This study was to investigate the effects of bilateral coordination training on cortical reorganization and upper limb motor function recovery of chronic stroke patients. Experiment 1 (title: bilateral and unilateral movement training on upper limb function and cortical excitability in chronic stroke patients) compared the neurophysiological and behavioral changes associated with two such rehabilitation protocols: unilateral and bilateral movement training. Ten chronic stroke patients were randomly assigned to the two training protocols involving two daily practice sessions a week through 12 week time period.

For this experiment, motion analysis system (Optotrack 3020), transcranial magnetic stimulation (TMS), EMG, Ag/AgCl surface electrode, rehabilitation training equipment, and hand function upper limb test kit were used. Training task involved repetitive practice of three tasks selected from: wooden dowel placement, peg targeting, and simulated drinking. During the unilateral training session, performed with the affected upper limb only and at the bilateral training sessions the practice trials were performed with both upper limbs simultaneously.

In the experiment 2 (title: the effects of bilateral coordination movement on temporal coordination of the arms: symmetric & asymmetric movement), neurophysiological and behavioral assessments of the affected upper limb were completed one day prior to initiation of the rehabilitation training. Using TMS, contralateral cortical responses to stimulation were recorded in the FDI muscle of the affected hand while the 8-coil was held over affected hemisphere. The behavioral ability of the affected limb of 4 patients was assessed using reaching kinematic assessment. This assessments were completed one day prior to initiation of the training protocol. Over the next six week period, the subject completed a series of unilateral followed by symmetric and asymmetric bilateral training sessions involving upper limb motion trainer and wooden block. To control for timing effects, a multiple baseline design was implemented in determining when each patient switched from unilateral to symmetric and asymmetric bilateral training. Each subject was assigned to begin symmetric and asymmetric bilateral training between 4 and 8 session. Experiment 3 (title: change in motor cortical excitability induced by interlimb 'Bi-directional' paired-associative stimulation) investigated the effect a dual-stimulation paradigm involving TMS over M1 paired with motor-point stimulation of the contralateral FDI muscle Motor-point stimulation consisted of trains of either two pulses at 3Hz or 20 pulses at 30Hz, every 10 seconds for 30 minutes (total of 180 stimuli). Single pulse TMS was delivered 25ms after the onset of each pulse train. It was found that 3Hz trains reduced M1 excitability, while 30Hz trains increased M1 excitability. This finding is of interest for bilateral paradigms given the observation of Werhahn et al. (2002) that reduced excitability in one effect of high frequency, dual-stimulation can be augmented if low frequency stimulation is simultaneously applied to the contralateral homologous muscles. To date a total of 18 younger adults and 10 older adults have completed the study (1 older adult has one session to go). Subjects participated in two sessions of dual-stimulation separated by a minimum of 7 days. The order of sessions was counterbalanced across subjects. In unilateral session, dual-stimulation performed with high frequency (30Hz) trains applied to the right FDI and TMS applied over the left M1. In the bilateral session, the identical protocol performed with the addition of simultaneous low frequency (3Hz) stimulus trains applied to the left FDI. Stimulus trains delivered every 10 seconds and TMS applied 25ms after the onset of the first stimulus of the train. M1 excitability and motor function assessments carried out prior to and following the intervention.

The conclusions of experiment 1, 2 and 3 were as follows.

In experiment 1, bilateral training group showed a reduction in movement time and increased in peak velocity and upper limb functional ability of affected limb compared to unilateral training group. In motor cortical excitability within affected hemisphere, an increased in recruitment curves (130% and 150% intensity rMT) following bilateral training.

In experiment 2, there was no consistent differences on the JTT upper limb function, and TMS test between asymmetric and symmetric training patients. However results from the peak velocity and movement time test revealed that symmetric training was more efficient than asymmetric
training.

In experiment 3, the current results are somewhat mixed. Older and younger adults showed a tendency toward a significant increased rMEP amplitude following unilateral and bilateral PAS. However both group showed a no significant in ICI and ICF following unilateral and bilateral PAS.

One possible explanation for this is that participants were not actively attending to the stimulation. Although participants were instructed to monitor the stimuli we did not include any control protocols to ensure this was the case. Before concluding that the procedure is ineffectual we will need to examine whether an attentional manipulation induces any effects.

* Note: The text above is the abstract of the thesis.
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