special Tactics Operators (Age=27.7±5.2 years, Height=177.6±5.9cm, Mass=83.8±8.3 kg) participated. All Operators were free of self-reported injury in the previous 3 months and were cleared for full active duty. **Interventions:** Isokinetic strength was measured using an isokinetic dynamometer. A biomechanical analysis of a single leg landing from a 46 cm height was captured using a 3D motion capture system. Analyses were conducted on the right leg only. Correlations between the dependent and independent variables were examined using Spearman’s rho with significance set at p<0.05 a priori. **Main Outcome Measures:** The dependent variables were average peak torque (normalized to body mass) and time to peak torque (TTPT) for knee flexion, knee extension, trunk flexion, and trunk extension. Biomechanical variables were collected at initial contact (IC) and included hip abduction, hip flexion, knee flexion, knee valgus/varus, peak vertical ground reaction force, and time to peak vertical ground reaction force. **Results:** Pairwise comparisons revealed significant correlations between the following variables: hip abduction at IC and trunk flexion average peak torque (r=0.206, p=0.023), hip abduction at IC and knee extension average peak torque (r=0.225, p=0.013), hip flexion at IC and knee extension TTPT (r=0.209, p=0.020), and hip flexion at IC and trunk flexion TTPT (r=0.258, p=0.004). **Conclusions:** The current study revealed few correlations between lower extremity strength and drop landing tasks. Trunk strength was shown to be most related to landing mechanics, yet still a weak relationship between the two. Lower extremity strength did not appear to be related to landing mechanics. These results indicate that landing mechanics are likely influenced by factors other than strength such as flexibility, neuromuscular control, and proprioception. More research is warranted to determine if modifiable musculoskeletal factors that influence movement patterns can be changed to encourage optimal landing biomechanics.

Supported by AFMC/AFRL FA86501226271