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EFFECTIVENESS OF HAND-ARM BIMANUAL INTENSIVE THERAPY (HABIT) VERSUS MOTOR IMAGERY ON IMPROVING UPPER LIMB FUNCTION IN STROKE SUBJECTS – A COMPARATIVE STUDY

Physiotherapy

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ABSTRACT

Stroke is a significant global health problem that results in high morbidity, mortality, and disability rates. Upper motor neuron paralysis is a common somatoneurological disorder following a CVA, affecting the musculature of the trunk and limbs on the affected side. Effective rehabilitation programs can help stroke patients recover upper extremity function, reduce spasticity and muscle tightness, and improve their ability to perform daily activities. HABIT is an intensive bimanual training program; its primary objective is to enhance the coordination and utilization of both arms in daily activities similar to CIMT. Motor imagery (MI) or Mental practice (MP) is a technique where the movement is imagined and mentally rehearsed without voluntary movement which induces neural plasticity, which is key to restoring movements. This quasi-experimental, comparative study was conducted from February 2021 to September 2021 in Konaseema Institute of Medical Sciences, Amalapuram. Subjects with upper limb dysfunction due to stroke were recruited from the physiotherapy OPD, referred by the neurology department. The study population consisted of 40 patients, and 30 patients met the inclusion criteria and were allocated into two groups (15 in each) by convenient sampling. Group A received HABIT, and Group B received motor imagery with mental practice. The intervention duration was 60 minutes per day for 3 days a week for six weeks. The Action Research Arm Test (ARAT) was used as the outcome measure. Both groups showed significant improvement in ARAT scores ($p<0.05$) after the intervention. Based on the posttest mean values between HABIT (30.2), Motor Imagery (20.4) HABIT group showing a significant improvement compared to Motor Imagery. The present experimental study concludes HABIT showed significant improvement compared to Motor Imagery. Therefore, administering a comprehensive neurological rehabilitation program like HABIT along with conventional therapy helps stroke patients in improving upper limb function which further helps them in performing activities of daily living.

KEYWORDS

Stroke, HABIT, Motor Imagery, ARAT

INTRODUCTION

Stroke is a severe medical condition that occurs when the blood flow to a particular part of the brain is interrupted, either by a blockage or bleeding in the brain. This interruption of blood flow causes the brain cells to be deprived of oxygen and essential nutrients, which leads to their rapid death. The symptoms of stroke typically include unilateral or bilateral motor or sensory impairment, aphasia, dysphasia, hemianopsia, diplopia, forced gaze, acute-onset apraxia or ataxia, and perception deficits.

Hemiplegia is the most common somatoneurological disorder, occurring in approximately 90% of stroke patients. Stroke is a significant global health problem, contributing to high rates of morbidity, mortality, and disability in both developed and developing countries. A research study conducted by Shyamal Kumar et al in 2016 found that stroke was responsible for the loss of 795.57 disability-adjusted life years (DALYs) per 100,000 person-years in India[1]. The prevalence rate of stroke in India varies based on geographical location, with rates of 84-262/100,000 in rural areas and 334-424/100,000 in urban areas, as reported in a study by Jeyaraj Durai et al in 2013[2].

Following a CVA, upper motor neuron paralysis is typically limited to one side of the body, affecting the musculature of the trunk and limbs on the affected side. This paralysis is characterized by increased muscle tone, known as hypertonicity or spasticity, and the loss of coordination or control of smooth, rhythmic movement. Normal postural mechanisms are also disturbed, and the ability to adapt muscle tone as a protective mechanism against the force of gravity is lost, leading to a loss of control over slow, unresisted movements in the direction of gravity (Pedretti LW, 1996)[3]. About one-third of patients experience initial upper extremity paralysis, with a further one-third experiencing moderate or mild paresis.

The evidence indicates that the primary motor cortex plays a critical role in the control of skilled hand movements. Studies have shown that damage to the primary motor cortex can result in a loss of fine motor control, such as difficulty with precision grip or finger individuation. Furthermore, studies utilizing techniques such as transcranial magnetic stimulation have demonstrated that the primary motor cortex is involved in the generation of finger movements during complex motor tasks. Overall, the evidence suggests that the corticospinal pathways, specifically its corticomotoneuronal component, originating from the primary motor cortex, is a crucial constituent of the motor system involved in skilled finger movements[4].

Effective rehabilitation programs can help stroke patients recover upper extremity function, reduce spasticity and muscle tightness, and improve their ability to perform daily activities. Novel self-management interventions in stroke rehabilitation like mirror therapy and mental practice have shown to be useful adjunct exercise therapies.

Hand-arm bimanual intensive therapy (HABIT) is a recent intervention developed at Columbia University that targets individuals with cerebral palsy. Its primary objective is to enhance the coordination and utilization of both arms in daily activities. HABIT is an intensive bimanual training program similar to CIMT (constrained-induced movement therapy) However, unlike CIMT, HABIT concentrates on improving the capacity to perform bimanual activities. The treatment's efficacy has been established through research studies conducted by Gordon AM, Schneider JA, Chinnan A, and Charles JR in 2007[5].

Motor imagery (MI) or Mental practice (MP) is a technique where the movement is imagined and mentally rehearsed without voluntary movement. This practice induces neural plasticity which is the key to restoring movements, especially the upper limb function[6].

METHODOLOGY AND MATERIALS REQUIRED

- Study Design- Quasi experimental, comparative in nature
- Study Population- Subjects with upper limb dysfunction due to stroke
- Study Setting- Subjects were recruited from Physiotherapy OPD who are referred by Neurology department, Konaseema Institute of Medical Sciences, Amalapuram.
- Ethical Clearance- The ethical clearance was taken from ethical committee of KIMS at Amalapuram.
- Study Duration- February 2021 to September 2021
- Intervention Duration- 3 days for 6 weeks
- Treatment Duration- 60 minutes
- Sampling Design- Convenient sampling

❖ Study Sample- A total number of 40 patients both male and female suffering with upper limb dysfunction due to Hemiplegia and who are willing to participate. In addition, as per the study only 30 patients met the criteria and after obtaining the consent forms from the patients they were allocated into 2 groups 15 in each by convenient sampling.

Group A: Hand-arm bimanual intensive therapy (HABIT)
Group B: Motor imagery with mental practice

❖ OUTCOME MEASURES: Action research arm test (ARAT)

❖ **Inclusion Criteria**
- Time since onset of stroke <6 months.
- Age:40-60 years
- Ischemic stroke
- Brunstrom stage of motor recovery of 3 to 5
- Intact sensation and protective reaction.
- There should be no cognition or perceptual problem.
- No other significant medical condition.

❖ **Exclusion Criteria**
- Uncontrolled medical problems that can alter vital signs
- Hearing problems
- Global Aphasia
- Cognitive impairment
- Cardiac arrhythmias
- Chronic stroke

❖ **Materials Used**
- Threads and needle.
- zipper of a jacket.
- pencil& sharpener
- Bottle.
- Tooth paste and tooth brush.
- Nuts and bolts.
- Scissors.
- Video displayed on the laptop screen
- Tea cup with handle.
- Book
- Mobile phone and Pen
- comb

Procedure

Interventional Procedure For Group A

Pre- and post-intervention measurement was done by ARAT scale which evaluates the upper extremity function. In Group A, subjects were treated with hand-arm bimanual activities (HABIT) for a duration of 60 minutes for 3 days a week for 6 weeks.

These activities are as follows.
- Threading a needle.
- Wrapping up gifts.
- Fastening the zipper of a jacket.
- Buttoning and unbuttoning.
- Sharpening a pencil.
- Taking the cap of a bottle.
- Squeezing toothpaste on the toothbrush.
- Nuts and bolts.
- Cutting paper with Scissors.

Interventional Procedure For Group B

Pre- and post-intervention measurement was done by ARAT scale which evaluates the upper extremity function. In Group B, subjects were treated with functional activity-based motor imagery with mental practice inducting physical practice with video previewed consisting of 5 tasks for the duration of 60 minutes for 3 days a week for 6 weeks.

The subject was made to sit on a chair in front of the table containing task-related materials like video displayed on the laptop screen, tea cup with handle, book, mobile phone, pen, and comb. The unaffected limb and affected limb were placed on the table. The subject was first asked to observe the video of motor tasks. Then the subject was asked to mentally practice each activity ten times. Then the instruction to physically practice each activity ten times was given to the subject.

The motor tasks given were, picking up a tea cup with a handle and taking it to the mouth, and then returning the cup to its initial position, turning pages of a book, reaching the top of the head to comb, picking up a mobile phone to receive the call and holding of a pen to write.

Outcome Measure: ARAT is used to evaluate upper extremity motor function using 19 tests across 4 subsets: grasp, grip, pinch, and gross movement of the hand both proximally and distally. The time required to administer the test is approximately 10 minutes. The baseline to complete the task was 1 min. The total score is 57.

Statistical Analysis

Statistical analysis was performed by using SPSS software version 23.0 and Microsoft Excel-2021. Descriptive statistical data was presented in the form of mean +/- standard deviation and mean difference percentages were calculated and presented.

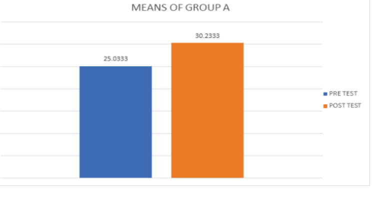
Between the Groups: Independent student "t test" was performed to assess the Statistically significant difference in mean value between the groups Hand-arm bimanual intensive therapy (HABIT) and Motor imagery

Within the Groups: Paired student "t test" was performed to assess the statistical difference within the groups for Hand-arm bimanual intensive therapy (HABIT) and Motor imagery

All the 30 subjects completed the entire study program as defined by 6 weeks in the outpatient basis. The outcome measure is Action research arm test (ARAT).

Table 1: Comparision Of Pre And Post Test Means Of Group A On ARAT

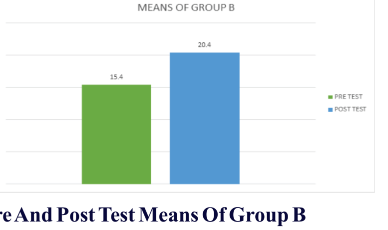
Groups	Tests	Mean	S.D.	T-Value	P-Value
HABIT	Pre	25.0333	3.10	-13.95	0.000
	Post	30.2333	3.66		



Graph-1: Pre And Post Test Means Of Group A

Table 2: Comparision Of Pre And Post Test Means Of Group B On ARAT

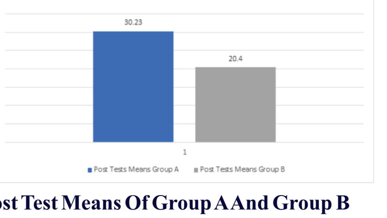
Groups	Tests	Mean	S.D.	T-Value	P-Value
Motor imagery	Pre	15.4	2.69	-9.52	0.000
	Post	20.40	3.28634		



Graph-2: Pre And Post Test Means Of Group B

Table-3: Comparision Of Post Test Means Of Group A And Group B On ARAT

Groups	Post Tests Means	S.D.	T-Value	P-Value
HABIT	30.23	3.66	10.943	0.000
MOTOR IMAGERY	20.40	3.28		



Graph-3: Post Test Means Of Group A And Group B

DISCUSSION

The findings from the present study revealed that there's statistically as well as clinically significant enhancement in hand motor functions in subjects who have undergone 6 weeks of HABIT training (Group A) (P=0.000) in pre- and post-values.

Stroke patients often experience difficulty with spatial and temporal coordination when using both hands simultaneously. In order to improve these specific coordination skills, it is necessary to engage in bimanual tasks like HABIT. To avoid overuse of the non-involved extremity and compensate for the involved extremity, it is important to carefully select appropriate activities and create an environment that promotes the use of the affected extremity. Simply reminding the person to use the involved extremity may not be sufficient, and additional attention is necessary to support the individual in utilizing their affected extremity. (Gordon AM, Schneider JA, Chinnan A, Charles JR, 2007)[7]. In this study, the activities were selected in such a manner that, the involved hand could also be used by the subjects. The improvement in hand function in this group may be due to underlying mechanism, The exercises in HABIT group are designed in such a way to challenge the individual's motor planning and coordination skills which facilitates hemisphere cortico-motor excitability (Stinear JW and Byblow WD, 2004) which further improves hand function.

On the other hand, Motor imagery training with internal practice also showed significant improvement in hand function(P=0.000) in pre-test and post-test values within the group (Group B). Motor imagery is a dynamic state in which the representation of a given motor act is internally rehearsed in the mind without any physical motor affair. There's a connection between the rudimentary ganglia and the prefrontal cortex to maintain a dynamic motor affair. (Decety J 1996)[9]. Motor imagery can be categorized into two types: kinesthetic motor imagery and visual motor imagery. The kinesthetic is the first-person perspective whereas the visual imagery is seeing others' conduct (Neuper C et al 2005)[10]. In this study visual motor imagery was applied through a videotape that was previewed to the subject, also the subject has to pretend the same movement in a real-world script followed by kinesthetic motor imagery by practicing the activities which further facilitate proprioception, tactile stimulation, and vestibular, visual and auditory information The scientific reason behind the significant changes in the group is due to activation of the damaged neural pathways by repeatedly imagining the movement of the affected limb, the which further rewire and form new connections which in turn induces neuroplasticity and improves upper limb function.

Therefore, based on the analysis of the present study, both HABIT and Motor imagery helps in improving hand function among stroke patients. But HABIT showed significant improvement compared to Motor Imagery. As there is much significant difference between the 2 groups in ARAT(p=0.00) my study accepts the alternate hypothesis.

This study finding suggests that adding the HABIT (hand-arm bimanual intensive therapy) program along with conventional physiotherapy will significantly improve hand functioning in stroke patients.

CONCLUSION

The present experimental study concludes that the 6 weeks of motor imagery with mental practice and HABIT (hand-arm bimanual intensive therapy), both showed a significant improvement of upper extremity function. However, HABIT showed significant improvement compared to Motor Imagery. Therefore, administering a comprehensive neurological rehabilitation program like HABIT along with conventional therapy helps stroke patients in improving upper limb function which further helps them in performing activities of daily living.

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