Neural Mechanisms of Balance and Gait Adaptations Following Downslope Walking

Nikki Aitcheson-Huehn, Jayne Kalmar (PhD), and Michael E. Cinelli (PhD)
Department of Kinesiology & Physical Education, Wilfrid Laurier University, Waterloo, ON Canada

INTRODUCTION

• DSW could improve physical functioning in MS through exercise-based neuro-plastic changes without invoking excessive fatigue
• DSW mechanically changes gait, which leads to neural adaptations and general balance and gait improvements (currently assessed with indirect measures)

METHODOLOGY

Participants:
• 30 young adults (6 males, 23±1.4y) randomized to (a) DSW or (b) level walking group

Behavioral Measures:
• 10 walking trials with 30s quiet standing on force plate (alternated eyes open and closed)
• Kinetics and kinematics collected at 100Hz
• Margin of Stability (MOS) calculated during quiet standing and on each step (AP and ML)

SOXG G-Reflex, measured with surface EMG:
• Repeated Tibial nerve stimulation to construct recruitment curve
• Slope of H reflex normalized to slope of M wave (H_{slope}/M_{slope})
• Curves fitted to 3-parameter sigmoid function and slopes calculated at 50% between upper and lower limits

H or M(s) = H or M_{max} / (1 + e^{s-s_{50}}) = H or M_{max} 

RESULTS

MOS_{AP} During Quiet Standing
• No main effect of group (p = 0.16, f = 0.28)
• No interaction effect of group x vision (p = 0.30, f = 0.20)

MOS_{AP} Over Steps 1-3
• Strong main effect of group (p = 0.005, f = 0.58)
• Medium interaction effect of group x step (p = 0.059, f = 0.33)
• Strong interaction effect of group x vision (p = 0.02, f = 0.48)

DISCUSSION & CONCLUSIONS

• DSW improved dynamic balance control (evident by MOS_{AP}) with the most changes evident on step 3, but did not influence static balance control (Fig. 2)
• DSW led to greater standing H reflex depression than level walking (Fig. 4, 5), similar to previous literature looking at seated H reflex following DSW
• Effects of DSW carry over to objective and direct behavioural measures of balance ad gait, not just indirect tests such as the 25ftWT test and TUG test
• Need to be in locomotion to see the benefits of DSW in young adult population, which may have implications for usage of DSW in the clinic with MS patients
• Next step: analyze changes in gait initiation profiles (COP in loading & unloading)

IMPLICATIONS

Provides baseline understanding of DSW on objective balance control measures before replicating study in Multiple Sclerosis (MS) patients

REFERENCES

Nikki Aitcheson-Huehn
MKin Student
aitc8260@mylaurier.ca