How carbon composite and plastic ankle foot orthoses influence balance in individuals with multiple sclerosis

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Research Objective: As part of a larger study looking into multiple clinical and experimental tests on balance, gait, and fatigue, this poster focuses on how standing and dynamic balance are affected by the use of an ankle-foot orthosis (AFO) for individuals with Multiple Sclerosis.

Hypothesis: It is expected that while wearing an AFO, individuals will sway less during standing, or static, balancing; and similarly, will have a restricted range of motion.

Study Background

- Multiple sclerosis (MS) is a neurological autoimmune disease, where the myelin sheaths coating nerves are broken down.
- The damage to the myelin and nerve fiber causes disruption of transmission between the brain and the desired action of the body.
- Various gait problems arise from the disruption such as ankle instability, muscle weakness, numbness, and tingling.
- Ankle-foot orthoses (AFOs) can be a possible solution to address these gait impairments, however there can be potential downfalls in using them such as restricted range of motion.
- AFOs are traditionally used for foot-drop, which is not a common symptom of MS. However, we believe they could be useful for helping ease the symptoms of muscle weakness, ankle instability, and numbness.

Introduction to AFOs

- The traditional polypropylene posterior leaf spring AFO (Figure 1) provides rigid support while being cost efficient.
- The carbon-fiber anterior shell AFOs (Figure 2) are lightweight, thinner, and designed to store dynamic energy.

Figure 1: Traditional Plastic AFO

Figure 2: Carbon Fiber AFO

Methodology

Balance Testing Procedure:

- Using the Bertec Balance Plate (shown in Figure 3), two tests were conducted:
  - Quiet Standing Posturography
    - Participants stand as still as possible for 30 seconds under 4 different conditions (eyes open, eyes closed, with a foam pad, and without foam)
  - Limits of Stability
    - Participants sway forward, backward, right and left going as far as possible without falling while only bending at the ankles.

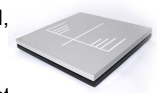

Figure 3: Bertec Balance Plate

Results and Discussion

Balance Results (shown in Figures 4 and 5):

- Quiet Standing Posturography - Inconclusive
  - Trend of balance under different conditions follows that of healthy individuals (least sway on flat plate with eyes open, and most sway on foam with eyes closed)
  - We hypothesize that tactile feedback from the AFOs will aid in decreasing the amount of sway, however the limited results do not show a clear picture of this.
  - M/L sway seemed to be more improved over the A/P sway. This is surprising because the AFOs worn are on either the anterior or posterior sides of the leg.

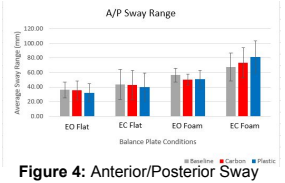

Figure 4: Anterior/Posterior Sway

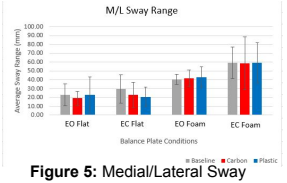

Figure 5: Medial/Lateral Sway

- Limits of Stability - Representative Data Set for all 6 participants (shown in Figures 5 and 6)
  - Left graphs show the baseline visit for Subject 1, and the right graphs show the carbon visit.
  - Data shows that the AFOs do not restrict the range of motion. This is not what we hypothesized, however it is a positive effect of wearing AFOs.

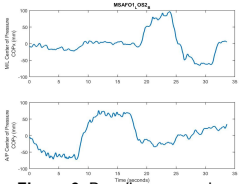

Figure 6: Baseline comparison

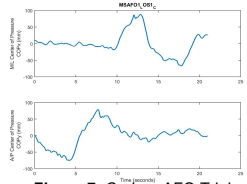

Figure 7: Carbon AFO Trial

Future Work

- Complete Data collection for all 20 participants.
- Take a comprehensive look into custom AFOs
- Expand study to populations outside of MS