

The Relationship Between Dorsiflexion and Single Limb Balance

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Background: Balance is a critical skill that is necessary for complex human movements. A loss of dorsiflexion (DF) at the talocrural joint is associated with a decrease in balance, which can have a profound impact on injury risk.^{1,2} A particularly common injury that is associated with decreased balance and DF is a lateral ankle sprain (LAS), which is the most common injury associated with sports participation.² The prevalence of LAS not only impacts participation but also costs the health care system millions of dollars every year in diagnosis and rehabilitation.³ LAS rehabilitation typically includes interventions that aim to increase both DF and balance. To develop the most effective rehabilitation, the relationship between DF and balance must first be studied on healthy individuals. Two common clinical measures of DF and balance are, respectively, the Weight Bearing Lunge Test (WBLT) and the Single Limb Balance Test (SLBT). As balance and DF are interconnected, this study aimed to determine if, and to what extent, does the WBLT predict performance on the SLBT. An additional aim was to explore if there is an optimal amount of DF that leads to the best performance on the SLBT.

Methods: For the study, twenty-two college-aged students' right limbs were tested using the WBLT and the SLBT. Foot length, width and dorsiflexion were measured after subjects met the inclusion criteria and consented to participate. Exclusion criteria included recent history of injury to the lower extremity, a history of concussions within the past six months, taking of medications that may affect balance, and any conditions, such as vertigo, that may affect balance. The WBLT was performed first. Each subject was instructed to lunge forwards and lightly touch their knee to the wall without picking up the heel of the test foot. Subjects started with their big toe at the four-centimeter mark and moved away from the wall in 1 cm increments. Once a heel lift was detected the subject's heel was moved forwards in half-centimeter increments until a heel lift was no longer detected. This test was repeated two additional times. Upon completion of the WBLT, the SLBT was then performed on the AMTI Accusway plus balance platform. The SLBT requires the subject to stand on one leg with eyes closed for 10 seconds. Each subject was given three practice trials with eyes open, and then performed the test with eyes closed. Subjects were instructed on potential errors and encouraged to avoid committing them. A test was considered an error if the subject moved out of the test position. If an error was committed the test was stopped and the subject had three additional opportunities per trial to complete the test. Subjects received minimal verbal encouragement while testing, but were instructed to establish their balance prior to closing their eyes. WBLT scores were reported in centimeters and measurements of balance were collected via the 95% confidence ellipse of the center of pressure (CoP) during the SLBT (cm²). To examine the relationship between WBLT and SLBT performance, a simple linear regression analysis was utilized.

Results: The initial simple linear regression revealed a very low correlation between WBLT and SLBT ($r=0.14$, $r^2=0.02$). Based on the distribution of data, we

determined that a 2nd-order polynomial fit the data the best ($r=0.44$, $r^2=0.20$). This distribution suggested a U-pattern in the data. Better performance on the SLBT was associated with the midrange on WBLT whereas the extremes of WBLT were associated with poorer performance on the SLBT. While the 2nd order polynomial fit the data most appropriately, there was still not a strong relationship between balance as measured by CoP area and WBLT in health young adults during quiet eyes closed standing.

Conclusions: We uncovered that there is not a linear relationship between weight-bearing dorsiflexion and single limb balance ability. Rather, it seems that those in the midrange of dorsiflexion on the WBLT had better balance performance compared to those on the extreme higher or lower ends. Uncovering the factors that are important to balance in healthy individuals as well as if DF is a critical factor, as assumed through clinical work with LAS patients, in balance for those with ankle injury are important avenues for future work.

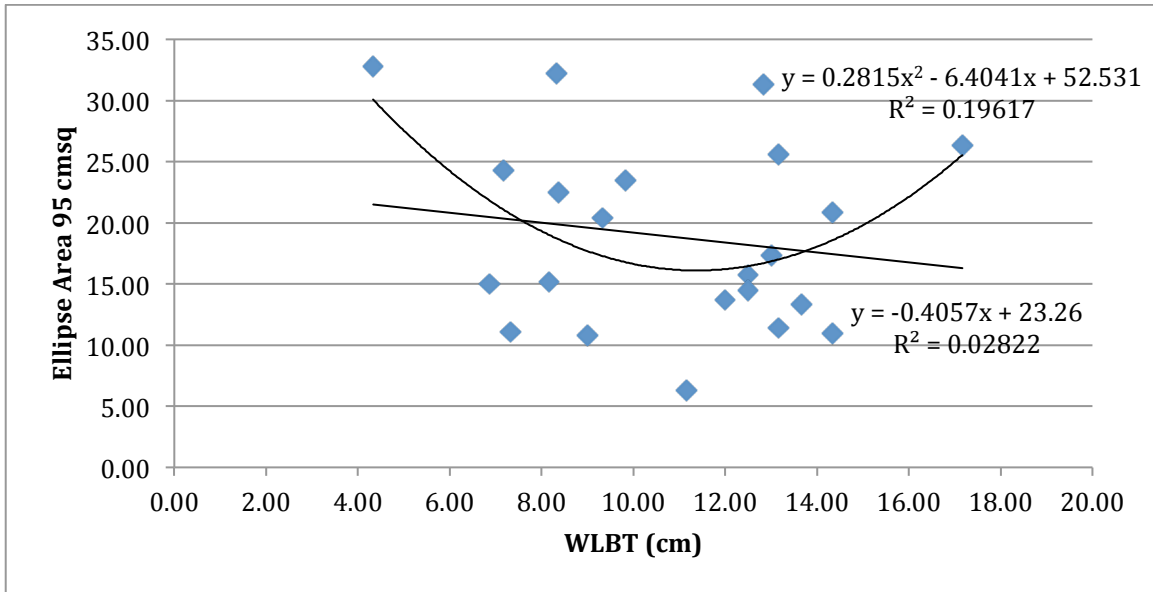


Figure 1. The interaction between WBLT and measures of balance.

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