The Effects of Walking Speed on Gait Propulsion When Wearing an Ankle-Foot Orthosis

Allison N. Kalina1, Sara A. Myers1

1Department of Biomechanics, University of Nebraska Omaha, Omaha, NE 68182

INTRODUCTION

- Peripheral artery disease (PAD) is a cardiovascular disease that results from blockage of one or more arteries in the lower extremity1.
- Often, patients with PAD have reduced ability to push off with the foot at the end of the gait cycle2.
- When walking, the ankle contributes the majority of the power to propel the body into the next step3.
- Deficiencies at the ankle are common in older populations, especially those with pathologies in which gait is affected, such as PAD.
- An ankle-foot orthosis (AFO) is a device that aids in ankle propulsion by increasing the energy return, thus decreasing the ankle deficit in pathological individuals.
- An AFO has the potential to immediately increase the distance patients can walk, enabling them to be more physically active.
- Purpose: To investigate the effect of walking speed on ankle propulsion during walking in healthy young subjects.

METHODS

<table>
<thead>
<tr>
<th>n</th>
<th>Age (yrs)</th>
<th>Mass (kg)</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>5</td>
<td>23.4 ± 3.91</td>
<td>73.76 ± 3.23</td>
</tr>
</tbody>
</table>

Table 1. Subject Demographics

Reflective marker position data was collected using a 12-camera motion analysis system (Motion Analysis Corp., Santa Rosa, CA).

Subjects completed 20 overground trials, that contained five conditions, each with four trials.

The five walking conditions included subjects walking at a self-selected speed, then walking at speeds that were 10% more, 10% less, 20% more, and 20% less than the self-selected speed.

Variables calculated were moment and power of the ankle, and average angle of plantarflexion and dorsiflexion of the ankle during each trial.

Differences between conditions were detected using a one way ANOVA and a Tukey post-hoc test with a significance level of 0.05.

RESULTS

- After running the ANOVA, there were two significant effects between conditions in the power group.
- Significant effects were between self-selected speed and 20% more (p<0.0161), and between 20% more and 20% less (p<0.0106).

<table>
<thead>
<tr>
<th>SS</th>
<th>+10%</th>
<th>-10%</th>
<th>+20%</th>
<th>-20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.271 ± 0.16</td>
<td>1.4 ± 0.17</td>
<td>1.136 ± 0.15</td>
<td>1.528 ± 0.19</td>
<td>1.03 ± 0.13</td>
</tr>
</tbody>
</table>

Table 2. Average walking speeds in meters per second.

Figure 3. Measures show the mean and standard deviation of ankle moment for each condition, where SS is self-selected speed.

Figure 4. Measures show the mean and standard deviation of ankle power for each condition, where SS is self-selected speed.

DISCUSSION

- The significance values show that power increases as speed increases, which is expected. However, looking at Fig. 3 and Fig. 4, both moment and power increase when the speed is increased. These patterns would be more apparent with a larger sample size.
- These results will serve as a baseline for further inquiry on the affects of AFO’s.
- Future work will consist of collecting more baseline data on the healthy young subjects and also while wearing the AFO to compare ankle moment and power.

REFERENCES


ACKNOWLEDGEMENTS

Funding by UNO FUSE, NIH (R01AG034995, P20GM109090, R01HD090333) and the VA RR&D (1I01RX000604)