Home-based Robot-assisted Ankle Rehabilitation for Chronic Stroke Survivors

James Lynskey, PT, Ph.D.
Brian Toogood, PT, DPT
Grace Abruzzo, PT, DPT

Background

- Stroke is the leading cause of disability in the US.
- Foot drop, a major sequella associated with stroke, contributes to locomotor impairments.
- Robot-assisted ankle rehabilitation is one approach that has recently been shown to improve lower extremity function and locomotion in stroke survivors (Mirelman et al 2008, Forrester et al 2011, Forrester et al 2013, Waldman et al 2013).
- Robotic training, however, is typically confined to large clinics or research laboratories. This limits patients access, and limits widespread adoption of the technology.

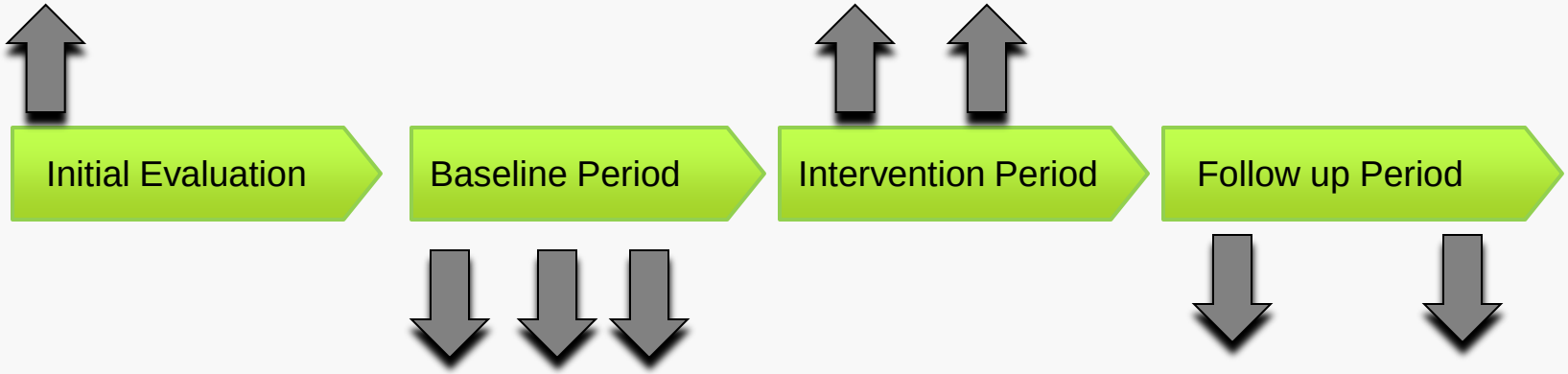
Purpose

- To investigate the effects of home-based robot-assisted ankle rehabilitation on strength, locomotion and quality of life in chronic stroke survivors.

Methods

- **Intervention:**
- **3x/week for 12 weeks**
- **Testing:**
- **Weeks 4 and 8**
  - Dynamometry
  - GAITRite™
  - 6 MWT
  - SIS

- **Screen and Consent**



- **Baseline Testing:**
- **Weeks -2, -1, 0**
  - Dynamometry
  - GAITRite™
  - 6 MWT
  - SIS

- **Follow up Testing**
- **Weeks 12 and 16**
  - Dynamometry
  - GAITRite™
  - 6 MWT
  - SIS

Methods

- Intervention:
  - robot-assisted ankle rehabilitation using the Foot Mentor™ for 60 minutes a day, 3 times a week, for 12 weeks in the home

- Spasticity Reduction
- Strong Man Up and Down
- Balloon
- Either Therapong/Hockey or Breakout
- Spasticity Reduction
- Tilt Table
- Either Therapong/Hockey or Breakout
- Spasticity Reduction

Participants

- 10 Participants enrolled in the study
- 7 Completed the study
  - 2 participants withdrew due to non-study related health issues
  - 1 participant removed from the study due to non adherence.

	Age	Side Effected	Gender	Time Since Injury (Months)	Total # of sessions	Total Minutes
Subject 1	57	Left	Male	47	34	2040
Subject 3	48	Left	Male	188	26	1569
Subject 4	52	Left	Male	46	35	2290
Subject 5	71	Left	Female	8	31	1597
Subject 6	70	Right	Male	67	30	1482
Subject 7	60	Right	Male	35	35	2556
Subject 8	64	Left	Male	77	37	2595

Data Analysis

- Kolmogorov-Smirnov test performed on all data
- A One-Way Repeated Measure ANOVA with Dunnett's post hoc was performed on walking speed and walking distance
- Friedman's ANOVA with Dunn's post hoc was performed on Dorsiflexion force and the Stroke Impact Scale

Results

- Dorsiflexion Strength

	Baseline (avg. ± SEM)	4 Weeks	8 Weeks	12 Weeks	16 Weeks
MVIC (ft*lbs)	23.8±5.4	25.4±5.6	25.4±5.3	**29.7±5.9***	28.6±6.6

- Significant improvements observed at week 12.
- The average improvement was 28.6% from baseline.

Results

- Walking Speed and Distance

	Baseline (avg. +/- SEM)	4 Weeks	8 Weeks	12 Weeks	16 Weeks
Self Selected (m/s)	0.97±.03	**1.08±.06***	**1.11±.07***	**1.14±.06***	**1.11±.06***
Fast Paced (m/s)	1.32±.15	1.37±.15	1.36±.13	1.41±.17	1.34±.20
6MWT (m)	308.43±16	**335.13±19***	330.85±19	**338.24±20***	330.83±22

- Significant improvements observed in self selected walking speed and distance

Results

- Quality of Life

	Baseline (avg. +/- SEM)	4 Weeks	8 Weeks	12 Weeks	16 Weeks
SIS Physical Domain	56.68±5.8	58.59±6.4	59.31±5.6	**62.88±5.2***	**62.30±4.3***

- Significant improvements observed at weeks 12 and 16

Results

- No significant changes were observed in the spatiotemporal parameters of gait

Discussion

- Home-based robot-assisted ankle rehabilitation is safe and feasible.
- Taken together, the results of this study indicate that the participants demonstrated significant improvements in dorsiflexion strength, gait velocity, distance walked during the 6 Minute Walk Test, and perceived quality of life.
- These results support previously reported research that investigated laboratory based ankle rehabilitation devices

Acknowledgments

- Jim Koeneman, Ed Koeneman and the staff at Kinetic Muscles Inc.
- Andrew Jarzabek, PT, DPT
- Zack Hall, PT, DPT
- Ryan Madden, PT, DPT
- David Gordon, PT, DPT
- Seth Peterson, PT, DPT
- Nick Schlichtman, PT, DPT

Questions