

POSTURAL STABILITY IN YOUNG AND ELDERLY ADULTS: A COMPARISON BASED ON LIMITS OF STABILITY DURING STATIC AND DYNAMIC TASKS

Evangelos Christou, Brian Moss, Angela Boule, Pat Yoon, Joshua Evans, Karl Rosengren.
Department of Kinesiology, University of Illinois at Urbana-Champaign
Email: christou@uiuc.edu Web: www.kines.uiuc.edu

INTRODUCTION

Balance is defined as the ability to maintain the center of body mass (COM) within the limits of stability primarily determined by the base of support (BOS). Differences in postural sway and movement strategies between young and elderly adults have been shown using various visual and postural conditions (Woollacott & Shumway-Cook, 1996). Most studies, however, ignore the limits of stability, which are an integral part of balance. Several ways exist to estimate base of support in posture; in this experiment we used the geometric outline (Figure 1) of the base created by the performers feet during a normal upright relaxed stance (Slobounov et al., 1997).

The aim of this study was to compare movement of center of pressure (COP) in anterior-posterior (AP), medial-lateral (ML), total area of movement created by COP (TAM) and the ratio of TAM to the base of support (TAM:BOS), in young and elderly adults, under different visual and postural constraints

PROCEDURES

Twenty healthy young adults (23" 5 years) and twenty healthy elderly individuals (65" 6 years) volunteered for this study. Postural stability was assessed using a force platform and each participant's predicted BOS (Figure 1). During each condition, participants stood barefooted within their predicted BOS, on the force platform, under different visual and postural constraints.

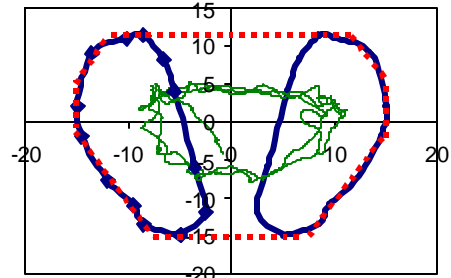


Figure 1. This graph illustrates the participant's feet and predicted BOS for dual and single leg stance, along with COP movement during the LS task.

The following conditions were used: 1) Quiet standing with eyes open (EO) and eyes closed (EC) for 30 s, 2) Single foot stance with both dominant and non-dominant feet (10 s each foot) and 3) A dynamic limits of stability (LS) test involving rotating around the base of support as far as possible without moving one's feet (for 20 s). Each condition was performed twice and each trial lasted either the indicated time length unless or until the participant lost his or her balance or changed postures. Performance on the force platform was measured by the range and standard deviation (SD) of movement of the COP in AP and ML direction, TAM and TAM:BOS.

RESULTS AND DISCUSSION

The predicted area for BOS was not significantly different between the two age groups ($p > 0.05$). During the single foot stance task, both TAM and TAM:BOS, were significantly different for the two age groups ($p < 0.01$). Furthermore, significant age x foot interactions were found for both TAM and TAM:BOS ($p < 0.01$).

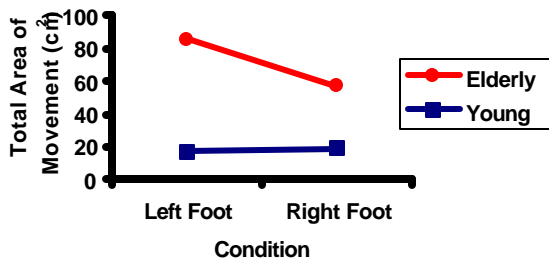


Figure 2. This graph illustrates the age x foot interaction found for TAM. Similar interaction was found for TAM:BOS.

Postural sway, during the single foot stance task, in AP direction revealed significant differences in SD and range of postural sway ($p < 0.05$). Furthermore, there was an age x foot interaction ($p < 0.01$). Postural sway in ML direction during the single foot stance also revealed differences in SD and range of postural sway ($p < 0.05$). However, there was no significant age x foot interaction ($p > 0.05$). During the dynamic limits of stability task, both for TAM and TAM:BOS, differences between the two age groups approached significance ($p = 0.076$). Both TAM and TAM:BOS were higher in young participants. Range of movement of the COP in the AP direction, however, was significantly higher in young participants ($p < 0.05$).

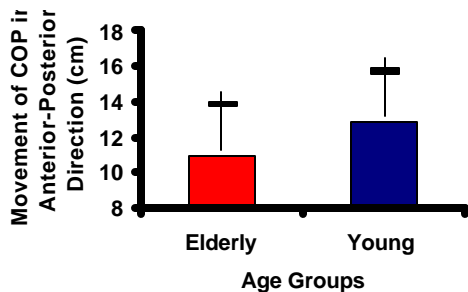


Figure 3. This graph illustrates that young participants produced greater movement of COP in AP direction compared to elderly participants during the LS task.

During the quiet standing task, both TAM and TAM:BOS, were significantly different for the two visual conditions ($p < 0.01$). Movement of the COP was greater during the EC condition. There

were no age related differences ($p > 0.05$). Postural sway in AP direction during the quiet stance revealed differences in SD and range of postural sway ($p < 0.05$) between visual conditions. Age related differences were found, furthermore, only for the SD, which had a significant age x visual condition interaction ($p < 0.01$). There were no significant differences for postural sway in ML direction ($p > 0.05$).

SUMMARY

Elderly, during the single foot stance, exhibited greater postural sway in AP direction, especially with the non-dominant foot. When the goal was to produce postural sway as close to the limits of BOS (LS task), however, elderly had significantly smaller postural sway in AP direction. Similar BOS was found for young and elderly participants in this study. During quiet standing, the two groups had similar performance. Performance with EC produced significantly greater postural sway compared with EO. The overall results of this study, suggest that elderly might be less stable in AP direction. This might be due to weakness of the leg and back muscles, primarily controlling balance strategies during AP movement.

REFERENCES

- Slobounov et al., 1997. *Journal of Motor Behavior*, 29, 3, 263-281.
- Woollacott & Shumway-Cook, 1996. *Journal of Aging and Physical Activity*, 4, 214-233.