ORIGINAL ARTICLE

The Effects of Constraint Induced Movement Therapy in Improving Functions of Upper Limb in Patients with Stroke

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ABSTRACT

Objective: The aim of this was to compare the effects of constraint movement therapy and conventional therapy for improving motor function of upper limb in patients with sub-acute stroke.

Study Design: A randomized controlled trial.

Place and Duration of Study: The study was carried out from January 2016 to December 2016 in Rafsan Neuro Rehabilitation Centre, Peshawar.

Materials and Methods: A total of 60 patients with sub-acute stage of stroke were randomly allocated into constraint induced movement therapy and conventional therapy groups. Patients in conventional therapy group followed conventional physical therapy rehabilitation activities while patients in the constraint induced movement therapy group were guided to perform the same activities while constraining their less effected limb. Patients in both groups were assessed just before and six weeks after the start of these therapies. Mann Whitney U test was used to compare the results of both treatment.

Results: The patients in constraint induced movement therapy group showed better results on upper arm function, hand movement and advanced hand activities of motor assessment scale as compared to the patients in conventional therapy group. The mean rank for upper arm function of constraint induced movement therapy and conventional therapy group were 40 and 20, respectively (p=0.001), hand movement for CIMT and CT were 40 and 20 (p=0.001) and advanced hand activities for CIMT and CT group were 43 and 17 (p=0.001), respectively. The patients in induced movement therapy group showed 20% better result on upper arm function, 21% on hand movements and 26% on advanced hand activities of motor assessment scale.

Conclusion: It is concluded that constraint induced movement therapy provides improved upper arm function, hand movement and advanced hand activities as compared to the conventional therapy for the patients with sub-acute stroke.

Key Words: *Constraint Induced Movement Therapy, Paretic Upper Limb, Upper Limb Motor Function, Sub-Acute Stroke.*

Introduction

Stroke or cerebrovascular accident affects a big proportion of population every year.[1] Globally, it is the third most common cause of death and has been reported to be one of the commonest causes for long term disability.[2] It has been reported that patients with stroke cost almost 9.0 billion pounds in UK.[3] It is surprising that no large scale epidemiological surveys have been carried out in Pakistan regarding stroke and therefore, the true incidence of stroke remained unclear from the available literature. However, still an estimated annual incidence of 200/100,000 population may be found in the literature in some trial with limited scope.[4] The increasing number of patients with stroke in low and middle income countries is alarming and it accounts for significant number of the stroke mortality.[5] The consequences of stroke are not limited to either of the limbs and it can significantly affects both upper and lower limbs.[6] Upper limb dysfunction amongst patients with stroke population reduces patient's independence and has a significant adverse impact on quality of life.[7] The common problems associated with stroke in upper limb are muscle spasticity and loss of dexterity which hinders their activities of daily living.[8] It has been reported that 55% to 75% of patients suffering from stroke have difficulty in grasping, holding and manipulating objects.[9]

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Therefore, strategies to improve upper extremity function amongst stroke population are important to ameliorate motor recovery in upper limb.[10]

Traditionally, neurophysiological approaches developed by Bobath, Brunstrom, Rood & Kabat are used for enhancing recovery in stroke rehabilitation.[11] However, new and convincing evidence techniques which have been reported to facilitate neuroplasticity included movement therapy protocols, task oriented approach, constraint induced movement therapy and mental imagery.[12,13] Movement therapy protocols are based on motor learning principles and are capable of facilitating neural reorganization following stroke.[14] While motor learning refers to permanent changes in behavior that occurs due to practices and experiences of individuals.[15] Movement therapy protocols target deficits in neuromuscular system and use repetition or an experience for improving skilled motor activity.[16] Repetitive practice for reaching to a glass of water improves the elbow extension, causes structural and functional changes in the motor cortex and cerebellum. These changes due to functional activities are resulted due to motor recovery and remain permanent.[17] On the other hand, changes resulted from doing simple exercises like performing elbow flexion-extension without any task remain may not achieve the proposed goals of treatments in patients having stroke.[18] Similar findings have resulted in the development of task oriented goals for improving function of upper extremity in patients with stroke.[19,20] It has been reported that task-specific training with or without constraining the less affected limb had resulted in improving performance of the involved limb in both chronic and sub-acute stroke survivors.[21] The physiology behind the latter fact involves an increase in signals from higher center to the affected limb resulting constraining the unaffected limb and enforcing it to significantly participate.[22] The rationale behind constraint induced movement therapy is to overcome learned non-use movements and bring about functional reorganization of primary motor cortex. Studies on the this model of constraint induced movement therapy have shown achieving better functional outcomes in patients with stroke.[23] However, the trials carried out on the effectiveness of constraint induced movement therapy are limited in proposing a minimum dose of constrained induced movement therapy for the treatment applied. Moreover, to the authors' knowledge no published data was found on the topic in the whole country. Therefore, this clinical trial was designed to compare the effectiveness of the distributed model of constraint induced movement therapy and conventional physical therapy in improving function of upper limb in patients with stroke.

Materials and Methods

This was randomized controlled trial carried out at Rafsan Neuro Rehabilitation Centre, Peshawar from January 2016 to December 2016. The inclusion criteria for the patients in this trial was limited to sub-acute stroke patients who were able to score 19 or more on Mini Mental State questionnaire, 20° of wrist extension and 10° of finger extension in the affected upper limb, a minimum of 2 score in the 'Upper Arm Function' section on the Motor Assessment Scale. Subjects were excluded if they exhibited; excessive spasticity > 3 on the Modified Ashworth Scale, Excessive pain in the affected upper limb, as measured by a score of > 4 on a 10 point visual analog scale. A total of 60 patients having stroke were randomly allocated into constraint induced movement therapy and conventional therapy groups. Random numbers were generated through an excel sheet and 60 pre-labeled envelopes (30 labeled as constrained induced movement therapy and 30 labeled as conventional therapy) were placed in a container. Each willing patients was asked to pick an envelope for group allocations. The study was approved by the ethical committee of Khyber Medical University, Peshawar. Informed consents were obtained from all the participants. All patients received routine 2 hours physiotherapy sessions for 5 days a week. However, the patients in constraint movement induced therapy group wore the constraint during the routine physiotherapy sessions. Constraint is a cotton upper arm sling, with a strap around the neck for support. Participants were not asked to wear the constraint in unstable environments and during bilateral hand activities (e.g. opening bottles, lifting jars). Participants were encouraged to wear the constraint independently; subjects who could not wear it independently were assisted for it. The subjects were provided with a log book to enlist all activities performed during the

constraint wear period. This log book was reviewed and discussed with the patients or their caregivers on regular basis before starting a new therapy session. The functional task practice includes: picking up glass of water and drinking it, reaching for an item and putting into mouth, opening lid of bottles, arranging puzzles, peg boards and in real environment the activities encouraged were turning handles of doors, turning pages of newspapers and magazines. The complex tasks were broken down into simple components for the individuals who were not able to perform those steps. The levels of the tasks were adjusted according individuals' needs and capacities. All participants were tested at baseline and after six weeks following the treatment. Participants were kept blinded to the group allocation. Moreover, the testing teams were also blinded to the patients' allocation, making the study a double blinded randomized controlled trial. The assessment tool used for evaluation of the participants was Motor Assessment Scale (Upper Arm Functions, Hand Movements and Advanced Hand Activities). It is 6-point ordinal scale, measuring the activity level of upper limb. The test-retest reliability and inter-rater reliability of the scale have been reported r = 0.98 and 0.95, respectively. Motor assessment scale responses are similar to the responses of action reach arm test which is one of the commonest outcome measures used in clinical trials carried out on evaluation of constraint induced movement therapy for upper extremity functions in patient with stroke.[24] SPSS version 23 was used to analyze data. A non-parametric test Mann Whitney U test was used to assess the difference between the outcomes of both treatments.

Results

Both the groups consisted of equal number of participants (30 participants in each group). The mean age for the participants in constraint induced movement therapy group and conventional therapy group was age 54.4 ± 9.7 years and 56.4 ± 7.3 years, respectively. The average duration from the onset of stroke to the recruitment was between 3 and 9 months in the patients in both groups. Baseline physical and clinical characteristics indicated no significant differences amongst the mean scores of the participants in both groups (table I).

Significant differences on Upper Arm Function, Hand Movement and advanced Hand Activities were observed amongst the patients in constraint induced movement therapy and conventional therapy groups. The patients in CIMT group showed 20% more improvement on Upper Arm Function of Motor Assessment Scale when compared with the outcomes of the patients in conventional therapy group (table II). Moreover, the patients in CIMT group showed better outcomes on Hand Movements and advanced hand activities compared to the patients in conventional therapy group (21% and 26% more improvement, respectively) (table II).

Table I: Baseline Test Statistic and Ranks for the patients in both groups

Variables (Baseline)	Groups	Mean Rank	Sum of Ranks	Mann Whitney U	P value
UpperArm Function	CIMT CT	30 30	914 915	449	0.99
Hand Movement	CIMT CT	29 31	876 954	411	0.49
Advanced Hand Activities	CIMT CT	31 30	930 900	435	0.79

CIMT: Constraint Induced Movement Therapy

CT: Conventional Therapy

Table II: Post Treatment Test Statistic and Ranks

Variables at 6th Week	Groups	Mean Rank	Sum of Ranks	Mann-Whitney U	P-value
Upper Arm Function	CIMT CT	40 20	1206 624	159	0.001
Hand Movement	CIMT CT	40 20	1214 616	151	0.001
Advanced Hand Activities	CIMT CT	43 17	1316 513	48.5	0.001

Discussion

The aim of this randomized controlled trial was to compare the effectiveness of constraint induced movement therapy and conventional therapy for improving function of upper limb in patients with stroke. In conventional therapy patients are engaged for around 60 hours of therapy during a six week rehabilitation program in a specialized rehabilitation center designed for patient in sub-acute phase of stroke. Patients in this program attended 2-hours

physiotherapy session for 5 days for the mentioned duration. Patients in the constraint therapy group followed the same pattern of rehabilitation along with restricting their less affected limb during performing the suggested activities. The use of constraint induce movement therapy has been suggested to the patients who are in their sub-acute or chronic phase of stroke rehabilitation.[25] The latter technique involved constraining less affected limb of stroke patients for 5 hours each day for 10 weeks. However, the same technique is not well developed in majority of the Asian countries including Pakistan. Therefore, with slight modification the duration was decreased to 2 hours each for six weeks. One of the other reasons for allowing this modification was exiting protocols of the rehabilitation center where this clinical trial was deployed. The center is one the few centers in the country working specifically on rehabilitation of stroke. The present study results indicated that constraint induced movement therapy for 6-weeks duration promoted significant improvement in upper limb function in patients who were in sub-acute phase of stroke. These findings are consistence with the findings reported by Wolf et al. 2006 in a randomized controlled trial comparing the effectiveness of constraint induced movement therapy and conventional therapy.[26] In the latter clinical trial, a total of 222 patients in a single center were randomly allocated to either of the groups and were assessed for functional abilities in upper arm. In the latter trails, patients in both experimental and control group were able to maintain activities of daily living with significant differences amongst the mean scores of the patients when assessed on functional outcomes.

In this clinical trial upper arm function, hand movement and advance hand activities of motor assessment scale were used for comparing the effectiveness of constraint induced movement therapy and conventional therapy for rehabilitation of stroke patients who were in sub-acute phase. This scale has been reported to be sensitive, valid and reliable measure for the assessment of upper limb function in patients who had stroke.[27] The same scale has been used in clinical trials assessing the acute effects of additional task for improving mobility and function in upper limbs of patients with stroke.[28] Moreover, the use of the same scale for assessing bilateral and unilateral functions of upper arm for patients with chronic has been reported.[29] This suggests that the scale may be used for assessing function of upper limb in stroke patients during different phases of rehabilitation.

One of the limitations of this clinical trial was performing assessment of the patients with only a patient-reported outcome measure (Motor Assessment Scale). Use of functional tests for assessing the gains in upper limb of the patients in both the constraint induced movement therapy and conventional therapy were not included in the trial. Still, the used of a sensitive, reliable and valid scale during the assessment provide findings that can be generalized. Another limitation of this clinical trial was lack of an objective assessment tools that would have been used for assessing compliance of patients to the proposed treatment protocols in both the constraint induced movement therapy and conventional therapy groups.

Conclusion

The findings of this clinical trial suggest that despite some modification in the techniques of constraint induced movement therapy, still the patients in the group are superior and the modified techniques can be used for enhancing functional activities in the patients with stroke.

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