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BACKGROUND

In the United States, 600,000 to 730,000 people a year experience a cerebrovascular accident (CVA) (Atchison & Dirette, 2007). A CVA results in impaired motor functions that include flaccidity and spasticity. Spasticity often presents itself in synergistic patterns usually causing shoulder adduction and internal rotation, elbow flexion, wrist flexion, finger and thumb flexion and adduction. Rosenstein, Ridgel, Thota, Samame, and Alberts (2008) state patients with hemiparesis following a stroke typically present with decreased muscle strength, decreased coordination, and increased flexor tone. Grip and bilateral function are significantly impaired.

The OT Practice Framework of the American Occupational Therapy Association (2008) lists motor control, sensory input, mental functions, and emotional regulation as client factors that affect functional performance. Such underlying factors influence the daily task requirements for activities of daily living and instrumental activities of daily living. Beyond basic activities of daily living, various areas of occupation can also be impacted based on the individual's lifestyle and priorities (Frisoli et al., 2012).

HAND MENTOR™

The Hand Mentor™ is a robotic medical device that provides neurological rehabilitation to patients with stroke or other brain injury who may have hyper-tonicity, spasticity and/or limited AROM. The device has a small air pump and several video games designed to engage the user in self-powered, repetitive motion of the wrist and fingers.

PURPOSE

The purpose of this case study is to evaluate the effectiveness of a robot-assisted therapy home program using the Hand Mentor™ without other direct therapeutic interventions to increase functional use of involved upper extremity (UE) in adults with chronic CVA.

RESEARCH QUESTIONS & HYPOTHESES:

Research Question 1: To what extent does a home program using the Hand Mentor™ improve UE movement in adults with chronic CVA?

H₁: The use of robot-assisted repetitive training home program with the Hand Mentor™ will increase the functional movement of the involved upper extremity in adults with chronic CVA.

H₀: The use of robot-assisted repetitive training home program with the Hand Mentor™ will not increase the functional movement of the involved upper extremity in adults with chronic CVA.

Research Question 2: To what extent does use of a home program with the Hand Mentor™ improve performance of daily activities that involve the use of the UE in adults with chronic CVA?

H₂: The use of robot-assisted repetitive training home program with the Hand Mentor™ will improve performance of daily activities that involve the use of upper extremity in adults with chronic CVA.

H₀: The use of robot-assisted repetitive training home program with the Hand Mentor™ will not improve performance of daily activities that involve the use of upper extremity in adults with chronic CVA.

STUDY DESIGN

The study design was an ABA case study. Participant was evaluated at baseline, re-evaluated after using the home program for 4 weeks, and reevaluated after an additional 4 week use of the Hand Mentor™ to assess changes in function.

PARTICIPANT:

Inclusion Criteria:

- English-speaking adults at least 6 months post stroke not receiving OT or PT during the study
- Cognitive and visual abilities for following video game concepts
- Able to initiate trace to minimal movement in wrist and digits

Exclusion Criteria:

- Interfering visual or cognitive issues
- Skin breakdown or fixed joint contractures on involved wrist or hand
- Anticipated medication changes

Participant Demographics:

- 29-year old Caucasian female
- 3.5 years post right-side brain hemorrhage
- Spasticity and functional movement impairment of left upper extremity
- Previously received OT and PT services; but none received during study



Photo adapted from Kinetic Muscles Incorporated

ASSESSMENT TOOLS

- COPM- client-centered tool used to set goals and measure changes over time in participant's perception of occupational performance
- SIS- evaluates participant's perception of how the stroke has impacted 8 areas of their life: Strength, Hand Function, ADL/IADL, Mobility, Communication, Emotion, Memory & Thinking, and Participation/Role Function
- ARAT- standardized test of grasp, grip, pinch, and gross arm movement
- Video Analysis- participant was filmed performing ARAT and functional tasks at home and analyzed for changes in motor abilities
- Motor Activity Log- participant utilized a written log to track changes in motor and functional skills

STUDY PROCEDURES

- Pre-assessment of motor skills and function using the SIS, COPM, ARAT, pinch gauge, dynamometer, and video-taping
- Individualized home program developed
- Participant trained in donning and usage of the Hand Mentor™ device and home program
- Home program completed for 4 weeks; participant contacted weekly to discuss Motor Activity Log
- After 4 weeks, re-evaluation of function using the SIS, ARAT, pinch gauge, and dynamometer
- Additional 4 weeks of home program and weekly phone contact using Motor Activity Log completed
- After 8 weeks, re-evaluation of motor skills and function was completed using the SIS, ARAT, COPM, dynamometer and video-taping

HOME PROGRAM

- Minimum of 1 hour/day at least 5 days/week
- Participant used Hand Mentor™ for eight weeks
- Hand Mentor™ automatically adjusted difficulty levels of games according to participant's performance

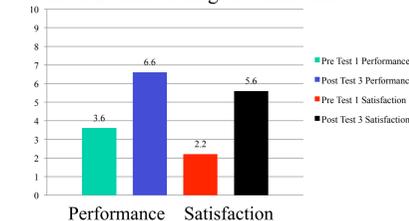
RESULTS

After use of the Hand Mentor™ home program, the participant:

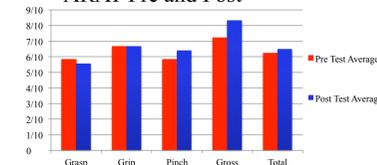
- Increased average scores of satisfaction and performance of goals on the COPM
- Increased overall ratings on the SIS
- Increased overall scores on the ARAT
- Reported incorporating left UE more often into functional tasks such as cooking, opening containers, and dressing
- Improved sensory awareness and a decrease in non-use of left UE



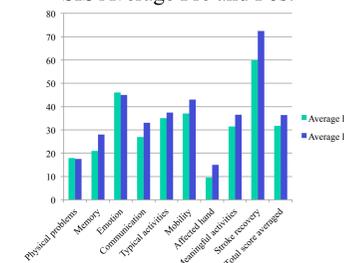
COPM Overall Average Pre and Post



ARAT Pre and Post



SIS Average Pre and Post



Averages across all goals for both performance and satisfaction, from pre-test 1 to post-test 3, identified a 3-point increase in performance and a 3.4-point increase in satisfaction showing an overall increase in both areas. Changes in scores of 2.0+ indicate clinically significant improvement on the COPM (Carswell et al., 2004).

Participant demonstrated increased scores on gross movement and pinch subscales after use of the Hand Mentor™ home program resulting in a small increase in overall scores on the ARAT. No change on the grip subscale; minor decrease in scores on the grasp subscale.

Participant increased ratings in the following categories: typical activities, home and community mobility, the ability to use affected hand, participation in meaningful activities, and overall stroke recovery.

CONCLUSIONS

For this participant, use of the Hand Mentor™ in the home was shown to be effective. Hand Mentor™ home program facilitated increased use of left UE in bilateral tasks and during daily activities.

CLINICAL APPLICATIONS

- Use of Hand Mentor™ facilitates concepts of Motor Control Theory such as motor pattern frequency, repetition, gradation, and motivation
- Use of Hand Mentor™ encourages UE engagement through virtual gaming
- Provides repetitive wrist flexion and extension, improving initiation of distal movement patterns
- Use of the tool in the home allows for personal scheduling
- Use of Hand Mentor™ Home program would allow clinicians to focus on more complex tasks during intervention sessions

LIMITATIONS

- Use of one participant limits ability to generalize results
- 3+ years since participant's stroke- may have made greater gains earlier on in recovery
- ARAT is not a sensitive tool for measuring functional changes, thus limiting changes in scores as compared to the beneficial changes seen in the video-taped results

RECOMMENDATIONS FOR FUTURE RESEARCH

- Evaluate with larger sample size and variety of demographics (age, time post-stroke, gender)
- Determine recommended dosage of time for home program to achieve optimal results

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