The Acute Effect of Modified Constraint-Induced Movement Therapy on Improving Upper Extremity Motor Performance

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Abstract

Purpose: Motor performance is a sufficient indicator that Constraint-Induced Movement Therapy (CIMT) improves the neuromuscular system in stroke, hemiplegia, and cerebral palsy patients. Research is limited in the time needed to improve motor performance and in individuals with fully functioning extremities. The purpose of this study was to examine if an acute, modified version of CIMT would increase the efficiency of participants’ motor program in their non-dominant arms.

Methods: There were 20 participants (8 men, 12 women; mean age 29.9 ± 1.2) recruited for this study. After recruitment, subjects were brought into the laboratory and given the Edinburgh Handedness Inventory to ensure they were not ambidextrous. For one hour a day, two days per week, over a two week period, the participants were enrolled in a modified CIMT session. A sling and swab wrapping technique was used with a sling and a six inch ace bandage to restrain their dominant hand. Each therapy session consisted of seven daily life activities: doing a puzzle, making a sandwich, pouring water, bouncing a ball, practicing handwriting, buttoning and folding sweaters, and weight lifting. Each participant was given specific instructions for each of the activities. Six of the activities were completed in a specific set time and one activity included a fixed number of sets and repetitions (Figure 2). Intervention was counterbalanced by randomizing the order of activities for each participant for each therapy session. Changes in motor performance were evaluated using the kinematic variable of reaction time. In this study, reaction time was measured on the Multi-Operational Apparatus for Reaction Time board (MOPART) through a choice reaction time test. The choice reaction time test uses a light as a stimulus over one of the keys; the subject then had to reach by pressing the corresponding key as quickly as possible. Subjects were familiarized with the choice reaction test on the MOPART board to decrease any learning effect. Participants did 10 trials on the MOPART board before the first therapy session, directly after the final therapy session as well as 24 hours after completing their last therapy session.

Results:
A repeated measures ANOVA was conducted to find statistical difference between all choice reaction time tests (F=1383.152, P<0.01). Specifically, participants improved their motor program in their non-dominant extremity between the pre-test and post-test directly after therapy (P=0.006). Furthermore, the motor program was maintained as data shows significant difference between the pre-test and post-test after 24 hours (P=0.029). The same Post Hoc ANOVA revealed no significance between the post-intervention test directly after therapy and the post-intervention test 24 hours later (P=1.00) (Figure 1).

Conclusion:
This study demonstrates experimental data observing the changes that occurred in motor performance, based on reaction time in individuals following the two week modified CIMT program. The data revealed that there was overall significance between choice reaction times (F=1383.152, P<0.01). Specifically, participants improved their motor program in their non-dominant extremity between the pre-test and post-test directly after therapy (P=0.006). Furthermore, the motor program was maintained as data shows significant difference between the pre-test and post-test after 24 hours (P=0.029). Additionally, data demonstrated the motor programs were maintained since there was no significant difference between the two post-intervention tests (P>1.00). Repetition within the CIMT protocol enables individuals to effectively pre-plan motor programs and have more efficient neuromuscular rate coding. This study demonstrated an improved motor performance through sustained neuromuscular rate coding 24 hours later. Evidence of this motor performance was seen in subjects’ shorter reaction times. These results are consistent with other modified CIMT studies. However, this protocol was acute in relation to modified CIMT which includes two hours of therapy per day for 15 days consecutively. These results suggest that future CIMT studies may not need to be conducted for modified CIMT program’s time duration. Past research has also demonstrated that 65% of patients were not likely to wear the restraining device for the appropriate amount of time during CIMT. It may be more beneficial to a CIMT program to conduct therapy for a shorter duration. As a result, individuals are less likely to remove the restraining device as often due to the inconvenience and discomfort. It is still unclear however if this acute modified CIMT is effective in a population of individuals with non-functioning extremities, such as hemiplegia, cerebral palsy, or stroke. This study also only included a 24 hour follow-up and did not observe any long term effects. Future research is needed on sustainability of a motor program with the use of an acute modified CIMT program.

References


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