EFFECT OF MOTOR IMAGERY WITH CONVENTIONAL PHYSICAL THERPAY ON UPPER EXTREMITY FUNCTIONS IN HEMIPARETIC STROKE PATIENTS

-An Experimental Study

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University towards partial fulfilment of the requirements of **MASTER OF PHYSIOTHERAPY (Advanced PT in Neurology)** Degree programme.

KMCH COLLEGE OF PHYSIOTHERAPY

(A Unit of Kovai Medical Center Research and Educational Trust)

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2009-2011

CERTIFICATE

This is to certify that research work entitled **"EFFECT OF MOTOR IMAGERY WITH CONVENTIONAL PHYSICAL THERPAY ON UPPER EXTREMITY FUNCTIONS IN HEMIPARETIC STROKE PATIENTS" – An Experimental Study** was carried out by the candidate bearing the Register No: **27091610**, KMCH College of Physiotherapy towards partial fulfillment of the requirements of the **Master of Physiotherapy (*Advanced PT in Neurology*)** of The Tamil Nadu Dr. M.G.R. Medical University, Chennai-32

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INTERNAL EXAMINER

EXTERNAL EXAMINER

Dissertation Evaluated on:

ACKNOWLEDGEMENT

I'm deeply indebted to **My Beloved Parents and sister** for their unconditional love, sincere prayers, encouragement, constant inspiration and care without which I would not have accomplished anything.

My warm hearted thanks to the KMCH Management, especially to the Chairman **Dr. Nalla G. Pallaniswami** M.D. (AB) and the Trustee **Dr. Thavamani D. Pallaniswami** M.D. (AB) F.A.A.P who are the stalwarts of the institute.

I thank **Dr. O.T. Bhuvaneswaran** Ph.D, Chief Executive Officer, for his intensive efforts towards the academics.

My sincere thanks to **Dr. Edmund M D'Couto**, M.B.B.S.,D.Phys. Med & Rehab, Principal, KMCH College of Physiotherapy, for his valuable support.

I express my heartfelt thanks in this instance to my invaluable project guide **Mr. K. Senthil Kumar, M.P.T. (Neuro)** Vice Principle for his benevolent guidance, support and valuable suggestions throughout the course of the study.

I sincerely thank **Mr. K. Siva Kumar, M.P.T.(Neuro)**, for his generous support and encouragement.

My heartfelt thanks to my class in-charge **Mrs.A.Brammatha, M.P.T. (Neuro)** for her guidance and encouragement throughout the study.

I extend my gratitude to **Mr. K. Venugopal, M.A., M.Phil**, Professor in Research & Biostatistics for letting me know the intricacies of Biostatistics.

I wish to express my thanks to all **the faculty members** for their support.

I perpetuate my thanks to my librarian, **Mr.P.Dhamodharan** and his fellow members for their co-operation and patience in providing books for reference, which helped me to complete this project successfully.

And last but obviously the most I would like to express my hearty thanks to my **classmates and friends** for their active participation and co-operation without which this study would not have progressed to be successful.

ABSTRACT

Objective: The main objective of this study is to evaluate the effect of motor imagery and conventional physical therapy in improving upper extremity function in hemiparetic stroke patients.**Study design:** Pre test post test experimental study design. **Study population:** Twenty ischemic MCA stroke patients with Movement imagery questionnaire-revised (MIQ-R) score more than 25 were taken into study. They were randomly assigned into group 1 and group 2 with ten patients in each group. **Intervention:** Patients in group 1 received motor imagery with conventional physical therapy. Patients in group 2 received conventional physical therapy alone. Motor imagery was given for about 1 hour a day, divided into two 20 min sessions with 10 min rest in between for 5 days a week. Conventional physical therapy was given for 1 to 1 ½ hours a day for 5 days a week. Treatment was given for 3 weeks duration. **Outcome measures:** The upper extremity section of Fugl-Meyer Assessment was used to assess the upper extremity function. **Results:** After 3 weeks of intervention patients in group 1 showed greater improvement in upper extremity function than patients in group 2. **Conclusion:** Motor imagery is an effective tool and it can be incorporated into conventional physical therapy to improve upper extremity function.

Key words: Motor Imagery, Movement Imagery Questionnaire- Revised, Conventional physical therapy

1. INTRODUCTION

The World Health Organization (WHO) defines stroke as a ‘‘clinical syndrome presumable of vascular origin, characterized by the rapid development of sings of focal (or global) neurological affection lasting more than 24 hours or which was fatal’’[37].

Every year approximately 5, 00,000 people have first or subsequent stroke. Upper extremity disability is one of the most debilitating effects of stroke, and it is primary impairment underlying functional disability following stroke[36].

Upper extremity disability is one of the most prevalent conditions treated by physical therapists. Over 50% of patients with upper extremity disability resulting from stroke face long term impaired arm functions and ensuing disability in daily life[21]. Traditionally the practice provided in neurological rehabilitation has focused on reducing motor impairments and minimizing physical disability. Intensive rehabilitation is expansive, however and many managed care organizations provide

their client with a limited number of therapy sessions before they stop financing rehabilitation.

Furthermore, the limited number of sessions can cover a wide range of services (Eg: Physical therapy, Occupational therapy, Speech therapy) and a large number of skills (Eg: bed mobility, transfers, use of affected arm, balance retraining) and therefore repetitive practice may not be provided at appropriate frequencies for motor learning to occur. As a result therapy intended to improve upper extremity function following stroke which may involve less repetitive practice if skills than is needed; it is not as effective what it could be.

In sports field, when the physical practice is not possible by the athletes due to injury, the motor imagery combined with physical practice has been found to promote the learning of motor skills and maintain the level of performance.

Motor imagery is a cognitive process in which a person imagines that he or she performs a movement without actually performing the movement even tensing

the muscles. It is a dynamic state which involved in the representation of a specific motor action is internally activated without any motor output[33].

Motor imagery is defined as “a dynamic state during which the representation of a specific motor action is internally reactivated within working memory without any overt motor output” and “occurring from the first person perspective.”[15]

A fast growing number of studies indicated that areas in brain engaged in the performance of movement are also active during motor imagery. Motor imagery might be used alongside physical rehabilitation in patients with neurological disorders and will probably be most effective in the reorganization of brain patterns is most prominent.

1.1. NEED FOR THE STUDY

The need of the study is to find the effect of motor imagery along with conventional physical therapy in upper extremity function following stroke.

The motor imagery is frequently used in the field of sports, and this study enables us to implement this specific type of treatment technique in stroke management and improving their upper extremity functions.

A therapy based on motor imagery may be a way forward as, in principle; imagery is not dependent on residual function. Imagery does incorporate voluntary drive[47], which is important for motor learning after neurological damage. Furthermore, motor imagery has been shown to access the cortical motor network after stroke and increase excitability of appropriate spinal reflex pathways.

Motor imagery is a cost effective [36], non invasive tool when combined with stroke can receive additional practice of functional skills and benefit greater outcomes.

2. REVIEW OF LITERATURE

2.1. STROKE

Goldstein, Barnett et al., 1988

Stroke is defined asana cite neurological dysfunction of vascular origin with sudden (within seconds) or at least rapid (within hours) occurrence of symptoms and signs corresponding to the involvement of focal areas in the brain.

WHO Guidelines for stroke

Stroke is a medical emergency which can lead to permanent neurological damage, complications and death if not promptly diagnosed and treated.

Hickey, 2003

Two main types of stroke are ischemic and hemorrhagic in which approximately 85% are ischemic and 15% are hemorrhagic. Of those approximately 45% of ischemic stroke are caused by small or large artery thrombus, 20% are embolic in origin and others have unknown origin.

Brust, 2000

Stroke can be ischemic (occlusion of cerebral vessels by clot or other particle) or hemorrhagic. Ischemic stroke occurs 5 times more often and may be the result of thrombus forming over athermanous plaque, abnormal clotting or embolus dislodged from vascular wall anywhere from the circulatory system. Infraction ensures if the area of brain supplied by occluded vessel if collateral circulation is not able to compensate for the ischemia.

Yun Mi Song et al,. 2004

Hemorrhage may occur at the brain surface or within the brain tissue. Hematoma forms which is accompanied by edema, both of which increases

pressure in the brain, further compromising blood supply leading to widespread damage. This contributes to much higher mortality rates in hemorrhagic stroke.

Arthur anconitz et al (1993)

They defined Stroke as a loss of functioning brain tissue, with an accompanying disability, such as weakness, paralysis, blindness (or) speech impairments. Stroke is triggered by deprivation of blood to part of brain.

Rowan harwood et al (2005)

Stroke can be defined as a rapidly developing episode of focal (or) global neurological dysfunction lasting longer than 24 hours (or) leading to death and presumed vascular origin.

2.2 MOTOR IMPAIRMENT AND DISABILITY

Chae et al (2005)

They investigated the Fugl-Meyer (FMA) motor impairment scale and physical disability measured by FIM as prediction of physical independence after stroke.

Fourty eight patients are admitted to rehabilitation within six weeks of stroke onset. They suggested that physical activity dependency of daily living after stroke is primary depend on the degree of motor impairment.

Kenneth et al (2001)

In their study, motor and cognitive abilities were measured by FMA and neurobehavioral cognitive status examination and functional performance was measured by FIM assessment was conducted at admission, after two weeks and at discharge. The results from this study, motor impairment, balance, lower limb ability, strongly accounts for functional recovery in rehabilitation of patients with in stroke staying in hospital.

Nancy et al (1999)

In their study with the purpose to describe the disabilities experienced by person with stroke during first year and explore the evaluation of impairment, disability, handicap, and health related quality of life. They suggest that much of improvement in impairment and disability occurs during the first month and then reaches a plateau. Handicap and quality of life continue to be issue later.

***Farhan et al (2005*)**

Studied 100 patients with ischemic stroke was assessed at neurology department. River mead motor assessment to measure motor impairment and Functional independent measure (FIM) to measure disability were used and the baseline and post stroke values were taken in seventh to tenth day and three month. They concluded that stroke related motor impairment and disability were found to be significantly correlated with each other.

2.3. MOTOR IMAGERY

Susan M Baraun 2006

If mental practice strategies involve active participation of the patients during the intervention the technique should be taught. Transferring the technique into cognitive strategies might help the patient applying mental practice during rehabilitation.

Page 2001

Mental practice may be a cost effective tool with patients with stroke who can receive additional practice of functional skills and realize greater outcomes than if therapy alone can be used.

Jackson FL et al., 2003

There is a valuable functional cerebral reorganization after following motor sequence learning through mental practice with motor imagery.

Francie Malouin et al., 2004

The impairment of working memory can compromise the long term retention of a skilled behaviour with motor imagery. The activation patterns in the brain observed in several functional imaging studies of motor imagery and involvement of working memory during motor imagery were consistent.

Jaqueline H Crosbie et al., 2003

They conducted a study on the role of mental practice in the rehabilitation of upper limb after stroke. The conclusion suggests that mental practice may be useful as an adjunct to physiotherapy after stroke.

Dickstein et al., 2004

They conducted a study using motor imagery practice for improving upper extremity functions in patients with hemi paresis following stroke and concluded that motor imagery is useful in enhancement of functions.

Butler A J et al., 2004

They conducted a study on mental practice with motor imagery evidence for motor recovery and cortical reorganization after stroke. Results show that mental practice is useful in improving upper extremity function.

Gentili et al., 2004

They performed a study about improvement and generalization of arm motor performance through motor imagery practice. Findings show that mental training has a significant effect in improvement.

Yagues L et al.,

They conducted a study about effectiveness of motor imagery ion learning new motor skills. The results show that there was significant improvement.

2.4. CONVENTIONAL PHYSICAL THERAPY

Geron et al., 1999

Increasing regional blood flow in bilateral inferior parietal cortex and sensorimotor cortex of hemiplegic patients during passive movements measured by functional imaging suggested that these may play an important role in the reorganization of sensory and motor system for preceding restoration of neurological function.

Alfieri 1982 & Baskar 1979

Electrical stimulation enhances motor cortex after stroke, reduces spasticity, strengthen muscles and increase range of motion of joint with prevention or correction of contracture.

David et al., 1999

Stretching and splinting the hemiplegic hand gave good results in the earlier stages of stroke rehabilitation as wrist flexion contractures develop rapidly after stroke in people who have no early movement recovery.

Carr and Sheppard et al., 1987

Positioning the hemiplegic arm in functional position with sand bags or other available materials is very simple therapy to prevent contracture formation.

Page and Levin 2005

Bilateral training may be very effective than unilateral training because the patient receives Proprioceptive and visual feedback from the unaffected upper

extremity which they do not receive during unilateral practice. Bilateral training is simply stated as what the one limb does other limb copies.

Price Ret al., 1993

Cryotherapy and one hour post cryotherapy measurement of spasticity were performed in 25 subjects with clinical signs of spasticity secondary to TBI, SCI & stroke. A statistically significant reduction in spasticity occurred during cryotherapy, post cryotherapy results were equivocal, although there was a tendency for diminished spasticity relative to the baseline measurement.

James W Stinear & Winston D et al., 2004

In patients with stroke, passive rhythmic flexion and extension by active flexion extension of contra lateral wrist, produces improvements in the cortical maps of the wrist flexors and extensors representation of affected hemisphere of patients with stroke.

Dejan B Popovic et al., 2004

In a review describes methods that interface peripheral systems (Eg: cyclic neural stimulation, stimulation triggered by electrical activity of muscles, therapeutic functional electrical stimulation) and trans-cranial brain stimulation with surface or implanted electrodes. Conclusion derived from reviewing these data is that integration of electrical therapy into exercise-active movement mediated mechanism enhances motor-relearning following damage to the central nervous system. An important observation is that therapeutic effects are likely to be much more effective when treatment is applied in the acute, rather than in chronic phase of stroke.

2.5. MOVEMENT IMAGERY QUESTIONNAIRE-REVISED (MIQ-R)

Hall and Martin 1997

MIQ-R was used to assess each subject's ability to imagine movement. This includes both visual and kinesthetic imagery movement. They concluded that the MIQ-R is an acceptable revision of MIQ.

2.6. FUGL MEYER ASSESSMENT (FMA)

Leyman et al., 1975

The Fugl Meyer assessment can be a potential method for evaluation of the physical performance as a whole in post stroke hemiplegic patient.

Platz T et al., 2005

The Fugl Meyer assessment of upper extremity (FMA-UE) is the most widely used clinical assessment of post stroke upper extremity impairment.

Platz T et al., 2005 & Woodbury M L et al., 2007

The Fugl Meyer assessment of upper extremity showed a very high inter rater and test retest reliability.

3. AIM AND OBJECTIVES

3.1 AIM:

- To find out the effect of motor imagery with conventional physical therapy in upper extremity functions in hemiparetic stroke patients.

3.2 OBJECTIVES:

- To find out the effect of motor imagery with conventional physical therapy in upper extremity functions in hemiparetic stroke patients
- To find out the effect of conventional physical therapy alone in upper extremity functions in hemiparetic stroke patients.
- To compare the effects of motor imagery with conventional physical therapy and conventional physical therapy alone in improving upper extremity functions in hemiparetic stroke patients.

4. METERIALS AND METHODOLOGY

4.1. Study design:

Pre test – Post test Experimental study design

4.2. Study population:

Ischemic MCA stroke patients

4.3. Study setting:

Department of Physiotherapy,

Department of Physical medicine and Rehabilitation,

Kovai Medical Center and Hospitals,

Coimbatore.

4.4. Sample size:

Totally 20 stroke patients

Group 1: 10 patients (Motor imagery with conventional physical therapy)

Group 2: 10 patients (Conventional physical therapy alone)

4.5. Sampling technique:

Simple random sampling.

4.6. CRITERIA FOR PATIENT SELECTION

4.6.1. INCLUSION CRITERIA

- First history of stroke, ischemic stroke
- Middle Cerebral Artery (MCA) stroke
- Haemodynamicaly stable patients
- Both genders
- Age between 40 & 70

- A score of greater than 25 in Movement Imagery Questionnaire- Revised (MIQ-R)
- A score of less than 2 in modified Ashworth scale for spasticity

4.6.2. EXCLUSION CRITERIA

- Hemorrhagic stroke patients
- Patients with sensory, perceptual, cognitive deficits
- Excessive spasticity in upper extremity muscles - score of greater than 2 on Modified Ashworth scale for spasticity.
- Patients with orthopedic surgeries of upper extremity
- Patient with shoulder hand syndrome

4.7. HYPOPTHESIS

4.7.1. Null hypothesis

H_{01}:

There is no significant improvement in upper extremity function with motor imagery and conventional physical therapy in hemiparetic stroke patients.

H_{02}:

There is no significant improvement in upper extremity function with conventional physical therapy alone in hemiparetic stroke patients.

H_{03}:

There is no significant difference between motor imagery with conventional physical therapy and conventional physical therapy alone in improving upper extremity function in hemiparetic stroke patients.

4.7.2. Alternate hypothesis

H_{a1}:

There is a significant improvement in upper extremity function with motor imagery and conventional physical therapy in hemiparetic stroke patients.

H_{a2}:

There is a significant improvement in upper extremity function with conventional physical therapy alone in hemiparetic stroke patients.

H_{a3}:

There is a significant difference between motor imagery with conventional physical therapy and conventional physical therapy alone in improving upper extremity function in hemiparetic stroke patients.

4.8 PROCEDURE:

A written consent was taken from patients who fulfilled the inclusion criteria. Pre test was taken with Fugl-Meyer assessment - upper extremity section (FMA). Subjects were randomly allocated to 2 groups. Patients in Group 1 received Motor imagery with conventional physical therapy and Patients in Group 2 received Conventional physical therapy only for 3 weeks duration. Post test was assessed after 3 weeks with the same outcome measures.

4.8.1. MOTOR IMAGERY

Motor imagery was given for about 1 hour a day for 5 days a week. Totally 15 sessions were given with two 20-minute periods of mental practice separated by a 10- minute rest [27].

Patient was made to sit in a chair in front of a table with forearms resting on table without elevated or depressed shoulder girdle.

During the training, patient's forearm is positioned either in pronation, mid position, or supination which is appropriate to the task to be imagined.

Before each session of motor imagery patients were instructed as "you are going to imagine some activities with your affected (right or left) arm in this session"

Before each activity the activity or movement to be imagined was demonstrated to the patient for 2 times. Then patients performed that activity or movement in his/her normal upper extremity for 2 times.

After that patients imagine the activity or movement in his/her normal upper extremity. Patients were instructed as, "Close your eyes, Concentrate on your arm and hand, imagine the movement or activity but don't move your arm and hand. Concentrate on how it feels just resting on table. Open your eyes after you have completed this action two times."

Then patient is instructed to imagine the activity or movement in affected (hemiparetic) upper extremity for 3 times with the same instruction given for normal side. Three sets were given to provide 9 times of motor imaging.

Patients were intermittently asked to describe what they were experiencing during the imagination.

MOVEMENTS OR ACTIVITES USED IN MOTOR IMAGERY:

- Flexion-extension of the thumb with forearm in pronation
- Flexion-extension of index finger with forearm in pronation
- Abduction-adduction of all fingers
- Making a fist-opening the hand
- Wrist circling
- Flexion-extension of wrist
- Flexion-extension of the elbow in all forearm positions (pronation, mid position, supination)
- Elevation-depression of shoulder girdle
- Shoulder flexion-extension (up to 90°)
- Shoulder abduction-adduction with elbow flexed (up to 90°)

- Lateral-Medial rotation of shoulder with elbow flexed end forearm resting on table
- Lateral-Medial rotation of shoulder with 90° of shoulder abduction
- Draw a triangle with index finger on the table
- Draw a square with index finger on the table
- Show Thumbs up sign then keep hand back on the table
- Stirring the water in bucket with index finger
- Pour sand from hand onto table
- Manipulating a doorknob
- Knock the table
- Slap on a table without moving the arm
- Take food to mouth
- Take a cup from the table bring it to mouth to drink and keep it back on table
- Take the phone, bring it to your same side ear and place it back on the table
- Combing hair
- Knock the door
- Stretch your arm upwards
- Touch your top of the head

- The hand behind head
- The hand behind back

4.8.2. CONVENTIONAL PHYSICAL THERAPY:

Conventional physical therapy was given for 1 to 1 ½ hours a day for 5 days a week. Totally 15 sessions were given for 3 weeks.

STRETCHING

- Type: Manual angular passive stretching.
- Hold time: 15sec.
- Repetitions: 5 times.
- Muscles: Biceps, Wrist flexors, Hamstrings, Tendo Achillies.

RANGE OF MOTION EXERCISE

- Active and active assisted range of motion exercises were done for the upper limb and lower limb.
- Repetition: 10 times.

NORMALIZATION OF MUSCLE TONE

- » Slow sustained stretching of agonistic spastic muscles through all the range of motion.
- » Cryotherapy to Biceps & Hamstrings.
- » Weight bearing positions. (Kneeling, Quadruped)
- » Slow rocking movements. (Rocking the body over the elongated body)
- » Superficial and deep pressure over the tendon of the muscles to increase muscles tone in hypotonic muscles.
- » Stretching: Quick stretching to facilitate muscle tone.

ELECTRICAL STIMULATION

- » Electrical stimulation was given to muscles of upper limb and lower limb.
- » Type of current used: Faradic current.
- » Pulse duration: 1 ms.
- » Pulse frequency: 50Hz.
- » Pulse amplitude: sufficient enough to achieve desired strength of contraction.
- » Muscles: Triceps, Wrist and Finger extensors, Dorsiflexors of ankle.

» Number of contractions based on the response of the muscles in order to avoid muscle fatigue.

SITTING BALANCE

» Head and trunk movements
» Sitting on firm surface, hands on lap, feet and knees approximately 15 cm apart feet on floor.
» Turning head and trunk to look over the shoulder return to mid position and repeating to other side.
» Looking up at the ceiling and returning to upright.

STANDING BALANCE

» Head and body movements
» Standing with feet a few inch apart, look up at ceiling and return to upright.
» Standing with the feet a few inch apart, turn the head and body mass and look behind, return to mid position. Repeat on other side.

SINGLE LEG STANDING

» Steeping forward with non paretic limb to place foot on the step

» Standing on either foot on the step, practice reaching in all directions

GAIT TRAINING

» Standing with in parallel bar or on the level ground, feet few inch apart, walking with support-alternative feet forward progression.

» Standing with in parallel bar or on the level ground -walking sideways

4.9. OUTCOME MEASURE

- The upper extremity section of the Fugl-Meyer Assessment (FMA) of motor recovery after stroke

4.10. STATISTICAL TESTS:

INDEPENDENT `t' TEST (between groups)

$$t = \frac{\overline{X1} - \overline{X2}}{S} \sqrt{\frac{n_1 n_2}{(n_1 + n_2)}}$$

Where,

$$S = \sqrt{\frac{\sum d_1^2 + \sum d_2^2}{n_1 + n_2 - 2}}$$

PAIRED `t' TEST (within groups)

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

Where,

$$S = \sqrt{\frac{\sum d^2 - [\bar{d}]^2 \times n}{n-1}}$$

S=combined standard deviation

$d_1 \& d_2$ =difference between initial & final readings in group 1 &group 2 respectively.

$n_1 \& n_2$=number of patients in group 1 & group 2 respectively.

$\overline{X_1} \& \overline{X_2}$ =Mean of group 1 & group 2 respectively.

5. DATA PRESENTATION AND RESULTS

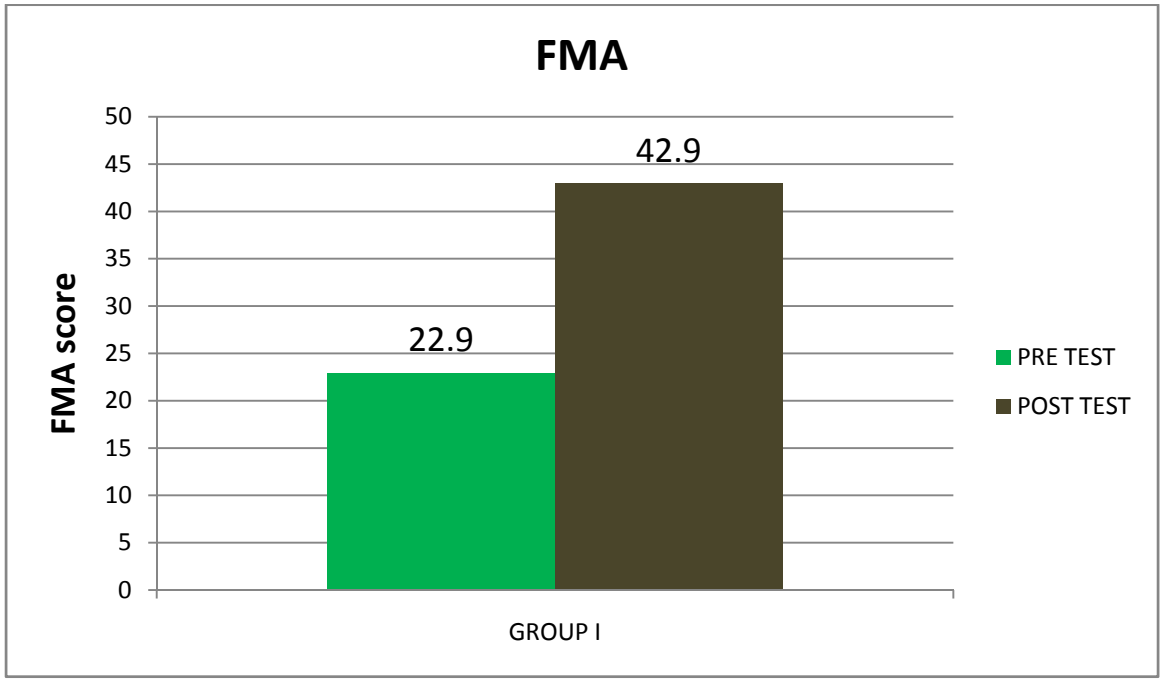
5.1. TABULAR AND GRAPHICAL PRESENTATION:

Group 1(Motor Imagery and conventional therapy):

Table 1: Paired‘t’ test of Fugl-Meyer Assessment (Upper extremity section) for Group 1

MEAN	GROUP1	
	PRE TEST	POST TEST
	22.9	42.9
CALCULATED ‘T’ VALUE	16.08	
TABLE ‘T’ VALUE	1.833	
MEAN DIFFERENCE	20	

For 9 degrees of freedom and at 5% level of significance, the table value is 1.833 and the calculated ‘t’ value is 16.08. The calculated value is greater than the table value, so alternate hypothesis (H_{a1}) is accepted.



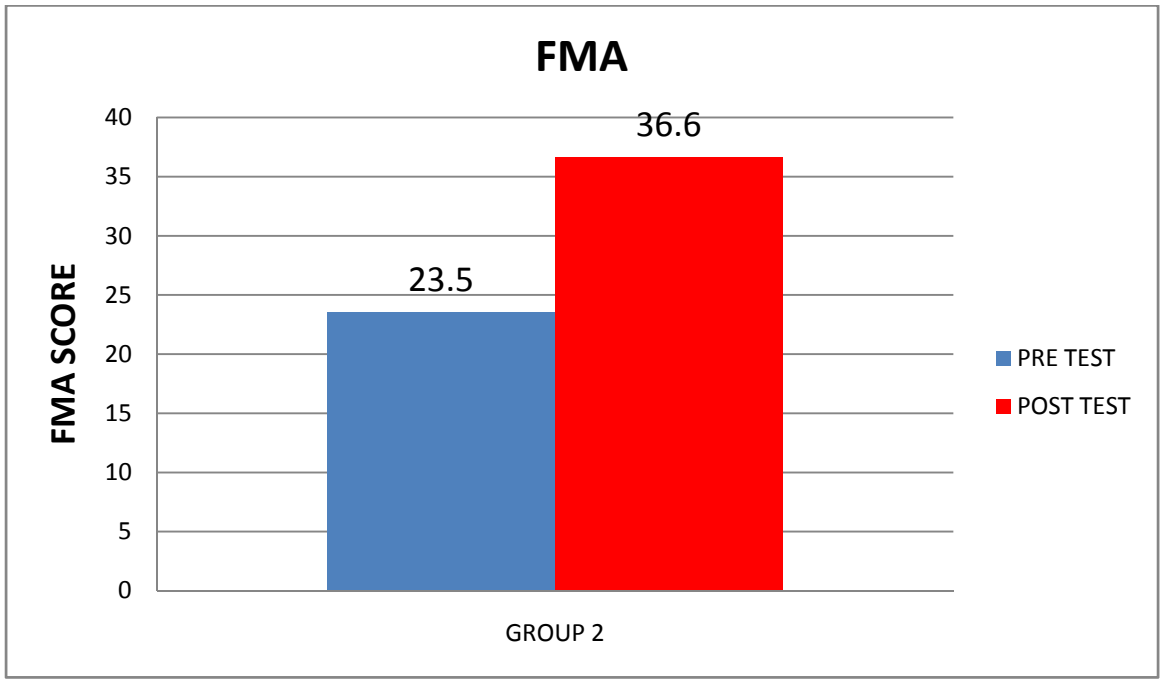
Graph 1: Pre test and Post test mean values of FMA scale for Group1.

Group 2(Conventional therapy):

Table 2: Paired‘t’ test of Fugl-Meyer Assessment (Upper extremity section) for group 2

MEAN	GROUP 2	
	PRE TEST	POST TEST
	23.5	36.6
CALCULATED ‘T’ VALUE	8.39	
TABLE ‘T’ VALUE	1.833	
MEAN DIFFERENCE	13.3	

For 9 degrees of freedom and at 5% level of significance, the table value is 1.833 and the calculated ‘t’ value is 8.39. The calculated value is greater than the table value, so alternate hypothesis (H_{a2}) is accepted.



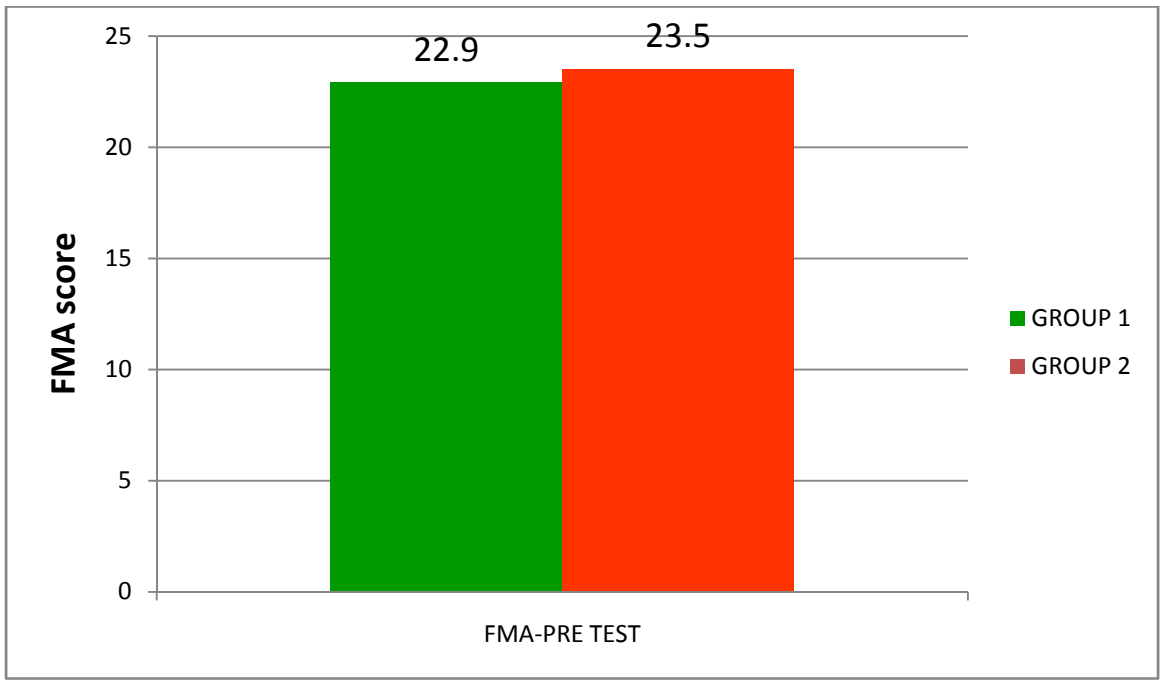
Graph2: Pre test and Post test mean values of FMA scale for Group2.

COMPARISON BETWEEN GROUPS:

Table 3: Independent‘t’ test for Pre test values of Fugl-Meyer Assessment (Upper extremity section)

MEAN	FMA(PRE TEST)	
	GROUP 1	GROUP 2
	22.9	23.5
CALCULATED ‘T’ VALUE	0.85	
TABLE ‘T’ VALUE	1.734	
MEAN DIFFERENCE	0.6	

For 18 degrees of freedom and at 5% level of significance the table value is1.734. The calculated value is 0.85. The calculated value is less than the table value, so there is no significant difference exists between per test values of group 1 and group2.

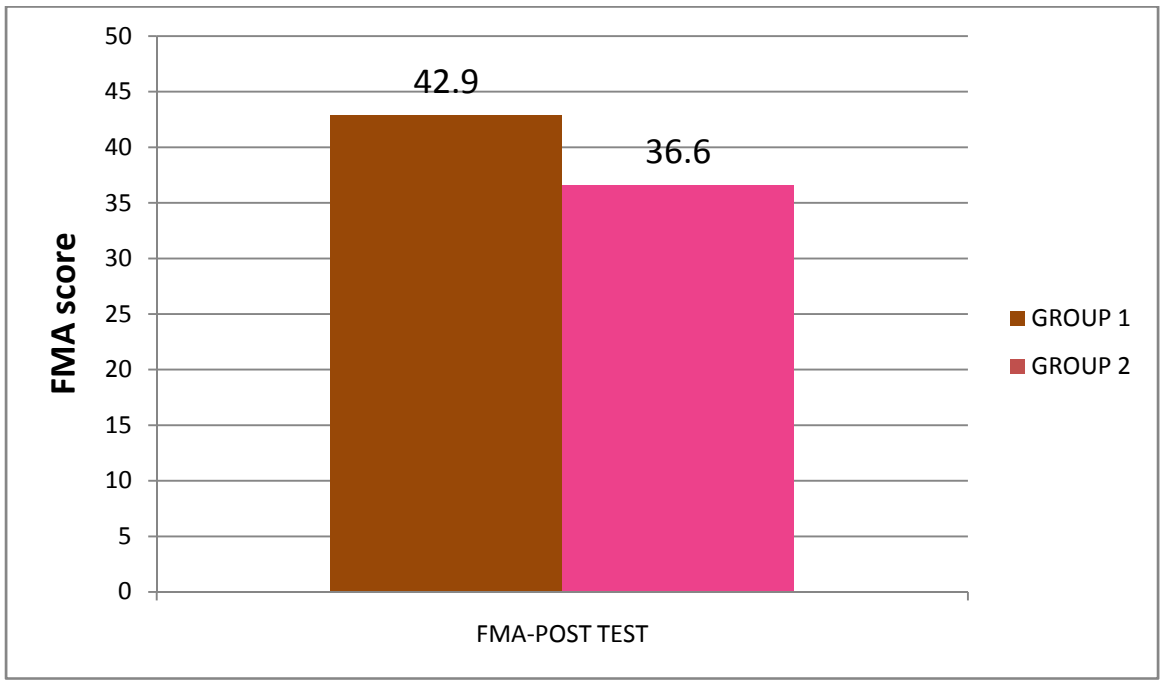


Graph3: Pre test mean values in FMA scale.

Table 4: Independent ‘t’ test for Post test values of Fugl-Meyer Assessment (Upper extremity section).

MEAN	FMA(POST TEST)	
	GROUP 1	GROUP 2
	42.9	36.6
CALCULATED ‘T’ VALUE	2.35	
TABLE ‘T’ VALUE	1.734	
MEAN DIFFERENCE	6.3	

For 18 degrees of freedom and at 5% level of significance the table value is1.734. The calculated value is 2.35. The calculated value is greater than the table value, so alternate hypothesis (H_{a3}) is accepted.



Graph4: Post test mean values of FMA scale.

5.2 DATA ANALYIS AND RESULTS

GROUP 1:

OUTCOMES IN FMA:

The mean value of per test and post test are 22.9 and 42.9 respectively. The calculated‘t’ value is16.08 at 9 degrees of freedom at 5% level of significance (Table 1 & Graph 1). Since the calculated value is greater than table value, the alternate hypothesis (H_{a1}) is accepted. Thus, there is a significant improvement in upper extremity function with motor imagery and conventional physical therapy in stroke patients.

GROUP 2:

OUTCOMES IN FMA:

The mean value of per test and post test are 23.5 and 43.3 respectively. The calculated‘t’ value is 8.39 at 9 degrees of freedom at 5% level of significance (Table 2 & Graph 2). Since the calculated value is greater than table value, the

alternate hypothesis (H_{a2}) is accepted. Thus, that there is a significant improvement in upper extremity function with conventional physical therapy in stroke patients.

BETWEEN GROUPS:

PRE TEST VALUES IN FMA:

The pre test mean values for Group 1 and Group 2 are 22.9 and 23.5 respectively. The calculated‘t’ value is 0.85 at 18 degrees of freedom at 5% level of significance (Table 3 & Graph 3). Since the calculated value is less than the table value there is no significant difference exists between pre test values and homogeneity is maintained.

POST TEST VALUES IN FMA:

The post test mean values for Group 1 and Group 2 are 42.9 and 36.6 respectively. The calculated‘t’ value is 2.35 at 18 degrees of freedom at 5% level of significance (Table 4 & Graph 4). Since the calculated value is greater than table value the alternate hypothesis (H_{a3}) is accepted. Thus, there is a significant difference between group1 (motor imagery and conventional physical therapy) and group 2 (conventional physical therapy) in upper extremity function.

6. DISCUSSION

Stroke is one of the common causes of disability affecting the human population. More than fifty percentages of patients with upper extremity disability following stroke face long term impairment of arm function and consequent disability in daily life [21].

Upper extremity disability is one of the most prevalent conditions treated by physical therapists. Traditionally the practice provided in neurological rehabilitation has focused on reducing motor impairments and minimizing physical disability. Intensive rehabilitation is expansive, however and many managed care organizations provide their client with a limited number of therapy sessions before they stop financing rehabilitation.

Motor imagery is a cognitive process in which a person imagines that he or she performs a movement without actually performing the movement even tensing

the muscles. It is a dynamic state which involved in the representation of a specific motor action is internally activated without any motor output[33].

Motor imagery is cost effective, non invasive tool when combined physical practice can receive additional practice of functional skills and benefit greater outcomes.

The Fugl Meyer assessment[16] of the upper extremity is the most widely used clinical assessment of post stroke upper extremity impairments and showed a high inter rater and intra rater reliability. The fugl meyer scale assess several dimensions of impairment, including range of motion and pain sensation.

The specific items in the upper extremity sub sections were originally derived from Brunstroms stages of post stroke recovery. It can be used to evaluate the physical performance as a whole in post stroke hemiplegic patient.

This was a pretest and post test experimental study, conducted on 20 Middle Cerebral Artery ischemic stroke patients. Patients who met all the inclusion criteria were randomly allocated into Group1 (n=10) and Group2 (n=10).

Patients in Group 1 underwent Motor Imagery along with conventional physical therapy. Patients in Group 2 were given conventional physical therapy alone. Motor imagery was given for 1 hour (two 20 mins period of motor imagery and 10 mins rest in between) a day for 5 days a week. Totally 15 sessions of motor imagery was given. The upper extremity section of the Fugl-Meyer Assessment (FMA) of motor recovery after stroke was used as outcome measure. Results were analysed using paired‘t’ test and independent‘t’ test.

According to the results obtained the from paired‘t’ test, the patients in group 1 who underwent motor imagery with conventional physical therapy showed a significant improvement in upper extremity function. Also patients in group 2 who underwent conventional physical therapy showed a significant improvement in upper extremity hand function. By this both the treatment strategies which are used in this study were found to be effective in improving the upper extremity and hand function in stroke patients.

By comparing both the groups with independent‘t’ test, the patients in group 1 who underwent motor imagery and conventional therapy showed a greater improvement than the patients in group2 who underwent conventional physical therapy alone.

The significant improvement in group 1 patients is considered to be because of neurophysiological changes during motor imagery.

Motor imagery activates the neural pathways which are normally activated while actively performing a movement. The neural pathways both in motor cortex and in corticospinal tract are activated. Motor imagery when it is combined with physical practice enhances the neural plasticity and helps in cortical reorganization than physical practice alone.

Kimberley et al. 2006 [25], Jeannerod 2001[22], Gerardin et al. 2000 [17] also confirmed the involvement of neural pathways during imagination of a task.

Stippich et at. 2002 [46], Fadia et al. 1999 [14] concluded that motor imagery activates the movement specific central activation pattern.

During mental rehearsal of a task the visual and kinaesthetic information's are maintained and manipulated in the working memory, which is consistent with brain activation patterns.

Francie Malouin et al. 2004 [15] also discussed the involvement of the working memory during motor imagery.

Motor imagery needs constant attention and concentration on the imaging task, which helps the patient to focus on the particular task throughout the intervention. But it is not necessary for the patient to fully focus on the task in physical practice, which sometimes leads to loss of brain activation.

Hence greater changes occur in the neural pathways with motor imagery than that which occurs with physical practice alone.

Hanakawa et al. 2003[19,] Dechent et al. 2004 [10] in their study confirmed the involvement of the premotor, supplementary motor, cingulated and parietal cortical areas, basal ganglia and cerebellum during the imagination of a movement.

With the advantages of greater proportionate changes that occur in muscular level with the conventional therapy and at cortical level with the motor imagery, it is advisable to combine motor imagery with conventional physical therapy.

7. SUMMARY AND CONCLUSION

The study was done to find out the effect of motor imagery with conventional physical therapy in upper extremity function in stroke patients. This study was conducted on 20 middle cerebral artery ischemic stroke patients, divided into 2 groups. Patients in Group 1(n=10) underwent Motor Imagery along with conventional physical therapy. Patients in Group 2(n=10) were given conventional physical therapy alone. The upper extremity section of the Fugl-Meyer Assessment (FMA) of motor recovery after stroke was used as outcome measure to assess the upper extremity functions.

In statistical analysis at 5% level of significance, paired‘t’ test shows that the patients in both group 1 and group 2 showed a significant improvement in upper extremity function. Also, at 5% level of significance, independent‘t’ test shows the patients in group 1 showed a greater improvement than the patients in group2.

Therefore it is concluded that motor imagery can be incorporated with conventional physical therapy in upper extremity function in stroke patients.

8. LIMITATIONS AND SUGGESTIONS

- This study can be done in a large in a large number of samples.
- Study can be done in chronic stroke patients.
- This study was done only in MCA stroke. It can be done in other artery involvement such as ACA and PCA.
- There was no account of long term effects of treatment in this study. So in future studies long term effects can be assessed.
- The duration of the treatment can be increased for a longer time.
- Other outcome measures such as STREAM can be used.
- The study took into account only the upper limb function, thus lower limb can also be assessed.

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APPENDIX I

ASSESSMENT FORM

Name:

Age: Sex:

Occupation:

Date of admission:

Date of assessment:

IP/OP Number:

Address:

Selection criteria

MIQ-R Score:

Modified Ashworth scale score:

Outcome measures

SCALE	PRE TEST	POST TEST
FUGL-MEYER ASSESSMENT (UPPER EXTREMITY)		

APPENDIX II

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY

I _____ voluntarily consent to participate in the research study “EFFECT OF MOTOR IMAGERY WITH CONVENTIONAL PHYSICAL THERPAY ON UPPER EXTREMITY AND HAND FUNCTIONS I9N STROKE PATIENTS”.

The researcher has explained me about the research in brief, the risk of participation and has answered the questions related to the research to my satisfaction.

Signature of the applicant: **Signature of the witness:**

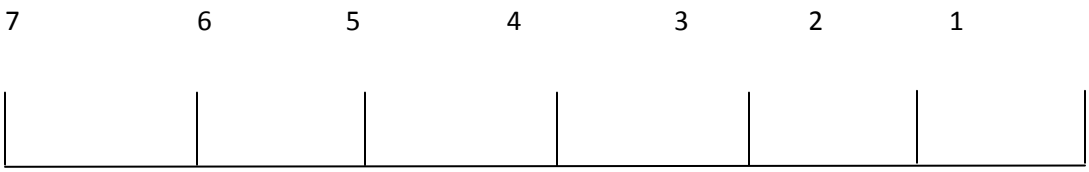
Signature of the researcher: **Date:**

APPENDIX III

MOVEMENT IMAGERY QUESTIONNAIRE – REVISED (MIQ-R)

Craig R. Hall and Kathleen A. Martin, 1997

Visual Imagery Scale



Very easy To see	Easy to see	Somewhat Easy to see	Neutral (Not easy not hard	Somewhat Hard to see	Hard to see	Very Hard to see

Kinesthetic Imagery Scale

Very easy To Feel	Easy to Feel	Somewhat Easy to Feel	Neutral (Not easy not hard	Somewhat Hard to Feel	Hard to Feel	Very Hard to Feel

MOVEMENT IMAGERY QUESTIONNAIRE REVISED TEST ITEMS

1. **STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.

   ACTION: Raise your right knee as high as possible so that you are standing on your left leg with your right leg flexed (bent) at the knee. Now lower your right leg so that you are again standing on two feet. Perform these actions slowly.

   MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

2. **STARTING POSITION:** Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up in the air as high as possible with both arms extended above the head. Land with your feet apart and lower your arms to your sides.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

3. **STARTING POSITION:** Extend the arm of your nondominant hand straight out to your side so that it is parallel to the ground, palm down.

   ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.

   MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

4. **STARTING POSITION:** Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

5. **STARTING POSITION:** Stand with your feet slightly apart and your hands at your sides.

ACTION: Bend down low and then jump straight up into the air as high as possible with both arms extended above the head. Land with your feet apart and lower your hands to your sides.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

6. **STARTING POSITION:** Stand with your feet and legs together and your arms at your sides.

ACTION: Raise your right knee as high as possible so that you are standing on two feet. Perform these actions slowly.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

7. **STARTING POSITION:** Stand with your feet slightly apart and your arms fully extended above your head.

ACTION: Slowly bend forward at the waist and try and touch your toes with your fingertips (or if possible, touch the floor with your fingertips or hands). Now return to the starting position, standing erect with your arms extended above your head.

MENTAL TASK: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

8. **STARTING POSITION:** Extend the arm of your non dominant hand straight out to your side so that it is parallel to the ground, palm down.

ACTION: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly.

MENTAL TASK: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

Rating

Movement Imagery Questionnaire (MIQ-R)

The Revised Movement Imagery Questionnaire (MIQ-R) (Hall & Martin, 1997) was used to assess each subject's ability to imagine movement. The purpose of the MIQ-R was to evaluate the subject's ability to see (visual imagery) and feel (kinesthetic imagery) movements. This instrument consists of 8 items, 4 visual and 4 kinesthetic, each item being a separate movement. The MIQ-R is a revised version of the MIQ (Hall & Pongrac, 1983). The test-retest coefficient for the MIQ is .83 for a 1-week interval (Hall, Pongrac, & Buckolz, 1985). Similarly, Atienza et al. (1994) reported internal consistencies of .89 for the visual subscale and .88 for the kinesthetic subscale of the MIQ. Hall and Martin (1997) found a significant correlation between the MIQ and the MIQ-R in both scales, visual and kinesthetic. They conclude that the MIQ-R is an acceptable revision of the MIQ.

Completing an item on the MIQ-R questionnaire requires several steps. First, the movement is produced by the subject exactly as described. Second, the movement is imaged either visually or kinesthetically (no movement is actually performed). Third, a value is assigned from a seven-point rating scale regarding the ease/difficulty with which the movement was imaged. A low rating indicates that a movement is difficult to image and a high rating indicates that a movement is easy to image. A visual score and a kinesthetic score for each subject is obtained by summing the items. Therefore, each of these two scores (visual and kinesthetic) can range from 4-26.

APPENDIX IV
THE UPPER EXTREMITY SECTION OF FUGL MEYER ASSESSMENT

Test	Scoring criteria	Maximum possible score	Attained score
I.Reflexes a. biceps b. triceps	0-No reflex activity can be elicited 2-Reflex activity can be elicited	4	
II.Flexor Synergy Elevation Shoulder retraction Abduction(at least 90^0) External rotation Elbow flexion Forearm supination	0-Cannot be performed at all 1-Performed partially 2-Performed faultlessly	12	
III.Extensor Synergy Shoulder adduction/internal rotation Elbow extension Forearm pronation	0-Cannot be performed at all 1-Performed partially 2-Performed faultlessly	6	
IV.Movement Combining Synergy a. Hand to lumbar spine b. Shoulder flexion to 90^0 elbow at 0^0 c. Pronation/supination of forearm with elbow at	a. 0-No specific action performed 1-hand must pass ASIS 2-action performed faultlessly b. 0-Arm is immediately abducted or elbow flexes at start of motion. 1-abduction or elbow		

90^0 and shoulder at 0^0	flexion in later phase of motion 2-Faultless motion c. 0-correct positon of shoulder and elbow cannot be attained, and/or pronation or supination cannot be performed 1-active pronation/supination can be performed even within a limited ROM. And at the same time the shoulder and elbow are correctly positioned. 2-complete pronation supination with correct positions at shoulder and elbow	6	
V.Movement Out of Synergy a. Shoulder abduction to 90^0 elbow at0^0 and forearm pronated b. Shoulder flexion, 90-180^0 and forearm in mid position c. Pronation/supination of forearm elbow at 0^0 and shoulder between 30-90^0 of flexion	a. 0-initial elbow flexion occurs or any deviation from pronated forearm occurs 1-motion can be performed partly, during motion elbow is flexed or forearm deviates 2-Faultless motion b. 0-initial elbow flexion or shoulder abduction 1-elbow flexion or shoulder abduction, occurs during shoulder flexion 2-Faultless motion c. 0-supination and pronation cannot be	6	

	performed at all/or elbow and shoulder position can be attained 1-elbow and shoulder properly positioned and motion performed in limited range 2-Faultless motion		
VI.Normal reflex activity Biceps and/or finger flexors and triceps	0-atleast 2 of 3 phasic reflexes are markedly hyper active 1-one reflex is hyper active or at least 2 reflexes are lively 2-no more than one reflex is lively and none are hyper active	2	
VII. Wrist a. Stability, elbow at 90^0 shoulder at 0^0 b. Flexion/extension, elbow at 90^0, shoulder at 0^0 c. Stability, elbow at0^0 shoulder at 30^0 d. Flexion/extension elbow at 0^0 shoulder at 30^0 e. Circumduction	a. 0-cannot dorsiflex wrist to 15^0 1-dorsiflexion is accomplished no resistance taken 2-can be maintained with some resistance b. 0-volitional movement does not occur 1-cannot move wrist actively throughout ROM 2- faultless smooth movement c. Same as a. d. Same as b. e. 0-cannot be performed 1-jerky/incomplete 2-complete motion	10	

VIII. Hand a. Finger mass flexion b. Finger mass extension c. Grasp 1 MP's extended, IP's flexed d. Grasp 2 thumb adduction with first CMC and IP at 0^0 e. Grasp 3 oppose thumb pad against index pad f. Grasp 4 holding a cylindrical object g. Grasp 5 a spherical grasp.	a. 0-no motion 1-partial motion 2-complete motion b. Same as a. c. 0-required position cannot be acquired 1-weak grasp 2-grasp can be maintained against resistance d. 0-cannot be performed 1-scrap of paper inter posed , but not against a slight tug 2-paper is held firmly against a tug e. Same as d. f. Same as d. e. g. Same as d. e. f.	14	
IX.Hand Coordination/speed finger to nose (5 repetitions in rapid succession). a. Tremor b. Dysmetria c. Speed	a. 0-marked tremor 1-slight tremor 2-no tremor b. 0-pronounced or unsystematic dysmetria 1-slight or systemic dysmetria 2-no dysmetria c. 0-activity is more than 6 sec longer than unaffected hand 1-2 to 5 sec longer than unaffected hand 2-less than 2 sec difference	6	
Total maximum score		66	

APPENDIX V

MODIFIED ASHWORTH SCALE FOR GRADING SPASTICITY

GRADE	DESCRIPTION
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of ROM when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch followed by minimal resistance throughout the reminder (less than half) of ROM
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement is difficult
4	Affected part(s) rigid in flexion or extension

APPENDIX VI

DATA PRESENTATION

GROUP I

FUGL MEYER ASESSMENT		
S.NO	PRE TEST	POST TEST
1.	27	48
2.	23	52
3.	21	39
4.	27	51
5.	24	41
6.	19	39
7.	19	37
8.	26	43
9.	20	40
10.	23	39

GROUP II

FUGL MEYER ASESSMENT		
S.NO	PRE TEST	POST TEST
1.	20	36
2.	31	55
3.	23	39
4.	26	37
5.	18	34
6.	24	33
7.	28	38
8.	20	28
9.	22	34
10.	23	32