

Effect of Time Constrained Induced Therapy on Function, Coordination and Movements of Upper Limb on Hemiplegic adults

Masoud Gharib, MSc;

University of Social Welfare and Rehabilitation Sciences, Neurorehabilitation Research Center, Tehran, Iran.

Hooman Ghorbani, MSc; Mehdi Abdolvahab, MSc; Nader Fallahian*, MSc; Masoud Kasechi
University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

Introduction: Stroke, is one of the major causes of disability in adults. So, the patient may prefer to use the non-involved limb to perform selfcare & named this phenomenon learned non-use. Constraint induced therapy is one of the rehabilitative interventions that can be effective in restoration of the function of the involved limb in some hemiparetic post stroke patients. Purpose of this study was to investigate effect of time constrained induced therapy on function, coordination and movements of upper limb on hemiplegic adults.

Method and Materials: In an interventional design, 15 hemiplegic patients attended in structure exercises for 2 hours a day, 5 days a week for 12 weeks in during while for 5 hours a day, 5 days a week for 12 weeks, the sound limb was restricted within an arm sling for movement & dexterity assessment were used Fugl-Meyer & Minnesota Manual Dexterity Test.

Results: the results of Fugl-Meyer & Minnesota Manual Dexterity Test were significantly improved in patients, after the intervention ($p < 0.05$).

Discussion: our study shows that using CIT in involved limb encouraged the patients to use their involved limb and improved function by conquering learned non-use of the limb. More research is necessary to define baselines or golden times for rehabilitation of the patients using CIT method.

Key words: Stroke, constraint Induced Therapy, Function, Dexterity

Submitted: 1 May 2011

Accepted: 22 Aug 2011

Introduction

Stroke, is one of the major causes of disability in adults and in most of the times is accompanied by considerable motor functional loss(1). It results in hemiplegia, and functional impairment in performing activities of the daily living(ADL). Many researcher are interested in finding more effective treatment modalities(2).

Recovering motor function and integration of recovered motor skills to improve functional independence level in ADL is one of the most important responsibilities of the occupational therapists. Because of the importance of the upper limb for performing the activities of daily living, improving the function is one of the most important aspects of retraining motor control, and has an important role in rehabilitation programs(3, 4).

Variety of methods have been used in rehabilitation of the stroke patients, such as biofeedback, neuromuscular stimulation, and motor learning. These methods may be effective in early functional restoration of the upper limb to perform ADL. When the function of one side is superior to the contralateral limb, the patient may prefer to use the sound limb to perform selfcare. As the time passes after the stroke, patients use their non-involved limb to perform ADL(5). Taub described this phenomenon as "learned non-use" of the upper limb. In other words, as the patient finds the limb useless, learns to "non-use" it(6).

Constraint induced therapy is one of the rehabilitative interventions that can be effective in restoration of the function of the involved limb in some hemiparetic post stroke patients(6, 7). "Constrained Induced Therapy"(CIT) and "forced

* All correspondence to: Nader Fallahian; Email: <N. Fallahian@uswr.ac.ir>

use” of the involved limb are new therapeutic interventions. In these approaches the non-involved limb is restricted to encourage utilization of the involved limb via performance of functional activities(8). Great amount evidence exists about the application of these methods in order to motor loss of the involved limb and improving the functional independence in stroke.

Also both Induced therapy and forced use of the limb include limiting the non-involved limb and performing exercises by the involved limb, These modalities are different from each other in types of exercises and time of the restriction. in forced use, the non-involved limb will be restricted and the patient has to perform all actions with the involved limb. in this method the exercises are not structured and the severity of exercises depends on the patient conditions. but constrained induced therapy is a structured exercise that includes shaping and repetitive tasks (7).

CIT was first introduced on behavioral cognitive basic science researches on monkeys. the results showed when the limb has no function, the animal would not use the limb for the activities of daily living. as non-use of the limb that gradually results in persistent non-use of the weaker limb(6).

In 2002, Page et al used CIT on 14 patients with stroke in 10 week interval, for 3 days a week; and found an improvement in results of the Fugl-Meyer test(9). In 2003, similar study was performed by Bonifer et al (10) on 7 patients with stroke after at least 1 year after the stroke. The patients had at least 10 degrees of wrist extension in involved limb and CIT was used for 3 weeks. The patients were asked to perform particular exercises, that caused more use of involved limb both in clinic and in home, for 3 weeks, 5 days a week for 6 hours a day. Fugl-Meyer test was also used to assess the movements before and after the intervention. the results significantly improved after the intervention.

In 2004, another research was carried out with Page et al(9) on 17 stroke patient, after 1 year of involvement. an intervention group of 7 patients were encouraged to use their involved limb to perform ADL. 4 patients received common treatments as the intervention group and 6 patients had no treatments. activities including writing, using utensils, brushing teeth and combing own hair, while their non-involved limb was constrained by splint for 10 weeks, 5 days a week for 5 hours a day. the scores of Fugl-Meyer test was significantly improved in

intervention group compared to custom treatment and no treatment groups($p < 0.05$).

In 2005, Bonifer used CIT on 20 patients, 1 year post-stroke(11). All subjects had 20 degrees of wrist extension. the patients were asked to use a mit on non-involved hand and perform CIT exercises for 6 hours a day in 3 weeks. The patients were assessed using the Fugl-Meyer test. The scores improved significantly after the intervention.

In 2006, Wolf et al used CIT in post stroke patients, 3 to 9 months post stroke(12). the goal of this study was to evaluate the effectiveness of CIT on functional movements of the upper extremity in two week intervals for a period of twelve weeks. the movements of the non-involved hand of 22 patients was restricted with a mit. using the shaping technique, each patient was encouraged to use the involved limb. at the end, the results within this group was superior than the control group in functional movement tests.

Tarka et al used CIT in 27 patients with stroke. the non-involved limb of each patient was restricted within an arm sling for 2 weeks, 7 hours a day. the patients completed CIT exercises for grasp-release and manipulation of small objects. This study showed that the functional movements of the involved limb improved significantly after the intervention(13). purpose of this study was to investigate effect of constrained induced therapy on function, coordination and movements of upper limb on hemiplegic adults.

Materials and Methods

In an interventional design, 15 hemiplegic patients (9 males and 6 females)&(9 right,6 left) were randomly selected from the patients referred to occupational therapy clinic of rehabilitation faculty of Tehran university. The average age of the patient was 60.8 years, with Standard Deviation(SD) of 10.8 years. Written consent was acquired from the patients before the intervention. Demographic characteristics of the subjects are summarized in table 1.

Inclusion criteria were:

- at least 1 year passed from the stroke
- no symptoms of frozen shoulder persist at the onset of the intervention
- the ability to sit on the edge of the table for 10 minutes, to ensure required stability of the trunk
- the ability to obey the verbal and functional commands
- at least 20 degrees of wrist extension preserved in involved limb

Exclusion Criteria were:

- unwillingness of the patient to continue the therapeutic sessions
- occurrence of orthopedic disease
- recurrence of stroke or other neurologic conditions

All patients completed specified routine occupational therapy exercises 45 minutes a day, 3 times a week meanwhile non-involved limb was constrained within an orthopedic sling (9) for 5 hours a day, 5 days a week for 12 weeks.

Occupational therapy stays on the principle that using purposful activities can facilitate rehabilitation, so in this study we used aimed activities to develop the required motivation for more use of the involved limb. In order to have the subjects perform a unique form of exercises, an educational video demonstration was recorded and the patients were asked to perform their exercises based on the media. these exercises include grasp and release of a tennis ball, opening and closing of the door, and utilizing a glass for drinking. Each

exercises was included of 10 minutes of practice and 10 minutes of rest. 2 sets of exercise, total of two hours were performed with the involved limb while the sound limb was restricted within an arm sling.

Fugl-Meyer Test was used to assess velocity and coordination in movements of shoulder, elbow, wrist and hand joints. Minnesota Manual Dexterity Test was also used to assess dexterity of the upper limb. Both tests were used before and after the intervention in two week intervals. Paired t-test was used to compare the score before and after the intervention. SPSS (version 11. 5) was used for data analysis.

Results

There are demographic characteristics of the patients in table (1). The results of Fugl-Meyer test are summarized in Fig (1). As it is demonstrated, the scores of the test were significantly improved in patients, after the intervention ($p < 0. 5$).

Table 1: Demographic characteristics of the subjects

variable	Average	Standard Deviation
Age (years)	60.8	10.8
Weight (kilograms)	67.87	5.05
Height (centimeters)	171.53	5.06
Time passed from stroke (years)	2.5	1.2

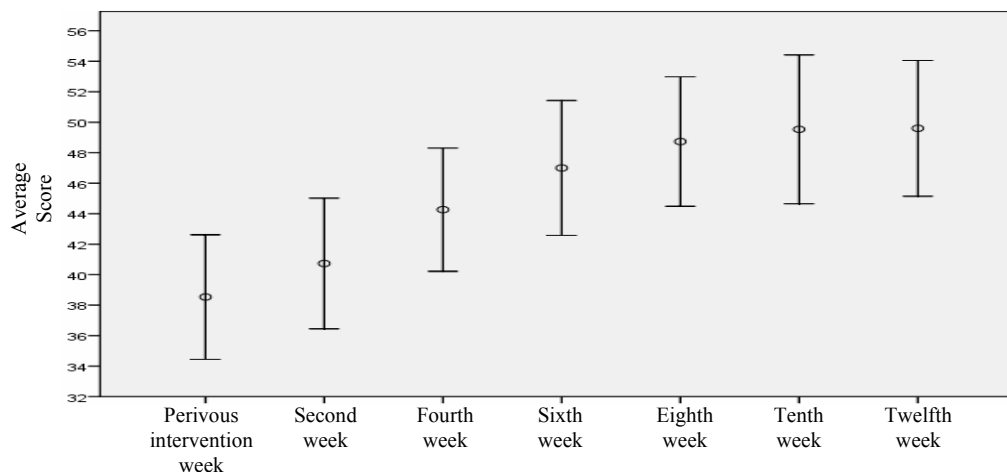


Fig 1. Averages for scores of Fugl-Meyer test in involved upper limb during twelve week intervals.

The results for Minnesota Manual Dexterity Test also improved and are summarized in Fig (2).

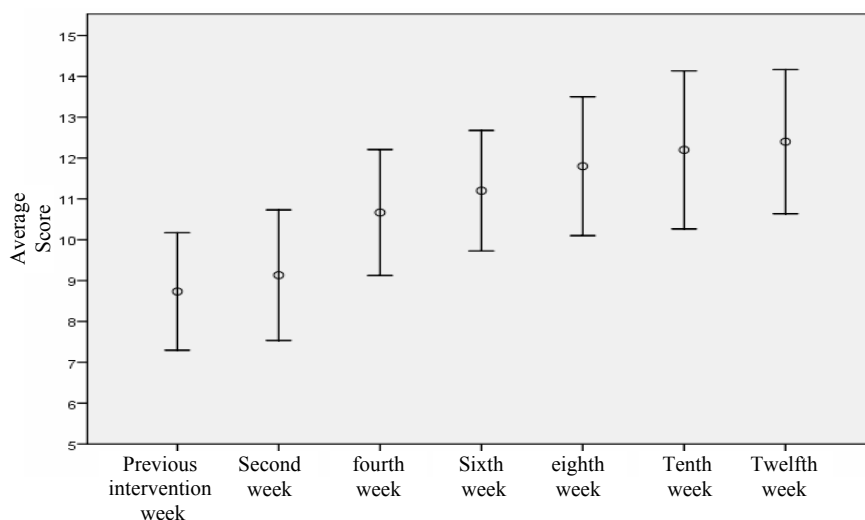


Fig 2. Averages for scores of Minnesota Manual Dexterity test in involved upper limb during twelve week intervals

Discussion

The results recommend that repeated and functional exercises, and implication of CIT approach can conquer learned non-use and improve utilizing of the involved limb, thus result in decreasing the disability. The significant improvements in scores may be attributed to several factors: improvement in physical abilities of the upper limb, changes in learned non-use behavior, or cortical neuroplasticity due to limb use.

Also Taub et al(6) stated that any kind of technic that can encourage the patients to use involved limb can be effective in treatment, it seems that constraint induced therapy approach can result in cortex plasticity and functional improvement. repeated application of the involved limb is one of the primary factors in CIT approach. That may cause cortical neuroplasticity that is necessary for functional improvement.

Great amount of evidence exist that recommends different methods of exercises and repetitive use of the involved limb result in cortical neuroplasticity and functional improvement. It seems that stroke patients grow more motor disability in involved limb, because they prefer to use non-involved(sound) limb and not use the involved limb for performing the activities of daily living. As the time goes on from stroke, learned non-use results in less use of the involved limb, and the limb becomes more and more non-used and weak.

Short time treatment protocols can make functional improvements or cortical changes, cortical neuroplasticity depends on using the limb. In this study, we found added use of the involved limb can

enhanced functional skills and has a positive effect on cortical neuroplasty. The results of this study show that CIT could be an effective modality to overcome the learned non-use of limb after stroke. As the results of the Fugl-Meyer test demonstrate, we can suggest that CIT can facilitate functional changes.

The results of this study were consistent with Page study in 2002(9) that used CIT on 14 stroke patients for 10 weeks, 3 days a week. Scores from the Fugl-Meyer were improved after intervention to more than 11 points, while in our study, the average score improved to 11.07. In this study, the most improvement of the results of Fugl-Meyer test were found by the eighth week. but the results did not improved significantly in 9th to 12th week for shoulder, elbow, wrist and hand velocity, motion and coordination. some possible causes would be as follows: 1. Fugl-Meyer test items can not assess the changes and improvement of the motion in latest weeks of the study, after the patients improved in motor abilities. 2. the patients improved faster in the first 8 weeks of CIT. in other words the rate of improvement was higher in early weeks of intervention and it went more steady and stabilized during the latest weeks. Maybe the patients will not more improve a certain level using CIT. 3. maybe improvement in function of the upper limb has a kind of effect on performing activities of daily living, that can not be assessed using the Fugl-Meyer test, and other tests that assess the activities of daily living should be used.

our results were also consistent with the findings of Bonifer in 2003(10) and 2005(11). also most of the

participants of Bonifer's study mentioned that after intervention they used their involved upper limb(10), it does not mean that the patients have gained the ability to independently use the involved limb, or the motor abilities have improved and reach the level of the time before the stroke.

In Bonifer's second study(11), the scores improved to 5.6 points after 3 weeks of intervention, while in our study the scores improved 11.07 points in 12 weeks. The higher scores found in our study may be

due to extended time of intervention(12 weeks) compared to 3 weeks of intervention in mentioned study.

Our study shows that using CIT in involved limb encouraged the patients to use their involved limb and improved function by conquering learned non-use of the limb. More research is necessary to define baselines or golden times for rehabilitation of the patients using CIT method.

References

1. Ferrucci L, Bandinelli S, Gurlnik J, Lamponi M, Bertini C, Falchini M. Recovery of functional status after stroke: post rehabilitation follow-up study. *Stroke* 1993;24:200-205.
2. Shumway-Cook A, Woollacott M. *Motor Control*. USA: Elsevier 2001.
3. Ekman L. *Neuroscience: Fundamentals for rehabilitation* USA: WB Saunders; 2002.
4. Gillen G, Burkhardt A. *Stroke rehabilitation: a function-based approach*. USA: Elsevier; 2004.
5. Pamela S, Vegher J, Gilewski M, Bender A, Riggs R. Client-centered occupational therapy using constraint-induced therapy. *Stroke* 2005;14(3):115-121
6. Taub E, Miller N, Novack T. Technique to improve chronic motor deficit after stroke. *Arch Phys Med Rehabil* 1993;74:347-354.
7. Morris D, Crago J, DeLuca S, Pidikiti R, Taub E. Constraint-induced movement therapy for motor recovery after stroke. *Neurorehabilitation* 1997;9:29-43.
8. Andrew M, Gordon M. Methods of constraint-induced movement therapy with hemiplegic cerebral palsy. *Arch Phys Med Rehab* 2005;86:837-844.
9. Page S, SueAnn S, Johnson M, Levin P. Modified Constraint-Induced Therapy after Subacute stroke. *J Intensive Care Med* 2002;17:111-119.
10. Bonifer N, Anderson KM. Application of constraint-induced movement therapy for an individual with severe chronic upper-extremity hemiplegia. *Physical Therapy* 2003;83(4):384-398.
11. Bonifer N, Anderson K, Arciniegas D. Constraint-induced therapy for moderate chronic upper extremity impairment after stroke. *Brain Injury* 2005 May 2005;19(5):323-330.
12. Wolf S, Winstein C, Miller J, Taub E. Effect of constraint-induced movement therapy on upper extremity function 3 to 9 months after stroke. *JAMA* 2006;296(17):104-296.
13. Tarka I, Pitkanen K, Sivenius J. Paretic hand rehabilitation with constraint-induced movement therapy after stroke. *Am J Phys Med Rehabil* 2005;84:501-505.