Coupled bimanual arm training for individuals with severe hemiparesis

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INTRODUCTION

Few options exist for training arm movements in subjects with hemiparesis when they have little active range of motion. An inability to move often leads to non-use, stalled recovery and progressive upper limb deformity. Immediately after stroke, the patient presents with predominant weakness or paresis, lack of muscle tone, and little voluntary movement. Then voluntary movements begin to return in stereotypical flexor and extensor synergy patterns. In individuals with severe hemiparesis, recovery is often stalled in the flexor synergy pattern.

Coupled bimanual training can prime the ipsilesional motor cortex for subsequent training with the paretic arm, and has been shown to lead to greater gains in arm function compared with practice with the paretic arm alone. An advantage of this approach is that it can be used in individuals with substantial paresis.

The purpose of this study was to test the safety and feasibility of training individuals with severe chronic hemiparesis with a non-powered device, the Bimanual Arm Trainer, to modify the flexor synergy pattern and facilitate progression of recovery.

METHODS

Nine patients with severe chronic post-stroke hemiparesis, preserved passive range of motion in shoulder, elbow and wrist joints and minimal spasticity, received training with the Bimanual Arm Trainer for 45 minutes twice a week for 6 weeks. All subjects tolerated the training and no adverse events were reported. Motor impairment on the upper extremity Fugl-Meyer Scale and active range of motion measured using motion analysis (The Motion Monitor, Innovative Sports Training, Inc.) were assessed pre- and post-training on the affected and unaffected sides. Electromyographic recordings from the following muscles were made simultaneously with active range of motion recordings using surface electrodes (Delysys, MA) on the affected side only: APB, FDI, ADQ, EDS, FUS, FCR, EDC, ECU, EBI, TRI, DA, DM, UT. Data was processed using Spike 2 (CED, UK).

RESULTS

Arm motor impairment reduced post training: reduced flexor synergy

Reduction in arm motor impairment correlated with increased active forearm pronation

CONCLUSIONS

- Post-stroke synergy patterns can be modified even in individuals in the chronic stage, long after stroke.
- Active range of motion in the affected arm can be increased in multiple joints with short-term bimanual arm training involving shoulder movements, with improvements occurring in both trained proximal and untrained distal movements.
- The reduction in co-activation patterns suggests underlying mechanisms of motor recovery in the chronic stage.
- The results demonstrate the feasibility and promise of using coupled bimanual arm training to facilitate motor recovery in individuals with severe chronic hemiparesis.

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BIBLIOGRAPHY


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