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Original Research Article

Does Trunk Restraint Really Improve Upper Limb Function in Chronic Stroke Patients?

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ABSTRACT

In chronic stroke patients functional recovery of upperlimb is restricted by excessive compensatory trunk movements.So the objective of the present study is to know if Modified constraint induced movement therapy (MCIT) with Trunk Restraint (TR) is effective or not in improving upper limb function. 30 individuals with chronic stroke who met the inclusion criteria were randomly divided into Group A of 15 patients which were given Modified constraint induced movement therapy (MCIT) with Trunk Restraint (TR) along with conventional therapy and Group B of 15 patients were given conventional therapy alone. The total duration of treatment is 2hrs/day, 5days a week for 4 weeks. Upper extremity function was assessed by 1. Action research arm test (ARAT) and 2. Wolf motor function test (WMFT) pre and post study. Results conclude that both groups have showed good results, but group A showed significant improvement than group B. So MCIT with TR is proven to be a significant and affective treatment approach in improving upper extremity function in chronic stroke patients.

Key Words: Modified Constraint Induced Movement Therapy, Trunk Restraint, Upperlimb, Chronic stroke.

INTRODUCTION

In India the prevalence of stroke ranges from 44 to 843 per 100,000 populations. [1] Incidence of stoke is rising rapidly with increasing age, two third of all strokes occur in people older than 60 years and after the age of 55 years the risk of stroke doubles every 10 years. [2] About 40% of people who survive a stroke have considerable impairment in their affected arm function after 3 months, whereas 40% have mild to moderate impairments and merely 20% have exclusively normal function. [3] Generally while reaching and grasping stroke patients with hemiparesis use “excessive trunk movements” (trunk anterior displacement and rotations) to compensate upper extremity motor impairment. This may help them in hand positioning and orientation for grasping. [4] Anatomically, in normal individuals the shoulder girdle has no direct articulation with vertebral column, which is very much dependent upon complex musculature activity in order to provide a stable, yet fully dynamic foundation for moving arm. The serratus anterior which together with the pectoralis minor draws the scapula forwards, is the leading muscle concerned with all reaching and pushing activities. It also plays an essential role in both upward and downward rotation of scapula. Both serratus anterior and pectoralis minor insert into the ribcage and therefore depend upon the stability of the thorax for their effective action1.The contractions of these two muscles would otherwise elevate the ribs instead of holding or moving the scapula. Likewise the vast pectoralis major, which is involved in so many movements of the arm in action, arises from not only the anterior surface of the clavicle and sternum, but also from the cartilages of nearly all the true ribs, and even from the aponeurosis of the oblique abdomens externus. The pectoralis would certainly elevate the rib cage if it is not held in place from below. To enable these muscles to function efficiently; the muscles of the abdominal wall must adapt their tension accordingly to hold the ribs down. All the muscles which act on the shoulder and enable it to be moved in so many complex ways are dependent upon the proximal anchorage provided by the shoulder girdle, which itself is dependent upon thoracic stabilization..The lack of proximal stabilization influences the limb profoundly in that the arm can only be moved in spastic synergies. Distal spasticity is further increased as the patient tries to compensate for the loss of fixation when he attempts to move against gravity. [5] Hence thorax plays a vital role for execution of upper limb function in a smooth and coordinated way. Till date many protocols are accessible to improve upper limb function in stroke patients. Among all the significance of Modified Constraint Induced Movement Therapy (MCIT) along with trunk restraint is increasing. Most of them were concentrated on reaching aspect. So, the objective of this study is to know whether Modified Constraint Induced Movement Therapy (MCIT) along with trunk restraint really improves overall upper limb function in stroke patients? The original protocol of CIMT by Dr. Taub requires minimum treatment of 6hrs/day. MCIT is more realistic approach which shows significant satisfaction even though 2-3 hrs/day treatment is practiced. [6] The specific technique of CIMT involves, restraining the use of the unaffected upper extremity with the help of MITT and intense motor training to the affected extremity through the use of shaping technique. [7] Modified constraint induced movement therapy engages the practice of functional task and is paying attention mostly on the ability to accomplish a task, and trunk restraint is focused on reducing compensatory movement strategies and normalizing motor control through practice of movement in specific and less functional way exclusively with the affected upper extremity, the shoulder belts attached back to the chair will prevent the trunk movement (sagittal displacement, rotation). [8,9]

MATERIALS AND METHODS

Subjects who met the inclusion criteria were randomly assigned into 2 groups, A & B. The *inclusion criteria* were - Age 40 to 60 years. [10] Both males and females with chronic stroke (more than 6 months) , middle cerebral artery stroke, no serious cognitive deficits, modified Ashworth scale score of <=2 in any upper limb joint, passive range of motion at least 90 degree of shoulder flexion and abduction, 45^o of shoulder external rotation, 45^o of forearm supination and pronation,10^o of wrist extension and finger extension, action research arm test score less than 51, WMFT (ability) less than 70 score. The *exclusion criteria* were -severe perception of cognitive defects, unwilling to participate, mini mental scale <24, modified Ashworth scale (MAS) >2, other neurological, neuromuscular or orthopedic disease, arm contracture/excessive pain in any joint of paretic extremity, severe shoulder pain which affects the therapy.

Materials used for MCIT protocol: [11]

Plastic rings and plastic prongs/bar, block and box, peg board, stacking blocks, ball, cylindrical jars, coffee cup, hair brush, cup of marbles, lock and key, MITT, trunk restraint.

Procedure: Group A patients were given MCIT with TR along with conventional therapy (mean age: 53.53,10 males, 5 females, 7 right, 8 left), Group B were given conventional therapy (mean age: 53.06, 8 males, 7 females, 6 right, 9 left) alone. Prior to the initiation of the study, the procedure was clearly explained to the entire subjects. Both the groups underwent subjective and objective assessment. Baseline values were collected using action research arm test and wolf motor function test.

Protocol for group A: Modified constraint induced movement therapy: Restraining the unaffected hand and wrist in a MIIT with self adhesive velcro straps every weekday for 4 hours is identified as time of frequent use. [12] Shaping and adaptive and repetitive task practice. Shaping guidelines: [11] Shaping is a training method in which a motor or behavioural objective is approached in small steps by successive approximations (i.e., a task is gradually made more difficult with respect to subject's motor capabilities). It may be viewed as a formal elaboration of training techniques commonly used in task practice. It differs in that it is systematic, proceeding by certain general rules that are specifiable, and it is quantified. It also differs in that patients are given frequent and explicit feedback concerning even small improvements in performance. *Following principles are used as guidelines when shaping is used for inducing recovery of motor function.* Shaping procedure involves: Individual task selection, gradual task difficulty, verbal feedback, prompting and physically assisting with movements and modeling.

Guidelines:

- Initial 15 min of therapy is spent on normalizing the tone of the affected upper extremity by using sustained stretching and weight bearing
- Each subject shaping program is individualized consisting of 10 to 15 tasks selected primarily from the basic battery of tasks. Each task is usually performed in a set of 10 and 30 second trails. At the end of each set of 10 trails, the task is typically changed.
- One measure frequently used is the number of task repetitions performed within the 30 second trial period. An alternate measure used less frequently is time required to carry out a set number of task repetitions.
- The level of difficulty of shaping task is slightly beyond what a patient can accomplish easily, thereby encouraging him/her to do a little better than on the previous trail.
- Rest intervals are allowed during each shaping session.

Therapy concentrates on the use of the affected upper extremity in the following functional tasks: ring toss, blocks on to a box, peg board, stacking the blocks, manipulating and moving ball on the table, reaching forward to move a jar, picking up a coffee cup and drinking from it, pick up hair brush and comb hair, picking up marbles from a cup, unlock and lock a key.

Exercise Protocol for Group A & B: (conventional therapy). [13] This includes:- active range of motion exercises to wrist/elbow/shoulder in sitting and standing, stretching, weight bearing activities, Reaching: in frontal and sagittal planes, reaching overhead, dynamic reaching to a target, grasping, holding and release of objects, upper extremity functional activities.

Statistical Methods:

Statistically non parametric tests were used to calculate the inter group results by *Mann-Whitney U Test* and intra group results by *Wilcoxon Signed Ranks Test*. Mean, standard deviation of all the values were calculated. The observed differences were tested with the Z at 95% level of significance ($p<0.05$).

RESULTS

After 4 weeks of intervention the results of group A and group B (post treatment) showed significant change proving that interventions given to both group A and group B are independently efficient in improving upper extremity function. If group A is compared with group B, significant difference is noticed in ARAT score of group A (p<o.o5) this was shown in table 1.

Table 1: Analysis of Action research Arm Test in "Group A" and "Group B". (Group Statistics)

	Group	N	Mean	Std. Deviation	Std. Error Mean	P value
ARAT_Pre	Group A	15	24.8000	13.95503	3.60317	p>0.05
	Group B	15	22.6667	12.37317	3.19474	
ARAT_Post	Group A	15	41.2000	9.32891	2.40871	P<0.05
	Group B	15	25.0667	12.56109	3.24326	

The scores of other outcome measure WMFT-ABILITY (table 2) also showed statistically significant difference in group A after treatment (p<o.o5).

Table 2: Analysis of WMFT_ABILITY in Group A and Group B. (Group Statistics)

	Group	N	Mean	Std. Deviation	Std. Error	P value
WMFT_Ability Pre	Group A	15	40.2000	16.27092	4.20113	p>0.05
	Group B	15	38.4667	11.43220	2.95178	
	Total	30				
WMFT_Ability Post	Group A	15	49.3333	15.81048	4.08225	P<0.05
	Group B	15	40.2000	11.68149	3.01615	
	Total	30				

Table 3 gives us inference that no significant difference was observed in WMFT-TIME ($p>0.05$).

Table 3: Analysis of WMFT_TIME in Group A and Group B (Group Statistics)

	Group	N	Mean	Std . Deviation	Std. Error Mean	P value
WMFT_TimePre	Group A	15	467.8667	253.41859	65.43240	p>0.05
	Group B	15	507.7333	258.75705	66.81078	
WMFT_TimePost	Group A	15	439.9333	231.41968	59.75230	p>0.05
	Group B	15	501.0000	257.04836	66.36960	

DISCUSSION

The repetitive practice of performing a particular task in Modified Constraint Induced Movement Therapy results in the formation of motor engrams. The motor engrams are the memorized motor patterns of the movement that gets stored in the motor cortex of the brain. [14] The shaping techniques used in the MCIT results in operant conditioning which is a type of associate learning, physiologically simple changes in the synaptic efficiency occurs without requiring complex learning networks. [15] Furthermore multiple efforts during practice lead to the unmasking of the silent synapses. Unmasking is the utilization of the existing axon and synapses which were previously unused for the particular action but having the potential for activation after the dominant system has dampened. [16] Repetitive training of the more affected upper extremity may, at the central level enhances motor planning in the inter joint coordination and at the spinal level decreases the latency between the activation of agonist and antagonist muscles, leads to straighter and smoother movements. Improved condition of movements might also at the spinal level be caused by an increase in the intensity of activation of spinal motor neuron pools, leading to increased synchronization of the muscle contraction. [17] Moreover all the muscles which act on the shoulder enable it to be moved in so many complex ways are dependent upon the proximal anchorage provided by the shoulder girdle, which itself is dependent upon thoracic stabilization, [5] the trunk restraint provides the thoracic stabilization and also enhances the somatosensory input from trunk and shoulder there by increases the joint range of movement. [18] Lastly Continuous auditory feedback for a well executed task serves as a positive reinforcement for the patients to achieve best results. [15]

CONCLUSION

MCIT with TR group showed greater improvement than the control group in both ARAT and WMFT (functional ability), nevertheless WMFT (time score) is same for both the groups. Although there are no excellent results for WMFT (time score), the results for other outcome measures provide us with absolute evidence which conclude that MCIT with TR is proven to be a significant and affective intervention strategy in improving upper extremity function in chronic stroke patients.

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REFERENCES

1. Wasay, M. Khatri, I. A. and Kaul, S. Stroke in South Asian countries. Nat. Rev. Neurol. 2014.10:135-143.
2. http://www.stroke.org/understand-stroke/preventing-stroke/uncontrollable-risk-factors
3. Vafadar, A. K., Côté, J. N. and Archambault, P. S. Effectiveness of Functional Electrical Stimulation in Improving Clinical Outcomes in the Upper Arm following Stroke: A Systematic Review and Meta-Analysis. BioMed Research International. 2015. DOI: 10.1155/2015/729768.
4. Roby Brami, A., Fuchs, S., Mokhtari M. and Bussel B. Reaching and grasping strategies in hemiparetic patients. Motor control. 1997. 1:72-91.
5. Patricia M Davies: “Right in the Middle: Selective Trunk Activity in the Treatment of Adult Hemiplegia” Springer-Verlag Publications, (1993). p:1-6 and 33-35.
6. Sterr, A., Elbert, T., Berthold, I., Kölbel, S., Rockstroh, B. and Taub, E. Longer versus shorter daily constraint induced movement therapy for chronic stroke. Arch of physical medicine and rehab. 2002. 83(10): 1374-1377.
7. Sunder land, A. and Tuke, A. Neuroplasticity, learning and recovery after stroke: A critical evaluation of constraint induced therapy. Neuro psycho rehab. 2005. 15:81-96.
8. Woodbury, M. L., Howland, D. R., McGuirk, T. E., Davis, S. B., Senesac, C. R., Kautz, S. and Richards, L. G. Effect of trunk restraint combined with intense trunk practice on post stroke upper extremity reach and function. Neural rehab neural repair. 2009. 23:78-91.

9. Wu, C. Y., Chen, Y. A., Lin, K. C., Chao, C. P. and Chen, Y. T. Constraint-induced therapy with trunk restraint for improving functional outcomes and trunk arm control after stroke. Physical Therapy. 92(4):483-492.
10. Hakkeners, S. and Keating, J. L. Constraint induced movement therapy following stroke: A systemic review of randomized controlled trails. Aus jour of physiotherapy. 2005. 51(4):221-31.
11. Taub, E., Uswatte, G., King, D. K., Morris, D., Crago, J. E. and Chatterjee, A. A placebo controlled trail of CIMT for upper extremity after stroke. Stroke. 2006. 37(4):1045-1049.
12. Lin, K. C., Chang, Y. F., Yi, C. and Chen, Y. A. Potential Predictor of Motor and Functional Outcome after DCIT for Patient with Stroke. Neuro Rehab and Neuro Pepair. 2009. 23(4): 336-342.
13. Susan O Sullivan. Physical Rehabilitation; 5th Edition. Chapter 13. FA Davis Company, 2007. p: 484-487.
14. Nudo, R. J. Plautz E. J. and Frost, S. B. Role of Adaptive Plasticity in Recovery of Function after Damage to Motor Cortex. Muscle Nerve. 2001. 24(8): 1000-1019.
15. Anne S. Cook and Marjorie woollacott. Motor Control Translating Research into Clinical Practice. Lippincott Williams & wilkins. 3rd Edition, pp:21-83.
16. Winstein, C. J., Miller, J. P., Blanton, S., Taub, E., Uswatte, G., Morris, D., Nichols, D. and Wolf, S. Methods for a Multisite Randomized Trial to Investigate the Effect of Constraint-Induced Movement Therapy in Improving Upper Extremity Function among Adults Recovering from a Cerebrovascular Stroke. Neuro Rehab and Neural Repair. 2003. 17(3): 137-152.
17. Dettmers, C., Teske, U., Hamzei, F., Uswatte G. and Taub, E. "Disturbed form of Constraint Induced Movement Therapy Improves Functional outcome and Quality of Life after Stroke. Arch of Phys Medicine. 2005. 86(2):204-209.
18. A L. Canning et al., "Task specific training and reaching and manipulation". UK Elsevier British Journal, (1994) 231-265.

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