



# Effects of Motor Imagery Techniques in Children with Spastic Cerebral Palsy



Breera Amjad<sup>1\*</sup>, Muhammad Asif<sup>2</sup>, Erum Tanveer<sup>3</sup>, Abdul Rashad<sup>4</sup>, Heba Haider<sup>5</sup>, M Faizan Hassan<sup>6</sup>, Shujaat Hussain Memon<sup>7</sup>, Hina Rathi<sup>8</sup> and Kanza Masood<sup>9</sup>

<sup>1</sup>Senior Lecturer, Ripah International University, Faisalabad Campus, Pakistan

<sup>2</sup>Principal, Professor, Isra Institute of Rehabilitation Science, Isra University

<sup>3</sup>Principal & Assistant Professor, United College of Physical Therapy

<sup>4</sup>Senior Lecturer, United College of Physical Therapy

<sup>5</sup>Physical Therapist, Mamji Hospital

<sup>6</sup>Physical Therapist, Ziauddin University

<sup>7</sup>Principal & Assistant Professor, Hyderabad Institute of Medical & Allied Sciences

<sup>8</sup>Assistant Professor, Suleman Roshan College of Physiotherapy and Rehabilitation Sciences

<sup>9</sup>Lecturer, University of Lahore, Sarghoda

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**\*Corresponding author:** Breera Amjad, Senior Lecturer, Ripah International University, Faisalabad Campus, Pakistan

## Abstract

**Aim of Study:** To explore the effects of motor imagery techniques on the balance and gross motor functions of Spastic Cerebral Palsy children.

**Study Design:** Randomized controlled trial RCT, was type of study.

**Study Settings:** Outpatient department of Physical Therapy at National Institute of Rehabilitation Medicine (NIRM) Islamabad.

**Subjects:** Twenty-two individuals with Spastic Cerebral Palsy were selected for the study.

**Interventions of Study:** Among study sample groups, interventional group did motor imagery techniques involving imagining different movements of body for 15 minutes surrounded with conventional physical therapy training for 30 minutes session (45 min./day, 3 sessions/week), the control group executed conventional physical therapy session only (30 min./day, 3 times/week).

**Outcome measures:** Gross motor functional capacity and balance were measured by the Modified Functional Reach Test, Timed Up-and-Go Test and Gross Motor Functional Measure scale (GMFM-IS66).

**Results:** All measurements improved significantly compared with baseline values in the experimental group. In the control group, there were significant improvements in all parameters except the GMFM-IS66.

**Conclusion:** Balance training along with motor imagery techniques increases the balance and motor planning capabilities of spastic cerebral palsy children considerably enhanced than conventional physical therapy alone in cerebral palsy.

**Abbreviations:** NIRM: National Institute of Rehabilitation Medicine; GMFM: Gross Motor Functional Measure scale; MI: Motor Imagery; MP: Motor Performance; FMRI: Functional Magnetic Resonance Imaging; TUG: Time Up and Go; MFR: Modified Functional Reach

## Introduction

Cerebral palsy is not an ailment, its impairment. Cerebral palsy is somewhat a clinical explanation and do not identify the nature of illness as the term indicates nothing regarding etiology, pathology or expected recovery time. The brain insults are important for cerebral palsy and can happen at any moment in the beginning of 1st trimester of infancy; so, it is a broad term that covers a lot of etiologies and pathologies and its clinical

details are manifold. So, cerebral palsy is a clinical syndrome that presents as a disorder in the development of postures, balance, coordination and movements due to lesion of immature brain occurring in the foetal period or infancy. The appearance of cerebral palsy can be comprehensive, psychological and physical disability or secluded instabilities in gait, perception, development or perception. The result is motor or sensory

nerve disorders and the incapability to accomplish many tasks in everyday life and participation restriction. CP causes damage to motor or sensory nerves, functional limitation and impaired performance of daily life activities [1]. Cerebral palsy patients do lack in motor planning and execution of motor task. Motor dysfunction in cerebral palsy is usually associated with disabilities in sensory consolidation and stability, weak muscular contractions, weak or totally absence of motor planning which is the prerequisite of a motor task execution.

Moreover, simultaneous stimulation of prime movers and its associated opponent muscles, absence of particular regulation of movement in organisms, and reduced anaerobic muscle capacity and activity cause impaired functions and tasks restriction. Patients with this neurological disorder usually have worse dynamic and static balance. Overhaul services have commonly been ignored. Generally, exist inside the well-being sector. It is especially because of deficiency of complete guidelines. Cerebral palsy rehabilitation centers are very necessary to combat this deficiency. Even many clinical institutes give proper guidelines and treatments for cerebral palsy but still it is deficient and old-fashioned. Even patients can expire due to the devastating effect of bodily impairment, but it is in very exceptional and intensive cases. New treatments need to be established in response to impairments. So, this study is going to evaluate a unique and rare technique to treat and rehab gross motor manifestations especially of motor planning deficit and balance impairments in cerebral palsy. During the previous decade, the usage of data-based interventions in cerebral palsy regimen has moderately increased and researchers have struggled to evolve further productive interventions to raise the standards of living of these individuals and their households.

A latest analysis has investigated that interventions established on motor learning improves functional levels in children with cerebral palsy [2]. Therefore, using Motor Imagery Techniques in CP might be a promising technique to ensure improvement in motor planning deficit. Motor imagery is the cognitive presentation of movement in the absence of any bodily movement. Profuse verification on the beneficial influence of motor imagery implementation on motor presentation and training in sportsperson, fit people, and individuals having neurological problems (e.g., stroke, spinal cord injury, Parkinson's) has brought out. Imagery refers to the creation

or re-creation of any practice in the mind like auditory, visual, olfactory, kinesthetic, organic. Specifically; motor imagery (MI) is the mental representation of movement without any body movement. It is a complex mental operation that is self-generated using sensory and perceptual processes, enabling the reactivation of specific motor actions within working memory. Therefore, sensory-perceptual, memory, and motor mechanisms are included in broader definitions of the term.

Motor imagery is the mental imagination of movement without any actual body movement. It is a mental activity by which an individual rehearses, or replicates a given action. It is mostly used in sport training as mental practice of action and also in neurological rehabilitation. Motor imagery is likely to develop more 'cognitive' aspects of motor behavior, and may, therefore, be helpful in promoting motor planning in patients with CP [3]. Several evidences show that motor imagery and actions are conveyed by the same brain circuits. For example, functional neuroimaging and transcranial Magnetic Stimulation studies demonstrate that the same brain structures are involved in action and imagining the same action. Functional brain imagines reviews have exhibited that many cortical as well as subcortical regions are triggered through definite motor performance, are equally triggered while imagination or cognitive execution of movements. Current verification shows that the primary motor cortex is associated with motor imagery procedure [4].

During motor imagery, many neural mechanisms are activated characterized by a marked elevation in tendinous reflexes of the limb part imagined moving, and by somatic variations which resembles with the level of mental work. At level of the cortex, precise planning of initiation narrowly looks like to the action executed, is noticed in areas concerned to motor control. This stimulation might oblige as the foundation for the special effects of mental training. A model that is called as, hierarchical model of the organization of action projected the temporary memory storage of a 'copy' of the many demonstrative stages. These retentions vanish when an action associated to the denoted goal takes place. By compare, if the act is partial or not performed, the entire system rest stimulated, and the content of the demonstration is experienced. This mechanism would be the foundation for conscious reach to this content during motor imagery and mental training [5].

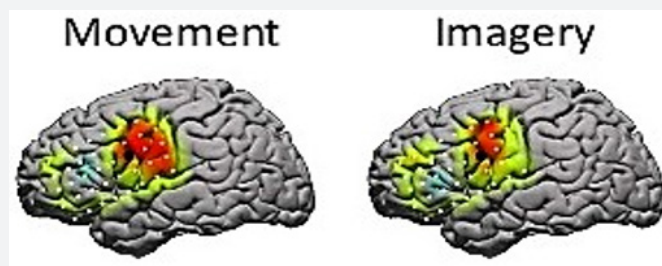


Figure 1: Movement Imagery Presentation in Higher Centers.

By functional magnetic resonance imaging (fMRI) techniques, the intensity and latitudinal distribution of functional activation in the left pre and post central gyri, during actual motor performance (MP) and mental representation of self-paced finger-to-thumb opposition movements of the dominant hand were investigated in fourteen right-handed volunteers [6]. For many patients, it is difficult or sometimes impossible to execute motor tasks, who have damaged central nervous system, even after initial involvement in a dynamic rehabilitation platform. It is lately offered by several investigators that these patients can use mental practice as a healing device to increase their motor functions, but very little experiential work reports this problem openly. This article deliberates the reason for inspecting mental practice for encouraging motor recovery in patients who have neurological syndromes. We first showed evidence that supports the presence of a resemblance between performed and imagined activities by using records from psychophysical, neurophysiologic, and brain imaging studies. Then this additionally describes the recurrence of movements through bodily and mental repetition of a mechanical skill. Lastly, a new model is suggested to focus the key role of motor imagery as a crucial method of mental rehearsal, and also to stimulate

further research on this type of training in the restoration of patients with motor deficiencies having cerebral origin [7].

There is evidence to suggest that mental practice of movement can produce normal effects recognized as practicing the actual movements. Imagining hand movements could stimulate restoration and redistribution of brain activity, accompanied by recovery of hand function, thus resulting in a reduced motor impairment. Current evidence for mental practice with motor imagery (MI) in stroke is insufficient due to methodological limitations [8] (Figure 1). Mental practice is the intended preparation of mental tasks, whereas motor imagery practice results in motor improvement through motor imagery rehearsal. These both italicized terms are sometimes used interchangeably. So, we will treat them synonymously. MI is cheapest and easily available. It is necessary for physical therapist to be informed about the use of MI, because of increasing number of reports about its benefits of MI in improving motor performance [9]. Mental Rotation Task / Paradigm is a tool to assess the child's ability of mental imagery. It is process of imagining an object rotating in three dimensional spaces. Person is asked to decide if these two figures are the same shape but rotated or they are two different shapes [10] (Figure 2).

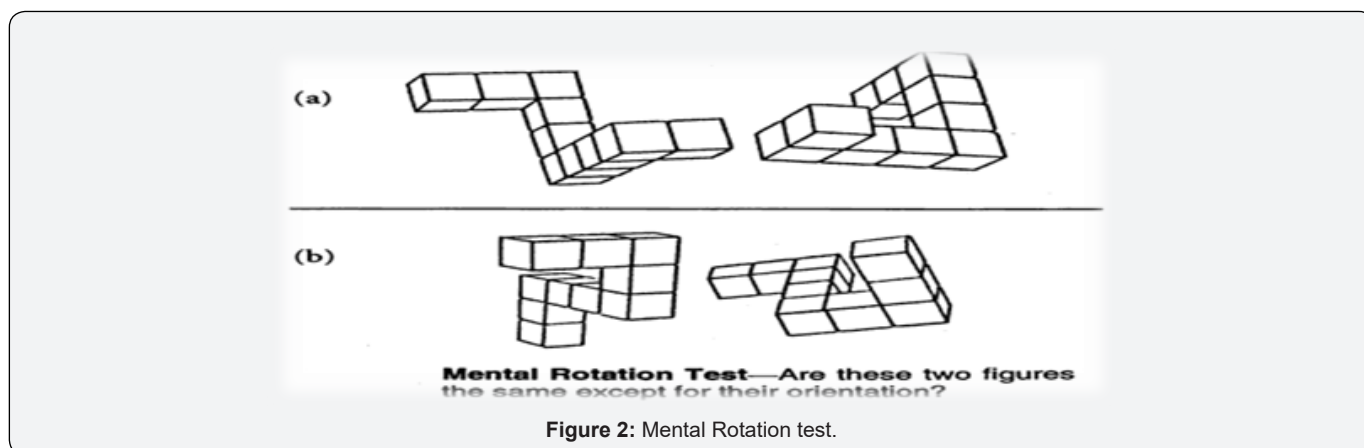


Figure 2: Mental Rotation test.

## Methodology

Randomized clinical trial was conducted in department of physical therapy of National Institute of Rehabilitation Medicine, Islamabad, for duration of 6 months. 30 patients with diagnosed with spastic Cerebral Palsy, then 22 participated in this study according to inclusion and exclusion criteria. After selection of patients who fulfilled inclusion criteria, they were arbitrarily divided into two groups by means of simple lottery method. i.e. Control group n=11 and Interventional Group n=11. Baseline assessment was done on 0 week; second Assessment on 4th week Post-intervention assessment was done after 8 weeks. Total duration of study treatment was 12weeks. The experimental group performed motor imagery training as specific intervention, that involves motor imagining of gross movements of lower limb 15 min. embedded in conventional therapy for 30 min. (45 min/day, 3 times/week). And, the control group was given conventional therapy only (30 min./day, 3 times/ week).

The interventional group received Motor Imagery training along with conventional therapy. In MI, a small animated Video clips were designed to display and guide the child through imagery process. Motor Imagery Training involves imagining task with external visual stimulus, given via short video clip i.e.

- i. Football playing
- ii. Running a race
- iii. Balancing on one leg
- iv. Keeping balance on a wobble board
- v. Jumping from block to block

The control group received Conventional Physical Therapy only including,

- a) Therapeutic Ball Exercises
- b) Balance Board Training

- c) Stretching Exercises
- d) Recreational activities.

**Results**

The Results of both tools TUF and MFR are significant indicates that Motor Imagery is an effective technique to improve balance and gross motor skills in Spastic Cerebral Palsy whereas tool GMFM results are non-significant indicating that this intervention techniques are not that much effective in case of cerebral palsy.

Overall, the Mean age of all patients was 9.36±3.170. and in control group mean and standard deviation values were 9.36±2.730 and in experimental group 9.36±3.695 were mean and standard deviation values. There were 77.3% male and 22.7% female in the study. In experimental group 72.7% were male and 27.3% female and in control group 81.8% were male and 18.2% female. In general, 31.8% patients were diagnosed with spastic hemiplegic CP (Rt), 22.7% patients with spastic hemiplegic CP (Lt), 27.3% patients with spastic diaplegia while 18.2% patients with Spastic quadriplegia. In experimental

group, there were 27.3% of patients were diagnosed with spastic hemiplegia (Rt), 18.2% patients with spastic hemiplegic CP (Lt), 36.4% with spastic diaplegia while 18.2 % were with Spastic quadriplegia. In control group, there were 36.4% of patients were diagnosed with spastic hemiplegia (Rt), 27.3% patients with spastic hemiplegic CP (Lt), 18.2% with spastic diaplegia while 18.2% were with Spastic quadriplegia.

Then, by relating Q-Q PLOT normality of data was checked, to recognize normal distribution of the data Kolmogorov-Smirnov test indicated that data were not normally distributed for Time up and go test (TUG) test and Modified Functional Reach (MFR) at baseline. Nonparametric test that is Mann Whitney U- Test for between group analysis and wilcoxon test were applied on both TUG and MFR test, but for GMFM-IS66 Independent T test was applied for between group analysis and Repeated measure anova for analysis of time interval within each group was applied for. These tests were used to compare Pre and Post Treatment of between Group A and B. As, the data for TUG and MFR was non-normally distributed at the baseline so Mann Whitney U Test was applied to compare the all three assessment values between control and experimental group (Tables 1-3).

**Table 1:** Between Groups Analysis of TUG.

Time up and Go test (TUG)		Interquartile range (IQ)	Mean rank	P-value
Baseline Assessment	Interventional group	21.90(10)	13.18	0.222
	Control group		9.82	
2 <sup>nd</sup> Assessment	Interventional group	21(9)	12.23	0.598
	Control group		10.77	
Final Assessment	Interventional group	20(9)	11.41	0.947
	Control group		11.59	

**Table 2:** Between Groups Analysis of MFR.

Modified Functional Reach Test (MFR)		Interquartile Range (IQ)	Mean rank	P-value
Baseline Assessment	Interventional group	3.30(1)	10.77	0.596
	Control group		12.23	
2 <sup>nd</sup> Assessment	Interventional group	3.40(0)	13.50	0.075
	Control group		8.73	
Final Assessment	Interventional group	3.60(1)	14.45	0.030
	Control group		8.55	

**Table 3:** Between Groups Analysis of GMFM.

GMFM-IS66		Mean ± SD	P-Value
Baseline Assessment	Interventional group	67.72±7.25	0.975
	Control group	67.80±4.38	0.975
2 <sup>nd</sup> Assessment	Interventional group	66.79±7.71	0.767
	Control group	67.59±4.34	0.768
Final Assessment	Interventional group	66.51±7.90	0.696
	Control group	67.59±4.35	0.697

**Discussion**

All patients with hemiplegia have difficulty with planning motor movements, Effect of motor imagery on hemiplegic

cerebral palsy and on Developmental Congenital Disorder and concluded that anticipatory motor planning was improved by this intervention [11]. Results of this study were supported by

the study, In 2013 by Bert Steen Bergen et al., on 'Impaired motor planning and motor imagery in children with unilateral spastic cerebral palsy' concluded that Motor imagery training may be a valid and useful tool to complement upper limb rehabilitation in young children with CP, supports researcher's study as Motor imagery techniques were helpful in increasing balance and gross motor function of children with cerebral palsy and showed significant p value <0.005 [2]. According to another study in 2012 by Hwai-young Cho et al; on 'Effects of motor imagery training on balance and gait abilities in post-stroke patients: a randomized controlled trial' concluded that if gait training with motor imagery training is used it will recovers the balance and gait of chronic stroke patients more better than gait training alone, that supports researcher's study as Motor imagery techniques were helpful in increasing balance and gross motor function of children with cerebral palsy and showed significant p value <0.005 [12].

According to another study in 2008 by Ayelet et al; 'Home-Based Motor Imagery Training for Gait Rehabilitation of People With Chronic Post stroke Hemiparesis' says that There were noteworthy rises in stride length, cadence, and single-support time of the pretentious lower limb, giving strength to my study as Motor imagery techniques were helpful in increasing balance and gross motor function of children with cerebral palsy and showed significant p value <0.005. According to another study in 2009 by Bert Steenbergen et al; on 'Motor imagery training in hemiplegic cerebral palsy: a potentially useful therapeutic tool for rehabilitation' gives that Motor imagery training may be a valuable additional tool for rehabilitation in children with hemiparetic CP giving strength to my study as Motor imagery techniques were helpful in increasing balance and gross motor function of children with cerebral palsy and showed significant p value <0.005 [11]. In 2012, a study by Hwai Young Cho et al., concluded that gait training along with motor imagery training increases the balance and gait capabilities of chronic stroke patients suggestively better than gait training alone thus, giving strength to my study as motor imagery techniques were helpful in growing balance and gross motor function of children up with cerebral palsy and revealed significant p value <0.005.

## Conclusion

The study results concluded that both treatment groups were improved by Physical Therapy. This study suggests that motor imagery techniques combine with conventional combination therapy has significant effects in improvement of gross motor functional skills of children with spastic cerebral palsy, age between 7 and 15 years. There was significant improvement in the balance level whereas, there was little increase in level of gross motor function. So, Motor imagery is an effective technique to improve motor planning and balance among cerebral palsy.

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