Center of Pressure Position and Velocity Control During Single Leg Standing on Sloped Surfaces

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ABSTRACT

Postural control during upright standing aims to maintain the center of mass within a base of support and prevent disturbances that may lead to a fall. Typically, the center of pressure (COP) position trajectory is used to index the degree of postural sway during various balance tests. However, recent literature has shown that COP velocity may be a more sensitive measure to detect changes in postural control over various internal and external perturbations. **PURPOSE**: The primary aim of this study was to investigate the influence of sloped surfaces on single leg standing in young, healthy individuals. A secondary aim was to determine whether there was consistency between the results from the COP position and COP velocity when analyzing the medial-lateral (ML) and anterior-posterior (AP) trajectories. **METHODS**: Sixteen participants (11 females, 5 males) performed 30-second, single leg balance tests on flat and sloped surfaces. Participants were instructed to stand as still as possible with arms at their sides and focus on a visual target located at eye level two meters in front of them. A total of 14 randomized tasks were completed with inclined and declined slopes of 10, 15, and 20 degrees. A force plate (AMTI) was used to obtain force and moment data in the x, y, and z directions, which was used to compute the COP position. Then, the COP velocity was calculated as the derivative of COP position. For both COP position and velocity, the following variables were used: AP and ML standard deviations (SDAP; SDML), length, and area. **RESULTS:** An analysis of variance (ANOVA) showed a significant main effect for condition for the COP position measure of length, F (6, 209) = 3.32, p = 0.004. Post-hoc analyses revealed increased COP position length as slope deviated from the flat (0°) condition. A significant main effect for condition was found for the COP velocity measures of SDML, F (6, 209) = 3.18, p = 0.005, and SDAP, F (6, 209) = 2.70, p = 0.015. Post-hoc analyses revealed increased COP velocity SDML and SDAP values as slope deviated from the flat (0°) condition. Additionally, a significant main effect for condition was found for the COP velocity measure length, F (6, 209) = 5.19, p = 0.000. Again, post-hoc analyses revealed increased COP velocity length as slope deviated from the flat (0°) condition. Finally, the results also showed a significant main effect for condition for the COP velocity measure area, F (6, 209) = 3.04, p = 0.007. Post-hoc analyses revealed increased COP velocity area as slope deviated from the flat (0°) condition. In general, a "U" shaped curve was found in post-hoc analyses, which demonstrated that as slope increased in both the inclined and declined directions, the amount of sway increased, as measured by both COP position and COP velocity. However, there was a larger increase in declined conditions than inclined conditions. **CONCLUSION:** In this study, specific control strategies were observed across sloped conditions. However, the findings suggest that there is no difference between legs in the stabilization control of upright posture. Additionally, the present results showed COP velocity parameters were more sensitive to differences between conditions than COP position parameters. This further corroborates the use of COP velocity as a more useful tool than COP position in identifying postural control system differences during various inclined and declined sloped conditions.