THE EFFECT OF OCCUPATIONAL FOOTWEAR ON DYNAMIC BALANCE

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INTRODUCTION
Upright maintenance of balance, which requires the individual to keep the center of gravity within the base of support, is a fundamental part of daily activity under both static and dynamic conditions. Proper balance is crucial in occupational and industrial settings in order to prevent falls and fall related injuries. The Bureau of Labor Statistics reported 208,470 cases of work related falls in 2010 of which 646 were fatal [1]. The increased probability of falls has been related to a decreased balance performance and previous studies have shown decrements in balance as a result of different footwear [2]. Occupational footwear is often designed for safety and may fail to provide appropriate foot biomechanics which may impact balance characteristics. The purpose of the study is to examine the differences in dynamic balance in an acute period while wearing different types of commonly used occupational footwear.

METHODS AND PROCEDURES
Twenty five healthy male adults (aged 21.2±1.4 years; height of 179±9.4 cm; mass of 82.6±15.4 kg), with no history of orthopedic, musculoskeletal, cardiovascular, neurological and vestibular abnormalities participated in this study. The motor control test (MCT) on the Neurocom Eqitest was used to assess dynamic balance which uses the translational capabilities of the dual force platform to create two testing conditions with forward [medium (FWM)/ large (FWL)] and backward [medium (BWM)/ large (BWL)] translations. The testing procedure included an initial familiarization session where each participant was exposed to the MCT balance assessment and a second experimental testing session which was separated by at least 24 hours. The experimental testing session consisted of an initial barefoot (BF) balance measurement followed by randomized balance testing with three other occupational footwear conditions; work boot (WB) (mass 0.39±0.06 kg), tactical boot (TB) (mass 0.53±0.08 kg) and low top shoe (LT) (mass 0.89±0.05 kg) separated by a 10 minute rest/washout period. The subjects were seated during the 10 minute rest period to prevent any undue fatigue and any possible adaptation to the balance tests. Latencies, quantified as the time period (msec) between the onset of the translation and the initiation of the participant’s active response were used as the balance dependent variable.

RESULTS
The latencies from the MCT were evaluated using a 1 x 4 [Testing Session x Footwear Condition (BF v. LT v. TB v. WB)] RMANOVA and independently for the backward and forward medium and large translations at an alpha level of 0.1 to identify any existing differences among the footwear conditions. Significant differences were found between the footwear conditions and post hoc pairwise comparisons revealed that BF condition had significantly lower latencies in the backward large (p=0.01) and forward medium (p=0.09) and large
(p=0.04) translations compared to LT, TB and WB. No significant differences were found among the occupational footwear for any of the translations.

Fig 1: MCT Backward Translations

Fig 2: MCT Forward Translations

**DISCUSSION**

The MCT assesses the automatic motor control postural responses which are the first line of defense against unexpected external perturbations, that might lead to a fall [3]. The results indicate a significant difference in the MCT latencies between the barefoot and the three occupational footwear. These differences can be attributed to the increased somatosensory and proprioceptive feedback that are available in a barefoot condition unlike the shod conditions where the footwear acts as an interface between the ground and the foot, lowering the available somatosensory cues. A recent study showed significantly lower postural sway in the tactical and work boots compared to low top shoes in the eyes open and eyes closed sensory organization test, which was attributed to the above ankle elevated boot shaft that provided stability around the ankle [4]. However, in this study no significant differences were found between the three occupational footwear which suggested that, although the elevated boot shafts of the tactical and work boots significantly reduced the center of pressure (COP) excursions, thereby decreasing the postural sway during quiet stance in the SOT, they did not influence the feedback control of postural adjustments to unexpected perturbations experienced during the MCT.

**CONCLUSION:**

The MCT latencies for the occupational footwear conditions although significantly higher than the barefoot conditions, were still under normal ranges for healthy adults. The findings from this study can be used as a series of recommendations for occupational footwear design. The midsole hardness of these footwear were not taken into consideration for this analysis. Future reasearch on the thickness-hardness of the midsole and its effects on the somatosensory system in maintaining dynamic balance is warranted. Additionally, dynamic balance assessment under occupational fatigue conditions may further help understand the efficiency of these occupational footwear.

**REFERENCES**

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