PORTABLE MYOELECTRIC BRACE USE IN CHRONIC, POST STROKE HEMIPARESIS

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INTRODUCTION

Stroke frequently causes debilitating upper extremity (UE) motor impairments that are retained well beyond rehabilitation discharge. Several UE motor rehabilitative approaches have been developed, with most adhering to the P.R.A.C.T.I.C.E. principles. Yet, many promising UE rehabilitative strategies are only efficacious in individuals already exhibiting high levels of active, paretic UE movement; only a small portion of the growing stroke survivor population.

Reduced UE impairment and increased function were reported among survivors with moderate UE impairment participating in repetitive task-specific practice (RTP) that integrated a portable, electromyography (EMG) triggered, brace ("Myomo"). We wished to compare the efficacy of this regimen with the use of RTP only (the standard of care in most outpatient environments) while concurrently characterizing the motor behavior of stroke survivors exhibiting moderate UE impairment.

METHODS

Subjects: Twelve subjects gave written consent to participate (4 males; age=53.5±5.35 years; mean time post-stroke=61.7 months; 11 Caucasians, 1 African-American; 6 left-sided strokes; 10 ischemic strokes; 1 basal ganglia stroke; 3 strokes in the left-middle cerebral artery; 1 in the frontal lobe; 2 in the parietal lobe; 5 in unspecified locations). They were randomized into two groups: 7 subjects were administered RTP+Myomo, and 5 RTP-only.

Apparatus: The Myomo e100 (Fig. 1) is an FDA approved, lightweight (~2lbs), myoelectric brace that uses surface EMG signals from the biceps and triceps brachii from active paretic UE movement attempts to assist the active muscle with movement of the paretic UE. A treating therapist can adjust the system parameters to alter the amount of mechanical assistance provided.

Intervention: Both groups (RTP+Myomo and RTP-only) participated in individualized, 45-minute therapy sessions occurring 3 days/week over an 8-week period. As described previously, the intervention’s design and therapy session content involved progressive difficulty in tasks. In all cases, the latter tasks were selected collaboratively with the patient, caregiver, and therapist. With or without the Myomo, chosen tasks were functional/goal directed, integrating the paretic UE into whole-arm tasks that were salient to the subject. Therapy included both bilateral and unilateral UE tasks, and included components of muscle control, coordination, strength, endurance, and proprioception.

Behavioral data: We administered the Stroke Impact Scale (SIS); a 64-item self-report measure. For this study, we focused on changes in the paretic UE (SIS arm and hand scales), ability to perform activities of daily living, and recovery scales.

Kinematic data: An 11-camera motion capture system (Motion Analysis Corporation Raptor-12 system, Santa Rosa, CA, USA) tracked 3D-motion of subjects’ paretic and less affected UEs during the experimental tasks. Twenty-six reflective markers were placed on the upper body (Fig. 2). Each subject performed 5 repetitions of two reaching
tasks with the paretic and non-paretic UE. For the ‘reach-out’ task, a cylinder-shaped object was placed in front of the subject on the table, aligned with the subject’s sternum at 2/3 of paretic UE length. For the ‘reach-up’ task, the same object was elevated by 24 cm. Subjects were instructed to reach for the object as if they were reaching for a glass of water, without specific instructions on movement speed. Joint angles were calculated based on a standard UE model and conventions for the shoulder joint. Main outcome measures were shoulder flexion (range), elbow extension (range) and hand velocity (peak). Statistics: Mann Whitney U tests compared all behavioral and kinematic changes between intervention groups.

RESULTS AND DISCUSSION

Subjects administered RTP+Myomo tended to exhibit larger improvements on all scales than subjects administered RTP-only. This difference between groups reached significance for SIS recovery (U=4, p=0.032, point probability=0.015), and came close to significance for SIS ADL (U=6, p=0.061, point probability=0.001).

None of the subjects were able to grasp and lift the object with their paretic limb. Therefore, kinematic analyses focused on the reaching part of the movement, which ended when the hand touched the object. When subjects were unable to touch the object, we analyzed the full attempt. Most patients demonstrated improved capability to move the object after completing the intervention. The change in hand velocity from pre-test to post-test in the ‘reach-up’ task was significantly larger in the RTP-only group compared to the RTP+Myomo group (U=3, p=0.018, point probability=0.04). None of the other changes in kinematic variables from pre-test to post-test were significantly different between groups (all p>0.53).

A trend towards a significant correlation was observed between the change in the SIS arm subscale and the change in range of elbow extension during the reach up task. However, Spearman’s correlation coefficient was negative (rho= -0.57, p=0.054), which indicates that subjects with larger elbow range of motion while reaching up tended to report lower arm function SIS scores. None of the changes in other kinematic variables significantly correlated with any of the changes in SIS subscales (all p≥0.12)

CONCLUSIONS

RTP integrating myoelectric bracing might be more beneficial than RTP only in improving subjects’ perceptions of their overall recovery. This approach does not convey superior benefits to RTP only in terms of UE kinematics, and no significant correlations were observed between changes in self-reported outcomes and reaching kinematics. Our findings suggest that clinicians may be able to reduce the debilitating impact of moderate UE impairment using RTP+Myomo.

REFERENCES