International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Motor imagery technique for motor recovery of hand among sub-acute stroke patient: A randomized controlled trial

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International Journal of Science and Research Archive, 2024, 13(02), 947–950

Publication history: Received on 07 July 2024; revised on 11 November 2024; accepted on 13 November 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.13.2.1287

Abstract

Stroke is the second leading cause of death globally, with a rising prevalence in line with increasing life expectancy. Hemiparesis, affecting up to 85% of stroke survivors, leads to impaired arm and hand movement, reduced strength, and limited coordination, significantly affecting daily activities. Despite rehabilitation efforts, many stroke survivors face persistent functional limitations or permanent disabilities. Intensive rehabilitation is often costly and constrained by the limited number of therapy sessions available in many centers. Therefore, strategies to enhance functional recovery while minimizing resource use are crucial. One promising approach is motor imagery (MI), a cognitive rehearsal of physical actions aimed at improving motor function. MI has been shown to activate similar brain areas as actual movement, such as the premotor cortex and supplementary motor area. While evidence supports MI's potential for enhancing motor recovery, clinical guidelines remain insufficient. This study aims to evaluate the effectiveness of motor imagery for improving hand function in subacute stroke patients. The primary objective is to assess the impact of MI on motor recovery using the Chedoke Arm and Hand Activity Inventory over a 4-week period.

Keywords: Motor Imagery; Motor Recovery of Hand; Mental Practice; Stroke

1. Introduction

Stroke is the second most common cause of death globally, and its prevalence is projected to increase in coming years in parallel in with an increase in life expectancy [1]. Up to 85% of stroke survivors experiences hemiparesis , resulting in impaired movement of arm and hand, characterised by limited active range of motion , limited strength, impaired coordination from the shoulder to hand and finger , and severely diminished ability to perform activities of daily living [1,2].

Even after joining a rehabilitation program , functional limitation , or permanent disabilities remain in these subjects [3].Most of the functional recovery is achieved within 3 month after onset. Thus ,in-patient rehabilitation usually continues in the acute and subacute phases of stroke.[4]

Intensive rehabilitation is expensive and many rehabilitation centers provide clients with a limited number of therapy session before discontinuation of rehabilitation financing. Given these limitations, we are committed to developing strategies that will minimize the use of costly resources and maximize practice opportunities to enable functional motor learning and recovery.[2,4,5]

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1.1. What is motor imagery(MI)?

Motor imagery is mental process of rehearsal for a given action in order to improve motor function.[2]Mental practice is a training method during which a person cognitively rehearses a physical skill using motor imagery in the absence of overt, physical movement for the purpose of enhancing motor skill performance.[4]

Previously, it was shown that MI and motor execution (ME) activated similar areas of the brain, such as the premotor cortex and the supplementary motor area (SMA).[2]

2. Material and methods

2.1. Material

- Pen
- Paper
- Chair
- Desk/table
- KVIQ-10 questonnaire
- Chedoke Arm and Hand Activity inventory test (CAHAI-7)
- Mini mental scale
- Consent form
- Data collection sheet

2.2. Method

- The study started with a presentation to the ethical committee of P.E.S. Modern college of physiotherapy Pune 05.
- Study started after obtaining ethical clearance from the committee.
- The participants selected according to inclusion and exclusion criteria.
- 4.Purpose explained to the participants and written consent had been taken.
- 5.Assessment done by using Chedoke Arm and Hand Activity inventory test as an outcome measure.

Experimental group received MI technique and control group received conventional therapy for 4 weeks,5 days/week.

Data collected and statistical analysis done.

3. Results and discussion

Effectiveness of motor imagery techniques in facilitating motor recovery among subacute stroke patients, particularly focusing on hand motor function has been a subject of interest. This study aimed to explore the effectiveness of motor imagery techniques in promoting hand motor recovery among individuals in the subacute stage of stroke rehabilitation.

Stroke is one of the main causes of longterm disabilities among adults. Up to 85% of stroke survivors have hemiparesis that affects the upper extremity on one side,and less than half of them can regain proper arm function 6 months after stroke. Generally, hemiparesis impacts the movement function of the hand and wrist more than shoulder and elbow. As we know, hand movement plays a core role in upper limb function because of its indispensable and sophisticated function in human daily lives. Many vital activities of daily living, such as using a fork, buttoning a shirt, and opening a door handle, require various hand functions.The losses in hand function can seriously affect patients functional independence and quality of life.

The hand is widely represented in a significant portion of the brain's motor cortex due to its enormous biomechanical complexity, which suggests that fine motor control of hand movement is highly dependent on an intact corticospinal tract. For patients with moderate to severe stroke, contralesional motor-related cortical recruitment takes over as the primary neural compensatory model when the ipsilesional corticofugal tract sustains significant damage from the stroke. Recovery of motor function can be achieved with ongoing rehabilitation training after subcortical injury in movement disorders.However, the patient's ability to move independently is partially or occasionally totally lost due to the impairment of movement function, and as a result, active training therapies are limited·

Numerous lines of study support the notion that motor imagery training could improve hand function recovery through motor imagery, however it is still challenging to establish broad guidelines for the therapeutic application of motor imagery.

Aditi Chaturvedi et al. came to the conclusion in March 2017 that while there appears to be potential for mental practice to improve upper extremity performance, it is challenging to provide broad guidelines for its clinical application. [3] Additionally, Wriessnegger et al. showed that a mere 10-minute training session was sufficient to enhance MI patterns in motor-related brain regions, such as SMA and premotor cortex, as well as frontoparietal and subcortical structures. These findings supported the positive techniques.

The statistical analysis of this study shows that motor imagery technique has significant effect on motor recovery of hand among subacute stroke patient. The difference between experimental and control group is found to be statistically significant. Although difference between pre and post training within both group is extremely statistically significant

Moreover, the implementation of motor imagery techniques presents several advantages, including its non-invasive nature, accessibility, and potential for integration into existing rehabilitation programs. Additionally, it offers a safe and cost-effective method for enhancing functional outcomes in stroke rehabilitation, particularly in contexts where physical limitations or environmental constraints may impede traditional therapeutic approaches.

Previous research has shown that both the motor execution and motor imagery processes of wrist motion significantly activate the rostral side of the bilateral motor area, inferior frontal gyrus pars opercularis, left inferior parietal cortex, adjacent intraparietal sulcus, bilateral secondary sensory cortex, left anterior and medial parts of the intraparietal sulcus, basal ganglia, and cerebellum (Vry et al., 2012). In contrast to motor execution, motor imagery training activates additional regions of the brain, including the caudal, ventral, and tegmental sections of the inferior frontal gyrus corresponding to the Broca region, the inferior frontal junction, other frontal lobe regions, and the left medial intraparietal sulcus (Vry et al., 2012).

Data was analyzed using Microsoft excel sheet.In between group (Group A and Group B comparison) significance was calculated using unpaired 't' test and within group (pre and post comparison of group A and group B) significance was calculated by using paired 't' test to see effectiveness of motor imagery technique for motor recovery of hand among sub-acute stroke patient.

There were three drop outs of the subject from the study.Table 1 shows extremely significant statistical difference ($p \leq 0.0001$) within experimental group A, post training (mean 25.44±3.57) and pre training (mean17.44±3.68) .however there is significant statistical difference ($p \leq 0.0001$) within control group B, post training (mean 19.80±4.78) and pre training (mean 14.20±4.24).

Table 1 Comparison within and inbetween group A and B

group gggg	**Training**	**Mean±SD**	**Paired t-value**	**Significant p value**	**Mean difference**	**Unpaired t value**	**Significant p value**
Aar	ppre	17.44±3.68	15.17	<0.0001	8.00±1.58	2.7940	01300.0130.
	post	25.44±3.57					
B	ppre	14.20±4.24	8.80	0.0001	6.11±1.27		
	post	019.80±4.7818					

4. Conclusion

The study can be concluded that Motor Imagery technique is effective on motor recovery of hand among subacute stroke individual as evidenced by extremely significant difference in pre and post score of Chedoke Arm and Hand Activity inventory test over the period of 4 week.

Hence, we accepted our (H1) hypothesis which stated "Motor Imagery technique will be effective on motor recovery of hand among subacute stroke individual with respect to Chedoke Arm and Hand Activity inventory test over the period of 4 week.

However, while the results of this study provide compelling evidence supporting the effectiveness of motor imagery techniques for hand motor recovery among subacute stroke patients, further research is warranted to elucidate the optimal protocols, duration, and intensity of such interventions. Additionally, investigating the long-term sustainability of the observed improvements and exploring potential individual differences in response to motor imagery training could contribute to refining and personalizing rehabilitation strategies for stroke survivors.

Compliance with ethical standards

Acknowledgments

P.E.S MODERN COLLEGE OF PHYSIOTHERAPY is a renowned institute as far as physiotherapy is concerned. It has always been encouraging for any research work from students. I am thankful to be a part of this institution.

I am grateful to DR.CHETALI PALIWAL , my guide for her able guidance and for showing faith in my project.

I also would like to thank all the teaching and non-teaching staff of the college for their share of co-operation and help in my undertaking.

I would like to express my special thanks to the Principal of the institution DR.SUCHETA GOLHAR for her support.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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