Targeted Lower Extremity Joint Training Effects on MS Gait Abnormalities

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Background

- Multiple Sclerosis (MS) is a chronic disease of the central nervous system (CNS) characterized by inflammation, demyelination, and the resulting neuronal damage. [1] One common motor deficit in the MS population is dorsiflexion weakness, a condition commonly referred to as “drop-foot.” [2] A previous study has shown that maximal voluntary dorsiflexion contraction was 27% lower in MS patients than in controls. [3]
- Drop-foot can lead to an inability to clear the foot during swing phase of gait, which results in an abnormal pattern of gait characterized by gait instability and compensatory movements such as hip circumduction and hip flexion/tilting. These compensatory movements result in additional injury and gait impairment, which can cause further loss of mobility. [2]
- Part-task training is a method of rehabilitation in which a locomotor task is broken up into naturally occurring segments, and each individual segment is taught in isolation before practicing the entire locomotor task. This method of training can be an effective way to retrain gait because the gait cycle can be divided into units that reflect the inherent goals of the task. [4, 5] Part-task training can be applied to the rehabilitation of drop-foot, where dorsiflexion can be trained in isolation before training the entire gait cycle.

Objectives

The primary objectives of this study were to:

1. Collect pilot data on the effectiveness of focused ankle part-task training using the Anklebot on subjects with Multiple Sclerosis (MS) who have drop-foot.
2. Compare the effectiveness of task-specific focused ankle training using the Anklebot with conventional focused ankle physical therapy.

This study was designed to test the hypothesis that part-task focused ankle training for “drop-foot” using the Anklebot will improve ankle control and range of motion resulting in improved gait and walking performance.

Methods

Inclusion Criteria:

- Diagnosis of MS by McDonald criteria [6]
- Self-reported ambulation problems
- EDSS score at or below 3.5-6
- 50-60 years old
- Currently not participating in physical therapy

Outcome Measures:

- Self-reported frequency of falls (% change from baseline)
- 5-minute walk (6MWT)

Study Design:

Results

- Anklebot Training:
  The Ankle-Bot (Interactive Motion Technologies, Inc.) is a robotic device that attaches to a knee brace and shoe worn by the patient. The patient then uses movements of their foot to play computer games displayed on a computer screen. In each Ankle-Bot training session each participant completed movements of dorsiflexion and inversion/eversion. If the participant could not achieve full range of motion, the robot would provide assistance to complete full range of motion.

Conventional Focused Ankle Physical Therapy:

The protocol for the conventional focused ankle physical therapy sessions was created by a panel of physical therapists at Mount Sinai Rehabilitation Hospital who determined appropriate exercises for the protocol and established standards of progression. These sessions included strength, coordination, balance, and range of motion exercises.

Results Summary:

- There was an improvement in the Anklebot target completion assessment, which may have been a testing effect rather than a training effect, given that all 3 groups improved.
- Range of motion: (1) Plantar flexion both passive and active ROM appeared to improve during treatment for the Anklebot group more than the other groups. (2) Dorsiflexion; there was no difference in active range of motion in the three groups, but there was slight improvement for both the Anklebot and conventional focused ankle physical therapy groups.
- There was an increase in the T25FW for the Anklebot group compared to the other groups.
- None of the 3 groups improved in the 6MWT.
- Change in falls slightly improved for the Anklebot group and conventional focused ankle physical therapy group, while the comparison group worsened by the final follow-up time point.

Conclusions

1. Overall, Anklebot training modestly improved ankle range of motion, particularly for plantar flexion. However, these improvements at the ankle did not translate to improvement in gait propulsion or endurance as measured by the T25FW and 6MWT, respectively.
2. Individual variability in repeated measurements of our outcomes and the small sample size may have contributed to our inability to detect differences between the groups.
3. Based on anecdotal patient comments, some patients perceived improvement in gait function. We suspect that there may be differences in patient responses to therapy.
4. Future studies might focus on identifying characteristics associated with responsiveness to Anklebot training.

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