MOTOR IMAGERY TOGETHER WITH CONVENTIONAL THERAPY WILL BE EQUAL TO OR MORE EFFECTIVE THAN CONVENTIONAL ALONE FOR IMPROVEMENT OF GAIT IN STROKE PATIENT

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Abstract

Strokes can result in many different disabilities, ranging from motor control and urinary incontinence to depression and memory loss. Stroke usually occurs on only one side of the brain, so decreased motor control (the ability to move muscles in a coordinated manner) usually develops on only one side of the body. Total 30 participants including both male and female who were previously diagnosed by Neurologist was recruited for the study. Subject will be selected as per convenient sampling and assigned into two groups i.e. Group –A (Experimental group) and Group-B (Control Group). In group-A subjects were given motor imagery and conventional therapy both; in group-B subjects were given conventional therapy alone. This group received Motor imagery (10-15 minute) & Conventional therapy (30-40 minutes) both and it was given in single session of 45-50 minutes. The program was conducted for 3 times per week. Total duration of both programs was for 4 weeks. For group B Intervention of Conventional therapy alone was given for 30-40 min. No significant differences were found between the groups regarding their age. Group A got 13 subjects with (mean age = 65.46 years $\pm$ 7.55) and Group B got 13 subjects with (mean age = 65.69 $\pm$ 5.58). Both programs were conducted in the respective participant's home and hospital environment. The procedure requires only a stopwatch, two felt tip marking pens with washable ink, and a 16-m (53ft) walkway that is premeasured and marked with masking tape at four points. Initially subjects were introduced with Motor Imagery technique. Statistics are performed by using SPSS 13 and Sigma state. t- Test was used for analysis of data. Paired t-test was applied to compare the data of Gait assessment (stride length, step length, gait velocity and cadence) within group. Student t-test was used to compare the data of gait assessment (stride length, step length, gait velocity and cadence) between groups. The statistical significance was set at 0.05 at 95% confidence interval and P value <0.05 was considered significant.

Key words: Strokes, Gait assessment, Motor Imagery and Conventional therapy.

1. INTRODUCTION:

Strokes can result in many different disabilities, ranging from motor control and urinary incontinence to depression and memory loss. Stroke usually occurs on only one side of the brain, so decreased motor control (the ability to move muscles in a coordinated manner) usually develops on only one side of the body. In fact, one side of the body may be paralyzed (hemiplegia), or muscles on the affected side may be weakened (hemiparesis). Because of the weakness or paralysis in large muscle groups, injuries from falls are common complications of motor control disturbances²

Functional magnetic resonance imaging (fMRI) showed activation in frontal, parietal cortical and sub-cortical areas that are involved in action planning, execution and modulation. Recently, the first fMRI study was published that investigated brain activation during imagination of whole body movements, supporting the findings from many MI intervention studies in sport psychology⁶. Functional brain imaging studies have indicated that several cortical and subcortical areas active during actual motor performance are also active during imagination or mental rehearsal of movements⁹

In the absence of the movement, there is detectable EMG activity during motor imagery, this shows there is a cortical excitability with no changes in spinal excitability⁷. Motor imagery is a high level process which however manifests itself in the activation of those same cortical circuits that are normally involved in the movement execution⁸. Imagery practice should focus on its specific impairments during gait in order to affect the performance of the paretic lower extremity with conventional therapy⁴⁻¹².

2. METHODOLOGY

2.1 Sample

Total 30 participants including both male and female who were previously diagnosed by Neurologist was recruited for the study.

2.2 Source of Subject

Subjects were taken from:

Institute of Liver and Biliary Sciences Hospital, New Delhi

Fortis Escorts Heart Institute & Research Centre Hospital, Okhla Road, New Delhi

Saket City Hospital, Saket, New Delhi

Bhopal Memorial Hospital & Research Centre (BMHRC), Bhopal (M.P.)

Narmada Trauma Centre, Bhopal (M.P.)

2.3 Study Design

2.3.1 Method of Selecting and Assigning Subject

Subject will be selected as per convenient sampling and assigned into two groups i.e. Group –A (Experimental group) and Group-B (Control Group). In group-A subjects were given motor imagery and conventional therapy both; in group-B subjects were given conventional therapy alone.

2.3.2 Inclusion Criteria

1. Ambulatory Stroke patients. Can ambulate 16 meter (with or without assistive device).
2. Stroke of at least 3 months duration.
3. No serious unstable medical complication.
4. Not receiving any other form of physiotherapy for lower limb.
5. Mini-mental state examination. (> 23).
6. Movement Imagery Questionnaire – Revised second (MIQ-RS): (score of 98 is good, score of 14 is worst.)

2.3.3 Exclusion Criteria

1. Spinal deformity.
2. History of spinal trauma or head injury.
3. Any other neurological disease.
4. Unhealed Fractures.
5. Peripheral arterial occlusive disease.
6. Orthopaedic disorder involving any joint of lower limbs.
7. History of neurologic disease other than the chronic stroke

2.4 Instrumentation

1. Plinth or couch. (Performing motor imagery)

2. Stopwatch. (For evaluation of gait velocity)
3. Plain surface for walk test(at least 16 m)
4. Chart paper. (6 + 6 m per subject)
5. White board marker (for heel strike mark)
6. Adhesive tape & double tape (for attachment of marker with shoe)
7. Inch/Measuring tape (measurement of space and chart)
8. Scale (measurement of step length and stride length)

2.5 Outcome Measure

1. Stride length measurement: (the average of middle three strides) cm
2. Step length measurement: (the average of the middle three steps) cm
3. Gait velocity measurement: $(6m \times 60 \text{ sec} \div \text{time for walk in sec}) \text{ m/min}$
4. Cadence measurement: $(\# \text{ marks} \times 60 \div \text{time for walk in sec}) \text{ steps/min}$

2.6 Protocol

This study consisted of two groups- Experimental group (A) and Control group (B). 26 subjects were chosen as per the inclusion and exclusion criteria, and informed consent was obtained from all subjects after the procedure was explained to them.

The 4 weeks intervention was given to the subjects of both groups alternately, 3days a week for Group A and 3days a week for group B. 45-50 minutes protocol for Group A and 30-40 minutes protocol for Group B.

2.6.1 Group-A Protocol

This group received Motor imagery (10-15 minute) & Conventional therapy (30-40 minutes) both and it was given in single session of 45-50 minutes. The program was conducted for 3 times per week. Total duration of both programs was for 4 weeks.

Motor Imagery technique used: The internal as well as external imagery scenes were applied in this intervention protocol. The 2 main goals were:

- To facilitate movement and posture of the

affected lower extremity during gait by focusing on specific impairments

- To enhance functional walking within subjects own environment

Conventional therapy technique used: The Conventional therapy for gait training in this group was given as per the protocol of Group B.

2.6.2 Group-B Protocol

In this group Intervention of Conventional therapy alone was given for 30-40 min. In Conventional gait training, Patient practiced functional,

Task-specific loco motor skill walking forward and side stepping) (5 minutes)

Elevation activities (e.g. step-up/step-down, lateral step-up, stair climbing,)

Community activities (walking on ramps, curves and over and around obstacles), and Quadriceps strengthening.⁴⁸

2.7 Procedure

A total of 26 subjects who were previously diagnosed as cases of Stroke by a Neurologist and met the inclusion criteria of the study were included in the study. The participants were screened by – mini mental state examination, before they were selected for the study. Prior to enrolling into the study, need and purpose of study were told to the participants. Informed consent was signed before study. Having given informed consent, subjects were allocated by convenient sampling into Motor Imagery & Conventional therapy both i.e. GROUP A and Conventional therapy alone i.e. GROUP B. Participants who were unable to perform or understand Motor Imagery task were excluded from Groups. They were allowed to terminate their participation at any time during study. There were 2 groups each with 26 participants. After obtaining a written consent form, demographic data were collected. No significant differences were found between the groups regarding their age. Group A got 13 subjects with (mean age = 65.46 years $\pm$ 7.55) and Group B got

front of subject and instructed for walk over the stick.

Quadriceps Strengthening: Resistive strength training was given to subject by tying weight cuff to the foot, and performing extension of knee.

3. RESULT AND DISCUSSION:

Statistics are performed by using SPSS 13 and Sigma state. t- Test was used for analysis of data. Paired t-test was applied to compare the data of Gait assessment (stride length, step length, gait

velocity and cadence) within group. Student t-test was used to compare the data of gait assessment (stride length, step length, gait velocity and cadence) between groups. The statistical significance was set at 0.05 at 95% confidence interval and P value <0.05 was considered significant.

Student T-test was done to compare the data of pre stride length between the groups. (p=0.928) [Table-1]

Table 1: Shows Mean and SD of Pre-Stride length (SDL) for Group-A and Group-B

SDL	Group-A		Group-B	
PRE	Mean	SD	Mean	SD
	65.03	15.08	64.46	17.14
	t= .091			
	P=.928			

Paired t-test was done to compare the data of Stride length within the groups. For Stride length both the groups showed significant difference [Group A (p=0.023) and Group B (p=0.000) [Table-2].

Table 2: Shows Mean and SD of Pre-Stride length (SDL) & Post-Stride length (SDL) for Group-A and Group-B

Group-A				Group-B			
SDL				SDL			
PRE		POST		PRE		POST	
Mean	SD	Mean	SD	Mean	SD	Mean	SD
65.03	15.08	79.00	24.41	64.46	17.14	74.301	19.3
t= 2.629				t=5.009			
P= 0.023				P=0.000			

Student T-test was done to compare the data of post stride length between the groups. (p=0.592) [Table-3]

Table 3: Shows Mean and SD of Post-Stride length (SDL) for Group-A and Group-B

SDL	Group-A		Group-B	
POST	Mean	SD	Mean	SD
	79.00	24.4123	74.3077	19.3052
	t=.544			
	P=.592			

Student T-test was done to compare the data of pre step length between the groups. (p=0.777) [Table-4]

Table 4: Shows Mean and SD of Pre-Step length (STL) for Group-A and Group-B

STL	Group-A		Group-B	
PRE	Mean	SD	Mean	SD
	31.4200	7.76	31.13	7.15
	t= -.286			
	P=.777			

Paired t-test was done to compare the data of Step length within the groups. For Step length both the groups showed significant difference [Group A (p=0.024) and Group B (p=0.002)] [Table-5].

Table 5: Shows Mean and SD of Pre-Step length & Post-Step length (STL) for Group-A and Group-B

Group-A				Group-B			
STL				STL			
PRE		POST		PRE		POST	
Mean	SD	Mean	SD	Mean	SD	Mean	SD
31.42	7.7	38.17	12.09	31.13	7.15	36.07	9.2
t=2.59				t=3.825			
P=0.024				P=0.002			

Student T-test was done to compare the data of post step length between the groups. (p=0.631) [Table-6]

Table 6: Shows Mean and SD of Post-Step length (STL) for Group-A and Group-B

STL	Group-A		Group-B	
POST	Mean	SD	Mean	SD
	38.1754	12.5092	36.0738	9.2997
	t=.486			
	P=.631			

Student T-test was done to compare the data of pre Gait velocity between the groups. (p=0.459) [Table-7]

Table 7: Shows Mean and SD of Pre-Gait velocity (VL) for Group-A and Group-B

VL	Group-A		Group-B	
PRE	Mean	SD	Mean	SD
	27.1492	10.9446	26.824	10.0134
	t= -.753			
	P=.459			

Paired t-test was done to compare the data of Gait velocity within the groups. For Gait velocity both the groups showed significant difference [Group A (p=0.015) and Group B (p=0.000)] [Table-8].

Table 8: Shows Mean and SD of Pre-Gait velocity & post-Gait velocity for Group-A and Group-B

Group-A				Group-B			
VL				VL			
PRE		POST		PRE		POST	
Mean	SD	Mean	SD	Mean	SD	Mean	SD
27.14	10.9	36.86	23.0	26.89	7.2	34.9	11.47
t=2.09				t=4.916			
P=0.015				P=0.000			

Student T-test was done to compare the data of post Gait velocity between the groups. (p=0.959) [Table-9]

Table 9: Shows Mean and SD of Post-Gait velocity for Group-A and Group-B

VL	Group-A		Group-B	
Post	Mean	SD	Mean	SD
	36.8615	23.0036	36.4823	13.0434
	t=.052			
	P=.959			

Paired t-test was done to compare the data of Cadence within the groups. For Cadence both the groups showed significant difference [Group A (p=0.024) and Group B (p=0.002)] [Table-10].

Table 10: Shows Mean and SD of Pre-Cadence & Post-Cadence for Group-A and Group-B

Group -A				Group-B			
CAD				CAD			
PRE		POST		PRE		POST	
Mean	SD	Mean	SD	Mean	SD	Mean	SD
74.63	23.76	85.89	33.39	74.18	19.69	83.72	23.29
t=2.578				t=3.848			
P=0.024				P=0.002			

Student T-test was done to compare the data of post cadence between the groups. (p=0.844) [Table-11]

Table 11: Shows Mean and SD of Post-Cadence (CAD) for Group-A and Group-B

CAD	Group-A		Group-B	
POST	Mean	SD	Mean	SD
	85.8938	33.1907	83.7215	21.0913
	t=.199			
	P=.844			

- From above graphs and tables we can say that both treatments were effective for both groups.
- From above graphs and tables we can say/infer that Group A showed significant improvement as compared to Group B in Step length, Stride length, Gait velocity and Cadence.
- Gait assessment of Group A showed significant improvement at post intervention compared to Group B.
- From these Results we conclude that the Group A is better Than Group B.

DISCUSSION:

Our study aimed to improve walking. Walking is basic mobility and enhances independence to anyone. The ability to walk independently is a life enriching activity and the most efficient way of getting from one place to another in the course of our daily lives.

The temporospatial gait characteristics indicate that cadence is especially adversely affected by stroke and that the improvement in gait speed is mainly due to an increase in stride length and, to a lesser extent, to an increase in cadence.

There is significant improvement in post interventional readings of (for stride length $p=0.023$, for step length $p=0.024$, for gait velocity $p=0.015$ and for cadence $p=0.024$) Group-A, because as per previous studies conventional therapy with motor imagery gives significant effect in intervention. S.Corina et al. says that motor imagery with conventional therapy is effective in the time difference to perform the task from pre to post-intervention.⁵⁸ S.A. Zimmermann et.al says that evidence suggests Motor imagery provides additional benefits to conventional physiotherapy or occupational therapy.¹² Some author says that loco motor imagery training can be considered as a useful option for restoration of ambulation for individuals with chronic hemiparetic stroke who are unable to participate in physical gait training.¹⁴ Ehrsson et al. showed an activation of specific limb-areas in the primary motor cortex.³⁵ Motor Imagery is a dynamic state during which

the representation of a specific motor action is internally activated without any motor output.

In other words motor imagery requires the conscious activation of brain regions that are also involved in movement preparation and execution, accompanied by a voluntary inhibition of the actual movement. Some author reported that the activation of the pre-supplementary motor area and the primary motor cortex during imagery of loco motor movements.

Researchers hypothesized that movement execution; motor imagery and action observation are all driven by the same basic mechanism. Motor imagery and action observation are conceived as “offline” operations of the motor areas in the brain.

Researchers also reported that better equilibrium characteristics in elderly women as measured by walking balance and foot placement measures as a result of a combined treatment of motor imagery and physical therapy.⁵⁰ As Motor Imagery intervention did not sufficiently modify the asymmetry that is an inherent feature of hemiparesis so it should be given with conventional therapy.⁴

Some researchers says that Imagery, in association with therapy, appears to be a non-invasive, efficacious complement to traditional therapy that substantially reduces impairment and improves outcomes.³⁶

On other side there is significant improvement in Post-readings of (for stride length $p=0.000$, for step length $p=0.002$, for gait velocity $p=0.000$ and for cadence $p=0.002$) Group-B also because as per the previous research results, conventional therapy for stroke is effective for getting ambulation and improvement in gait. Researchers say that Task-specific activities with strength training are effective therapeutic interventions for post stroke. Possible mechanisms associated with response to therapy were related to improve motor unit activation associated with increased strength in key muscles used in gait.⁵¹

Authors present an intriguing hypothesis that over ground gait training such as walking forward, sideward's, may be better suited in educating patients regarding safety, while encouraging participation in therapeutic exercise to improve strength, cardiovascular fitness, movement efficiency, and agility. "Over ground gait training improves loco motor function and is a major goal of rehabilitation, and if patients want to improve walking, they need to practice walking. Over ground gait training represents the most task-specific approach in improving gait for individuals with hemiparesis after stroke."⁵²

It was also hypothesized that Muscle strengthening and physical conditioning are to reduce impairment and disability in chronic stroke survivors.⁵³

Stroke rehabilitation provides a targeted and organized plan to re-learn functions lost in the shortest period of time possible. Some studies suggest that successful and meaningful recovery is more likely to be accomplished if you are dedicated and keep a high level of motivation during your rehabilitation process.⁵⁴

It is recognized that repeated participation by patients in active physical therapeutic programs probably provides direct influence on the process of functional reorganization in the brain and enhances neurologic recovery. A key aspect of neural plasticity that has important implications for rehabilitation is the fact that the modifications in neuronal networks are use-dependent. Clinical trials have shown that forced use and functional training contribute to improved function.⁵⁵

Standardized community-based rehabilitation therapy also helps stroke patients to improve their neurological function.⁵⁶

Clinical studies demonstrated that training or inpatient rehabilitation increases cortical representation with subsequent functional recovery, whereas a lack of rehabilitation or training decreases cortical representation and delayed recovery.⁵⁷

Results of post readings in both groups (For pre stride length ($p=0.928$) and post stride ($p=0.592$), for pre step length ($p=0.777$) and post step length ($p=0.631$), for pre gait velocity ($p=0.459$) and post gait velocity ($p=0.959$), for pre cadence ($p=0.986$) and post cadence ($p=0.844$)) show significant improvement, but improvement in Group-A was more than Group-B. In past two studies it was seen that Motor imagery provided additional benefits to conventional physiotherapy when given for upper limb functioning¹². This can be a reason for the post intervention results of the present study where the mean value of experimental group showed better results than the mean value of control group. Researchers determined that embedded MI (Motor Imagery with conventional therapy) is superior to added MI (Conventional therapy separately). Brain areas activated during MI and real movements show a strong congruity for single arm movements as well as complex whole body movements in stroke patients.⁶

These studies and researches give evidence that the Motor Imagery with conventional therapy is beneficial in gait rehabilitation. Motor imagery takes less effort and gives motivation to the subject for performing tasks hence easy to apply.

4. CONCLUSION:

As per the results of the present study, Motor imagery program is found to be effective when given with conventional therapy in improving gait in stroke subjects. Moreover it can be done easily by the patient as it takes less effort and motivates the subject for performing the desired task. It also does not fatigue the patient. Thus, it is a feasible method and can be applied in conjunction with conventional therapy while treating stroke patients with gait issues.

Clinical Relevance: Motor imagery program can be given together with conventional therapy to improve gait in stroke subjects and it can be done easily as it takes less effort and gives motivation to the subject for performing tasks. Thus it does not fatigue the patient.

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