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Effect of Modified Constraint Induced Movement Therapy Versus Motor Imagery in Improving Upper Limb Functioning in Chronic Stroke Patients: A Randomized Control Trial.

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KEYWORDS

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ABSTRACT:

Stroke is a cerebrovascular accident leading to neurological complications, muscular weakness being the most prevailing one. Stroke has a very high global burden along with 150-152/100,000 cases in India investigated through a recent systematic review. In a study done by Wolf et al. it was established that 85% of all the stroke sufferers experienced upper extremity hemiparesis, even 3 to 6 months later, between 55% and 75% of survivors continue to have upper extremity impairments, which are associated with low quality of life. There is also reduction of dexterous functions which also comprises one of the major causes of disability in stroke patients.[1,2]

Introduction

Stroke is a cerebrovascular accident leading to neurological complications, muscular weakness being the most prevailing one. Stroke has a very high global burden along with 150-152/100,000 cases in India investigated through a recent systematic review. In a study done by Wolf et al. it was established that 85% of all the stroke sufferers experienced upper extremity hemiparesis, even 3 to 6 months later, between 55% and 75% of survivors continue to have upper extremity impairments, which are associated with low quality of life. There is also reduction of dexterous functions which also comprises one of the major causes of disability in stroke patients.[1,2]

There are several conventional protocols designed for upper extremity function restoration in physical therapy which have been proven to produce designated outcomes but the adaptation to social atmosphere and also the time and energy inefficiency were the other shortcomings of these protocols. The novel approaches directed to task specific training with transference of training to daily life have been developed which includes Constraint Induced Movement Therapy (CIMT) and Motor Imagery (MI).

The CIMT training works on repetitive practice and restraining the unaffected extremity as Taub et al. described the principle of learned non use of affected extremity which was trained using "forced use" by Wolf et al. which encourage the targeted limb's use without massed practice.[3] Traditional CIMT designed by Taub and colleagues restrained the extremity 90% of the waking hours for 6 hours per day and 5 days/ week which resulted in difficult adoption of its practice in clinical settings, impracticality and wearing adherence.[4] To overcome these setbacks, the modified protocol (mCIMT) was structured for 30 minutes- 2 hours/day and 5 days/week (Wu et al., Page et al.).[5,6,7,8,9] Motor Imagery is a technique in which the movements assigned to be performed are imagined rather than implementing it. This hypothesis works on the presence of mirror neurons which provide sensory feedback along with activation of pre motor cortex, primary motor cortex areas and supplementary motor cortex and hence improving motor functions. The

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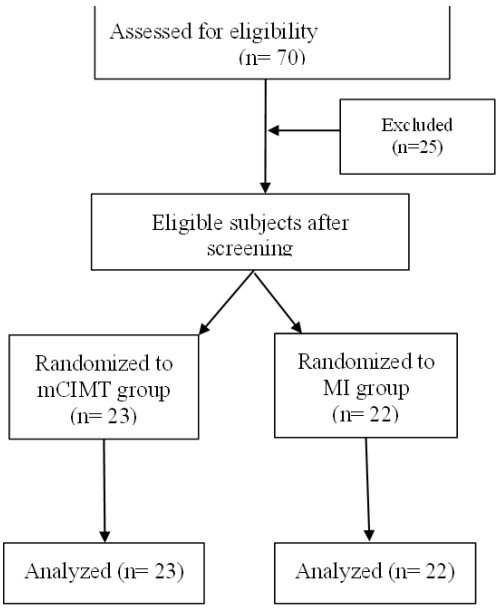
fundamental essence of neuroscience rehabilitation for modern medical care is neural plasticity, which has been used to restore motor functions after stroke. MI is critical in motor network reorganization as an effective intervention for motor rehabilitation. Hence, MI is a cognitive method that, rather than compelling a patient to learn different techniques or activities, results in neural changes in order to re-acquire motor skills learned prior to stroke.[10,11,12]

Both of the aforementioned approaches have enough evidence-based literature to prove their effect on improving upper limb functioning in chronic stroke patients but there is a lack of comparative research between the aforementioned protocols in the Indian population. In this randomized controlled study, we have compared the effect of mCIMT and MI on upper limb functioning in chronic stroke patients.

Materials and Methods:

This randomized controlled trial was designed as a single blinded study. The procedure for randomizing was automated, and the research therapists entered the data for randomization. This research therapist also delivered the intervention and was never the assessor at either the baseline or the outcome. This ensured that assessors were blind to the patients' group allocations for the duration of the study. 70 stroke patients were screened after an informed consent was obtained. The patients were included if the episode of stroke occurred 6 months prior with ability to perform antigravity movement, Brunnstrom stage of recovery ≥4 for proximal part of affected extremity, and Mini Mental State Examination score greater than 20 and patients with ability to extend Metacarpophalangeal joint (MCP), Proximal and Distal Interphalangeal joint (PIP and DIP) for minimum of 10°. Patients with a history of cardiac disease, any physical disability prior to stroke, coordination problems, vision or hearing disability were excluded from the study. 45 patients were finally included in the study as they fulfilled the inclusion criteria. Each patient was included in either of the two groups randomly, after a comprehensive assessment was undertaken which consisted of history taking, neurological and physical examination and investigations.

There were 23 patients in Group A. They underwent mCIMT protocol which included performing functional tasks of the upper limb like combing hairs, picking up the glass and drinking water, writing using pencil/pen and buttoning up the shirt. Patients performed the protocol alternatively for 6 weeks and three hours per day. The unaffected extremity was constrained for 5 hours/day, 5 days a week using a mitt splint. Group B consisted of 22 participants who performed MI technique which included a 45 minutes session per day, 5 days a week for 6 weeks. Session started with 30 minutes session of mental practice which consisted of patient actively imagining the sequence of task or a movement like washing hands, buttoning up and unbuttoning the shirt, reaching, grasping and drawing followed by a 15 minutes session of motor imagery with patients using mirrors while performing the aforementioned tasks along with feedback and verbal facilitation of movements. The pre and post intervention assessment for both the groups was done by an assessor using Fugl-Meyer Assessment- Upper Extremity (FMA-UE) designed to analyze the upper limb motor and functional recovery after stroke and other cortical disorders (intrarater and interrater reliability >79%).[13] This scale consists of 9 subscales with a maximum score of 126 in which the motor component comprises 66 score and sensation, passive joint motion and joint pain constitutes 24 score. Other outcome measures included a timed manual dexterity performance test in which participants press 2 buttons alternatively for 20 seconds and the result is recorded based on the number of buttons pressed, speed and coordinates.[14]



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The statistical analysis was done using t-test to examine the difference between both the groups. CIMT and MI protocol are the independent variables and FMA-UE and manual dexterity performance test are dependent variables.

Results:

The descriptive analysis revealed the mean age of Group A to be 41.83 ± 4.489 and of Group B to be 39.05 ± 5.269. There were significant improvements in pre and post test readings for FMA-UE and dexterity test (number of buttons pressed in 20 seconds) but in between the group analysis demonstrated no significant difference in FMA-UE scores in between both the groups ($p > 0.05$), however dexterity tests revealed a greater improvement in mCIMT group ($p < 0.05$).

	FMA-UE		Dexterity test	
	Pre Test	Post Test	Pre Test	Post Test
Group A	56.26 ± 12.643	62.61 ± 12.142	6.57 ± 1.273	7.96 ± 1.022
Group B	57.95 ± 13.080	62.55 ± 13.366	5.59 ± 1.008	6.45 ± 1.011
p value		.987		.000

Table 2.0 - Comparison of mean and t-test analysis for group differences for mCIMT and MI group respectively.

Discussion and Conclusion:

This research yielded data that replicated earlier studies reported in the literature, which demonstrate that the task-oriented strategy used in both the mCIMT and MI approaches significantly improves motor functioning and control in chronic stroke patients. However, the current study demonstrated that mCIMT was comparatively successful than MI, which is likely due to its idea of causing "forced use" of the injured extremities as put out by Wolf and colleagues.[3] Treger et al. conducted a study to determine the impact of mCIMT on upper limb functioning in stroke patients. The study's findings indicated that mCIMT significantly improved all outcome measures when compared to standard rehabilitation programs.[15]

In a randomized controlled experiment, Parezisi and colleagues discovered that mCIMT reduced arm disability through FMA-UE more effectively than the control group. Through a randomized controlled experiment, Wu et al. came to the conclusion that mCIMT had incremental impacts on hand dexterity and upper limb functionality along with several other evidences.[9,16,17,18,19] However, there is also substantial literature support for MI's beneficial effects on upper extremity dexterity, strength, and motor control in stroke patients, which aligns with the results of our study. Studies validate the activation of the same areas of brain during attempting functional tasks and performing MI which inturn provides strong evidence for the neurological impact of MI.[20,21,22] The notion put forth by *Ehrsson*, which indicated that movements of the upper limb activated portions of the primary motor cortex, was supported by Kim and colleagues' demonstration of a significant rise in FMA-UE scores in stroke patients. When participants imagined moving various body parts, precentral gyrus activation was also observed, demonstrating the beneficial effects of MI (*Stippich et al.*).[23,24,25]

However, the comparison of the two protocols showed a rise in FMA-UE scores for the mCIMT group slightly more than MI group, which is thought to be the outcome of training in a more conducive environment for ADLs. Additionally, the MI protocol has demonstrated its efficacy in a longer-term rehabilitation protocol, which is attributed to one of the considerable factors for the outcomes of the study. To increase the validity of the results, longer intervention periods and broader sample sizes could be used in future research.

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