Effect of proprioceptive neuromuscular facilitation and motor imagery training to improve gait on sub-acute stroke

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ABSTRACT

Introduction and Aim: Stroke leads to persistent difficulties in walking and subsequently improved walking ability is one of the highest priorities in activities of daily living. Motor Imagery leads to excitation of similar areas of brain which are involved in actual performance of the movements. It has been demonstrated that even simple passive observation of motor movements activates the cortical motor areas. Hence this study aims to know the effect of Proprioceptive Neuromuscular Facilitation (PNF) and motor imagery training to improve gait in sub-acute stroke subject.

Materials and Methods: An experimental study was done for 60 sub-acute stroke patients using Convenient Sampling method. They were divided into Group A (n=20) (control group), Group B (n=20) (MI and Gait Training) and Group C (n=20) (PNF and Gait Training), followed up period of 2 months with intervention duration of 30 mins daily and were assessed with Morse Fall Risk and 10mins walk test. Paired t-Test was used for assessing pre and post values.

Results: There was a significant difference in Group B & Group C with $p<0.001$ at both Morse Fall Risk Score and 10 mins walk test.

Conclusion: Group-B Gait training with Motor Imagery Training improved significantly than other groups in Morse Fall Risk Score, cadence, Stride length, Walking velocity and Ten Minute Walk Test and were able to gain confidence and had better performance in their activities of daily living.

Keywords: Sub-acute stroke; motor imaginary; PNF; Morse fall risk.

INTRODUCTION

Muscle weakness is one of the most common impairments after stroke and it significantly contributes to reduced gait performance although the majority of the stroke patients achieve an independent gait but they lack their ability to perform their daily activities (1). Gait deficit are associated with significant functional limitation Hemi paretic gait pattern is characterized by being stereo typed with reduce weight bearing on the paretic lower limb Contacting the floor while the foot is flat is one of the most common stance phase kinematics disturbances (2). Activities of daily living are affected resulting from the impact of paralysis, poor coordination. Lack of awareness and one side of body is affected that causes difficulty in initiating movement or planning sequence of movement (3). Motor Imagery leads to excitation of similar areas of brain which are involved in actual performance of the movements. It has been demonstrated that even simple passive observation of motor movements activates the cortical motor areas. Motor imagery is a conscious process that induces the muscle activity related to an actual motor output by creating a mental image of the action without the intent of performing. It is a cognitive method which instead of forcing a patient to learn new techniques causes a neural change in order to obtain motor techniques learned before the stroke damage or imitate the action of others.

Motor imagery entail the cognitive task of imaging the performance of given movement or specific task without physically executing it. Motor imagery is also known as "Mental Practice". The mental imagery of the movement or task to be learned is systematically repeated. Studies using noninvasive brain stimulation techniques are allowed observation of cortical activation in motor areas during motor imagery and Neuro imaging studies have shown that there is cortical re organization after motor imagery in person with stroke (4).

There are innumerable physical therapeutic approaches used to improve motor control in person's recovery from stroke. These therapies aim to improve the biomechanical performance of lost or limited movement enhance the neural plasticity mechanism that occurs after central nervous system lesion avoid disuse and promote function within this context. The discovery of mirror neurons in the 1990 lead to the development of new therapeutic technique and approaches based on cognitive strategies such as use of virtual reality, mirror therapy, motor imagery.

PNF aimed at improving the muscle tone, strength, and flexibility. Wang reported that the effectiveness of PNF based treatment have been both supportive and conflicting (5). Influence of initial MI vividness on gait improvement. The study implies that hold relax techniques shown greater increment in the gait parameters. Most of the studies on PNF have mostly tested only gait speed, cadence and hardly functional ambulation's to help patients to achieve their higher functional level. PNF uses the body proprioceptive system to facilitate or inhibit the muscle contractions and to improve the activities of daily living. Hence this study aims to know the effect of PNF and motor imagery training to improve gait in sub-acute stroke subject.

METHODOLOGY

Comparative study of 60 chronic hemiplegic subjects from Neuro rehabilitation centre, Kovilambakkam and Chennai using convenient sampling were included in the study based on inclusion criteria: Age 40-60 years, both male and female subjects, Brunnstrom grading 4 and 5 in paretic lower limb, subjects who were able to walk with support or without support, subjects with MMSE score 24- 30, fall risk score 25 to 45. Exclusion criteria Patients with open wounds in leg, impaired sensory loss in leg, any recent surgeries in lower limb, deep vein thrombosis, any other neurological and orthopedic conditions. Then informed consent was obtained from them and subjects were classified into three groups. Group A (Control group) n = 30, Group B n= 30 (Experimental group) and Group C n= 30 (Experimental group).

Procedure: The hemiplegic subjects who fulfil the inclusion criteria were included and informed consent was obtained from them. Subject's demographic data, onset duration and hemiplegic side was noted. The subjects participating in this study were informed that they have to do the exercise regularly and can withdraw from the study if they have any difficulty. Group therapy was given under supervision. Groups were divided using lot method into Group A, Group B and Group C.

Group A was considered as control group (conventional physical therapy and gait training for 30 minutes).

Group B: Motor imagery 15 minutes and gait training for 15 minutes.

Group C: was done the receive PNF and gait training for 30 minutes.

Conventional Physiotherapy: Stretching exercises: Hamstring stretch-3 Repetitions, 20 sec hold; Quadriceps stretch -3 Repetitions, 20 sec hold; Calf stretch -3 repetitions, 20 sec hold. Strengthening **Exercises:** Quadriceps isometric exercise -5 Repetitions, 3 set; Straight leg raising -5 Repetitions, 3 set; Ankle plantar flexion -5 Repetitions, 3 set; Ankle dorsi flexion -5 repetitions, 3 set. Gait Training: Gait refers to the manner of walking and gait training refers to process of improving the ability to walk. Gait specific lower limb movements was given to the subjects. (i.e) hip flexion & extension, Knee flexion & extension, Ankle dorsi flexion. Forward walking -5 minutes, Backward walking -5 minutes & Lateral walking - 5 minutes.

Motor Imagery Training: Subjects were seated in an arm rest chair and instructed to keep their eyes closed. The visual, auditory and sensory cuing is given to each patient to imagine the walking pattern in limb movement. The subjects were asked to do the breathing exercise for relaxation for 3 minutes and visual information was given for 3 minutes, auditory information was given for 3 minutes, imagine for 3 minutes and finally the subjects were asked to do the breathing exercise for relaxation for 3 minutes.

Proprioceptive Neuromuscular Facilitation (PNF): Hold Relax Technique: Hold for 10 sec, relaxed for 15 sec, Subjects were asked to lie in supine position with one knee flexed and were asked to extend the knee for 5 repetitions of 3 sets. Subjects were asked to place the foot in a dorsiflexion and asked to do the plantar flex for 5 repetitions of 3 sets.

The subjects were followed for the period of 3 months with intervention duration of 30 mins for 4 days per week for 3 months and Morse Fall Risk Scale and 10 Minute Walk Test (stride length left & right foot, steps, velocity, cadence, laps and distance) values were noted before and after the treatment for sub- acute hemiplegic subjects.

Data Analysis and interpretation: All statistical analysis was performed on IBM compatible micro computer using Statistical Package for The Social Sciences (SPSS 17.0).

The significance was set at alpha=0.005 level Paired t Test was used to compare the pre and post values of Morse Fall Risk Scale & 10 Minute Walk Test in sub- acute hemiplegic subjects.

RESULTS

- **Table 1** Shows the Group A (Control Group) mean value of Morse Fall Risk score: 32±1.35, Stride length- LL-RL : 26.6±1.49, RL-LL : 25.9±1.75 Cadence: 45.74±2.22, Walking velocity: 11.97±0.64 Ten Minute Walk Test: Laps : 12.7±0.62, Steps: 367.55±19.48 and Meters : 101.6±5.02

- **Table 2** Shows the Group B (Experimental Group 1) mean value of Morse Fall Risk score: 28.5±1.06, Stride length- LL-RL : 26.6±1.65, RL-LL : 26.52±2.36 Cadence: 65.35±3.9, Walking velocity: 16.9±1.07 Ten Minute Walk

Test: Laps : 13.57±0.55, Steps: 392.35±15.07 and Meters : 108.6±4.68

- **Table 3** Shows the Group C (Experimental Group 2) mean value of Morse Fall Risk score: 27.75±0.88, Stride length- LL-RL : 26.25±1.00, RL-LL : 27.1±0.93 Cadence: 66.95±3.24, Walking velocity: 16.55±0.93 Ten Minute Walk Test: Laps : 15.07±0.54, Steps: 425±17.2 and Meters : 120.5±4.21.

Table 1: Group A (Conventional physical therapy and gait training)

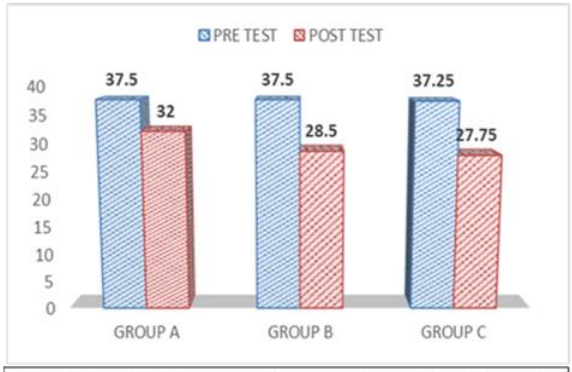
Outcome Measure	Mean		Standard Deviation		T Value	P Value
	Pre- value	**Post value**	**Pre- value**	**Post value**		
Fall Risk	37.50	32	2.56	5.48	4.0669	0.0002
Cadence	34.70	45.75	5.12	8.52	4.97	0.0001
Stride Length LL-RL RL-LL	 24.25 24	 26.60 25.95	 4.71 5.42	 4.75 5.67	 1.57 1.11	 0.1245 0.27
Walking Velocity	9.02	11.97	1.28	2.57	4.58	0.0001
10 Minutes -walk Test Laps	 11.3	 12.7	 1.983	 1.989	 2.229	 0.0318
Steps	340.95	367.5	62.14	61.10	1.36	0.186
Meters	90.4	101.6	15.86	15.92	2.22	0.0318

Table 2: Group B (Motor imagery and gait training)

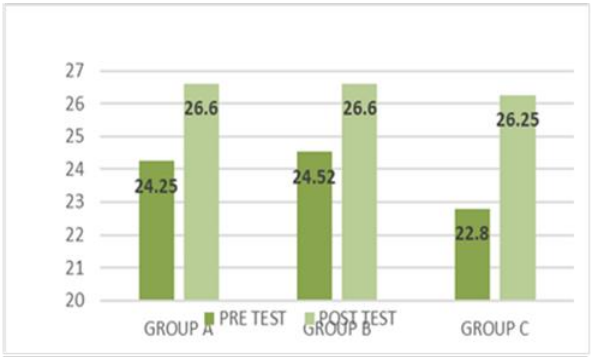
Outcome Measure	Mean		Standard Deviation		T Value	P Value
	Pre- Value	**Post Value**	**Pre- Value**	**Post Value**		
Fall Risk	37.50	28.50	2.56	4.01	8.46	0.0001
Cadence	45.30	65.35	11.01	13.55	5.13	0.0001
Stride Length LL-RL RL-LL	 24.52 24.27	 26.60 26.52	 5.19 7.16	 5.25 7.75	 1.25 0.95	 0.216 0.346
Walking Velocity	13.10	16.90	3.21	3.6	3.52	0.0011
10 Minutes -walk Test Laps	 12	 13.57	 1.72	 1.77	 2.65	 0.0012
Steps	351.6	392.3	46.12	49.18	2.70	0.010
Meters	95.7	108.6	15.36	14.23	2.75	0.009

Table 3: Group C (PNF and gait training)

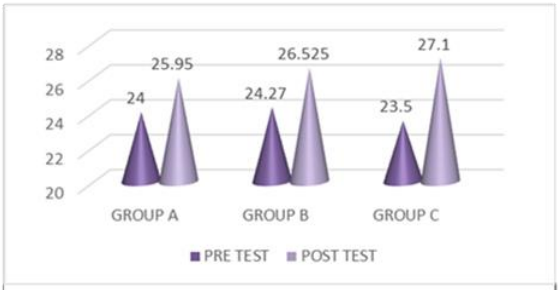
Outcome measure	Mean		Standard deviation		T Value	P Value
	Pre- Value	**Post Value**	**Pre-Value**	**Post Value**		
Fall Risk	37.25	27.75	2.55	3.02	10.73	0.0001
Cadence	43.35	66.95	8.13	12.03	7.26	0.0001
Stride Length LL-RL RL-LL	 22.80 23.5	 26.25 27.1	 2.93 3.00	 3.39 2.90	 3.44 3.85	 0.0001 0.0004
Walking Velocity	11.55	16.55	2.72	3.15	5.36	0.0001
10 Minutes-walk Test laps	 11.7	 15.07	 1.74	 1.72	 6.15	 0.0001
Steps	326.15	425	49.7	58.8	5.74	0.0001
Meters	92.6	120.5	12.93	13.7	6.62	0.0001



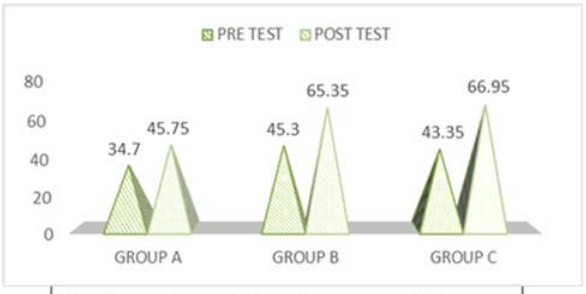
Graph 1: Fall risk score of Group A, Group B and Group C



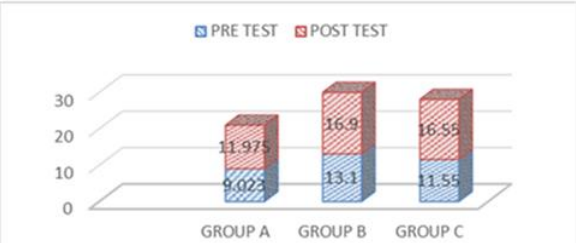
Graph 2: Stride length (LL-RL) of Group A, Group B and Group C



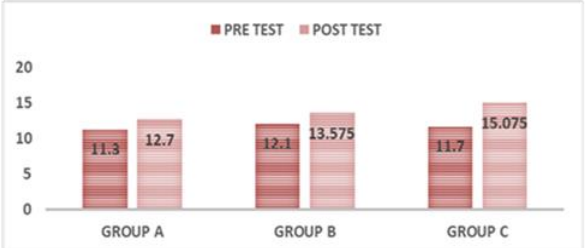
Graph 3: Stride length (RL-LL) of Group A, Group B and Group C



Graph 4: Cadence of Group A, Group B and Group C



Graph 5: Walking velocity of Group A, Group B and Group C



Graph 6: 10 Minute walk test Laps of Group A, Group B and Group C

DISCUSSION

Gait deficit is associated with significant functional limitations and it is characterized by being stereotyped with reduced weight bearing on the paretic lower limb. Motor imagery training was well cooperated by all participants. Patients involved in motor imagery have highly appreciated the training and were highly motivated. They frequently prevented further use of motor imagery as a strategy in daily activities after finishing the study, engagement in motor imagery increased self-efficiency those having a positive effect on motivation and self-confidence. Combination of gait and motor imagery training showed greater improvement than another group. PNF uses the body proprioceptive system to facilitate or inhibit the muscle contractions and to improve the activities of daily living. Hold relax technique of PNF was more effective to improve walking abilities of stroke patients. Morse Fall Risk score showed a significant difference in group B and group C (PNF and gait training), there was a significant improvement in gait and their level of functional independence level improved in group B. Limitations: Specific type of lesion was not included, gender bias, functional activity level was not considered. Recommendations-acute and chronic stroke patients can also be included in further studies, influence of patient's activity level can be determined, to increase in therapies combining different training principles, for example, the combination of neuromuscular electrical stimulation and robotics or neuromodulation.

CONCLUSION

The present study concluded that the Group B gait training with motor imagery training improved significantly than other groups in Morse fall risk score, cadence, stride length, walking velocity and ten-minute walk test and were able to gain confidence and had better performance in their activities of daily living.

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