Promoting hemiplegic gait

Logeshwari Selvaraj[1], J. Sakthi[2]

[1]Assistant Professor, [2]Student, School of Physiotherapy, Vels Institute of Science, Technology and Advanced Sciences (VISTAS), Chennai, Tamil Nadu, India

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Corresponding author: **Logeshwari Selvaraj.** Email: Lokeshwai.sp@velsuniv.ac.in

ABSTRACT

Introduction and Aim: Balance synergy includes a number of postural response that enable an individual to arise and remain erect during standing and locomotion. Balance deficits causes an insufficient coordination, postural instability and impaired gait. Maintaining the independence in activities of activities of daily living is an important factor for the quality of life. Hence this study is done to promote Hemiplegic Gait in stroke patients.

Materials and Methods: 150 community dwelling hemiparetic subjects from Chennai aged <65 both male and female subjects were allocated in three groups (n=50) using convenient sampling method and were followed up for a period of 12 weeks with intervention duration of 45 mins daily and were assessed with POMA, FALL RISK , TUG and 6 minute walk test. Paired‘t’ test was used for assessing pre and post-test values.

Results: There was significant difference with $p < 0.001$ at both Tinetti Performance oriented mobility assessment, Time up and Go Test, Fall Risk and 6 minute walk test minimal significant difference in chair stand test in both the groups.

Conclusion: There was significant difference in POMA, FALL RISK , TUG and 6 minute walk test p <.005 in Group C & Group B.

Keywords: Stroke; balance; gait; fall risk.

INTRODUCTION

Cerebrovascular accidents leads to inability of muscles to generate the appropriate forces, decrease in motor unit firing rates, decreased multisensory integration, consequently leads to poor balance control and force deficits depends on the muscle length (1) and it is commonly associated with a decrease in balance ability.

Balance synergies include a number of postural responses that enable an individual to arise and remain erect during standing and locomotion. Standing is an active process in which the sway of the body is kept within the limits of the base of support provided by the feet. Anticipatory postural responses are changes in postural muscle groups that precede voluntary movements made to offset disturbances in balance that would result from the voluntary control (2).

Balance deficits causes an insufficient coordination, instability and also compromise the reduced postural stability during standing and less coordinated responses to both self induced and external balance perturbations (3) and sensory information for postural control are somatosensory, visual, vestibular symptoms (4) and motor responses that affects the joint range of movement, abnormal muscle tone, loss of motor coordination and reduction in muscle strength affects the person ability to transfer, ambulate within home environment and community and it deteriorates balance function which consequently increases their fall risk and

reduces the independence in activities of daily living.

Maintaining the independence in activities of daily living is an important factor for the quality of life. Stroke survivors who need assistance for activities of daily living always feel socially isolated, overwhelmed, and abandoned. Gillespie *et al.,* stated that the hemiplegic patient also place burden to their family caregivers, therefore, affecting their family relationships. Jia *et al.,* stated that age, education, care givers, history of past illness, smoking and muscle strength are influencing factors of activities of daily living for stroke subjects(5).

Fear of falling is concerned with falling due to loss of self efficacy sense in body balance and mobility which results in restricted activities of daily living and social deprivation(3). Weedersteyn *et al.,* found the incidence of falls is higher in community dwelling stroke individuals than in the general healthy elderly population. Forster et al, found the majority of falls occur during walking which suggests that dynamic balance control during gait is an important issue (2). Hyndman *et al.,* found no significant difference between the characteristics of their community based faller and non-faller groups in stroke. Mackintosh et al, also reported that reduced mobility and poor balance among recurrent fallers in community stroke peoples (6).

Walking is one of the most important activities for enabling community participation (7). Initial walking function is impaired in two – thirds of the stroke population and this impairment is the greatest contributor to post stroke functional disability (2). Characteristics walking pattern of stroke includes a slow walking cycle, a short stance phase on the affected side and relatively long swing phase (8). Subjects with hemiplegia displays increasing recovery of their independent walking ability however they lack the ability to walk fast or far enough, which reduces their ability to walk outside (7) and the walking adaptability is the ability to adjust walking to behavioural task goals and environmental circumstances and it is a complex of gait adaptability that is obstacles, clearance, negotiation and locomotor adaptation and it is one of the component to generate stepping and maintain the postural equilibrium (9) so the individuals walk with lesser distances with higher oxygen consumption. Thus, indicating they walk with higher oxygen demand (2).

Walking exercise has diverse effects and to improve gait and balance ability. So, that feet are called the second heart. It may enhance cardiovascular endurance as well as developing leg muscles. The effect of walking exercise aimed at improving balance sense and motor control ability with elderly people, patient with a chronic disease. Backward walking improves the movement components to stimulate the muscles in lower limbs more than the forward walking (10). Nadeau et al, reported that backward walking and forward walking had different exercise physiology. The temporal spatial characteristics of backward walking could increase the frequency and endurance for walking (11). Osugi *et al.,* reported that walking speed, step length, and cadence were lower in backward walking than in forward walking. Winter et al, reported that joint movement patterns are similar for backward walking and forward walking (12). Grasso *et al.,* suggested that the patients trained for backward walking requires a greater level of energy expenditure than in the patients trained for forward walking and it increases the cardiorespiratory and metabolic responses and oxygen consumption (7).

Balance plays one of the major role in one's life to do their activities of daily living independently. Muscle weakness, imbalance is one of the major factor leading to reduced mobility and reducing the independency level in hemiplegic subjects. The effect of progressive body weight supported treadmill training in forward and backward gait training and the differences between progressive body weights supported treadmill training in forward and backward gait training in hemiplegic subjects showed that the gait performance of the subjects

improved in progressive body weight supported treadmill training in forward and backward gait training. Hence this study aims to know the effect of dynamic balance exercise in forward and backward walking in hemiplegic subjects.

MATERIALS AND METHODS

150 chronic hemiplegic subjects from Vadallur and Chennai were included in the study based on inclusion criteria: Age 50-70 years, both male and female subjects, Brunn strom 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. Patients with open wounds in leg, impaired sensory loss in leg, any recent surgeries in lower limb, Deep Vein Thrombosis, any disability other than stroke, like spinal cord lesion, polyneuropathy, peripheral nerve lesion, recent fractures in lower limb were excluded. Then informed consent was obtained from them and Subjects were allotted in three groups. Group A (Control group) n = 50, Group B n= 50 and Group C n = 50 (Experimental group) using randomized controlled trial method. The randomization was done by using lot method. Group A (Balance Exercises and Conventional Physical Therapy Exercises. Group B (Balance exercises and forward walking with and without support) and Group C (Balance exercise and backward walking with and without support).

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 and assessment was noted. The pre test was taken and the exercise was demonstrated to the subjects involved in the study and was informed that they have to do the exercise regularly and can withdraw from the study if they have any discomfort or difficulty. Group therapy was given under supervision. The subjects were asked to wear comfortable clothing and they have to do warm up and cool down exercise before and after the exercise. Group A: Balance exercises (20 minutes) and Conventional Physiotherapy (15 minutes). Group B: Balance exercises (20 minutes) and forward walking with and without support (15 minutes). Group C: Balance exercise (20 minutes) and backward walking with and without support (15 minutes).

Warm up exercises - 5 minutes

S. No	Exercise	Repetition
1.	Hip Flexion	5 Times
2.	Knee Extension	5 Times
3.	Seated Marching	30 Seconds

Cool down exercises - 5 Minutes

S. No.	Exercise	Repetitions
1.	Leg Press	5 times
2.	Seated Kick	5 times
3.	Wide Half Stands	30 seconds

Dynamic balance exercises

Wobble board exercise: The subjects were asked to stand on the wobble board with eyes open; the subjects' feet and shoulder width apart. Asked to hold a rail for support and stand for 2 to 3 minutes. The subjects were asked to stand on the wobble board with eyes open. The subjects' feet and shoulder width apart and stand without support for 2 to 3 minutes.

S. No	**Exercise**	**Repetitions**
1.	Stepping	2 Minutes

2.	Step Up & Step Down	10 Repetitions
3.	Cross Walking	2 Minutes
4.	Tandem Walking	2 Minutes
5.	Side Walking	2 Minutes
6.	Step Back	2 Minutes
7.	Trunk Rotation With Medicinal Ball	10 Repetitions

If subjects feel any discomfort they can take rest for 5 minutes between the sessions. Subjects were followed up for a period of 3 months with intervention duration of 35 minutes for 4 days per week for 3 months and will be assessed pre and post-test with Morse Fall Risk Scale, POMA (Tinetti Performance Oriented Mobility Assessment), Time Up and Go Test, and 6 Minute Walk Test.

Data analysis and interpretation

All statistical analysis were 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, POMA (Tinetti Performance Oriented Mobility Assessment), Time Up and Go Test, and 6 Minute Walk Test in chronic hemiplegic subjects.

Table 1: Morse Fall Risk Score of Group A, Group B and Group C

FALL RISK PRE TEST –FALL RISK POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	-6	4.95	0.70	-8.573	49	.000
GROUP – B	-9	5.62	0.72	-11.31	49	.000
GROUP - C	-11.6	6.42	0.91	-12.77	49	.000

Graph 1: Morse Fall Risk Score of Group A, Group B and Group C

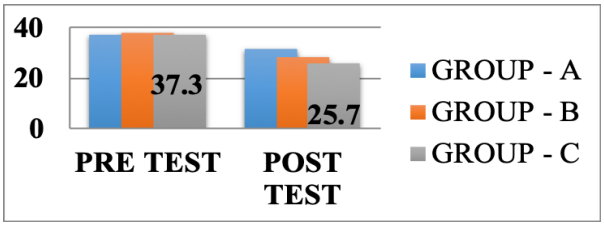


Table 2: POMA of Group A, Group B and Group C

POMA PRE TEST - POMA POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	2.06	1.48	0.21	9.87	49	.000
GROUP – B	3.02	1.57	0.22	13.59	49	.000
GROUP - C	4.42	1.01	0.38	30.88	49	.000

Graph 2: POMA of Group A, Group B and Group C

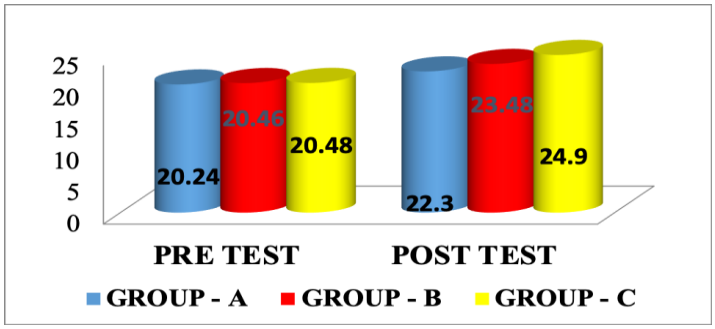


Table 3: Time Up and Go Test of Group A, Group B and Group C

TUG PRE TEST - TUG POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	-0.46	0.3	0.04	-11.51	49	.000
GROUP – B	-0.61	0.24	0.03	-16.96	49	.000
GROUP - C	-0.73	0.17	0.06	-29	49	.000

Graph 3: Time Up and Go Test of Group A, Group B and Group C

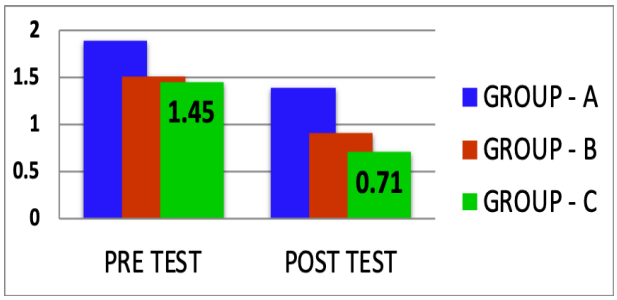


Table 4: 6 Minute Walk Test Laps of Group A, Group B and Group C

LAPS PRE TEST – LAPS POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	1.19	0.69	0.10	12.16	49	.000
GROUP – B	2.3	0.99	0.14	16	49	.000
GROUP - C	2.72	0.88	0.33	21.81	49	.000

Graph 4: 6 Minute Walk Test Laps of Group A, Group B and Group C

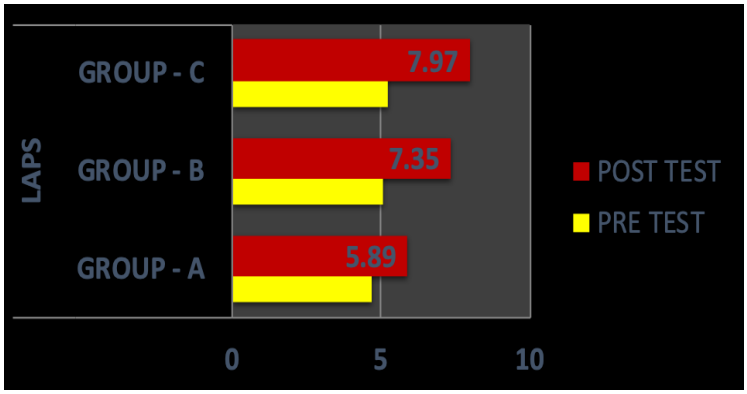
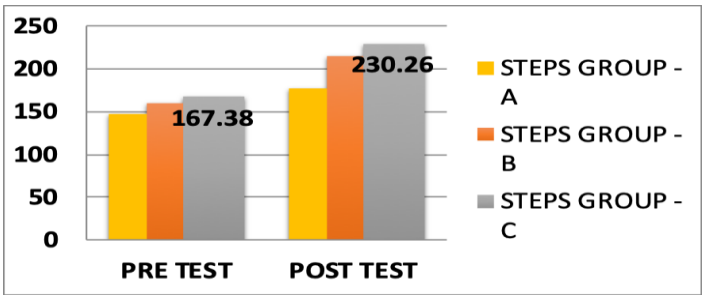


Table 5: Steps of Group A, Group B and Group C

STEPS PRE TEST – STEPS POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	30	21.21	2.99	10.09	49	.000
GROUP – B	55.78	29.11	4.12	13.55	49	.000
GROUP - C	62.88	29.10	10.95	15.27	49	.000

Graph 5: Steps of Group A, Group B and Group C



Graph 6: Minutes of Group A, Group B and Group C

METERS PRE TEST – METERS POST TEST	Mean	Std.Dev	Std.Error Mean	t- value	df	Sig. (2-tailed)
GROUP – A	9.52	5.53	0.78	12.16	49	.000
GROUP – B	17.86	7.82	1.11	16.15	49	.000
GROUP - C	21.22	7.20	2.71	20.82	49	.000

RESULTS

- **Table 1** Shows the Group A (Control Group) mean value of Morse Fall Risk score: 32±1.14, Tinetti Performance Oriented Mobility Assessment (POMA): 22.4±0.38, Time Up and Go Test: 1.49±0.07, Six Minute Walk Test: Laps: 5.75±0.16, Steps: 174.9±5.13 and Meters: 46±1.28.
- **Table 2** shows the Group B (Experimental Group 1) mean value of Morse Fall Risk score: 37.75±1.25, Tinetti Performance Oriented Mobility Assessment (POMA): 23.1±0.28, Time Up and Go Test: 0.98±0.05, Six Minute Walk Test: Laps : 7.35±0.21, Steps: 214.75±6.85 and Meters : 58.35±1.7
- **Table 3** shows the Group C (Experimental Group 2) mean value of Morse Fall Risk score: 25.75±1.41, Tinetti Performance Oriented Mobility Assessment (POMA) : 25±0.21, Time Up and Go Test: 0.71±0.04, Six Minute Walk Test: Laps: 8±0.20, Steps: 229.55±6.75, and Meters: 63.55±1.7

DISCUSSION

Balance deficits causes an insufficient coordination, instability and also compromise the reduced postural stability during standing and less coordinated responses to both self induced and external balance perturbations[3] and sensory information for postural control are somatosensory, visual, vestibular symptoms(4) and motor responses that affects the joint range of movement, abnormal muscle tone, loss of motor coordination and reduction in muscle strength affects the person ability to transfer, ambulate within home environment and community and it deteriorates balance function

which consequently increases their fall risk and reduces the independence in activities of daily living.

Fear of falling is concerned with falling due to loss of self efficacy sense in body balance and mobility which results in restricted activities of daily living and social deprivation(3).

The walking adaptability is the ability to adjust walking to behavioural task goals and environmental circumstances and it is a complex of gait adaptability that is obstacles, clearance, negotiation and locomotor adaptation and it is one of the component to generate stepping and maintain the postural equilibrium(9) so the individuals walk with lesser distances with higher oxygen consumption. Thus, indicating they walk with higher oxygen demand (2).

Walking is one of the most important activities for enabling community participation (7).Walking exercise has diverse effects and to improve gait and balance ability. So, that feet are called the second heart. It may enhance cardiovascular endurance as well as developing leg muscles. The effect of walking exercise aimed at improving balance sense and motor control ability with elderly people, patient with a chronic diseases. Backward walking improves the movement components to stimulate the muscles in lower limbs more than the forward walking (10).

Backward walking on a treadmill challenges the stability and thus it is possible that step shortening can be partially attributed to the subject's uncertainty and attempt to maintain stability. If this is the case, proprioceptive information from lower limbs may be important for proper correction of step length. Backward walking activates the patella femoral joint and femoral muscles in a more stabilized manner (10). According to this result, three groups were statistically significant in Morse Fall Risk, POMA (Tinetti Performance Oriented Mobility Assessment), Time Up and Go Test, and Six Minute Walk Test (p=0.0001).

Monitoring the Fall Risk over post stroke period is important even when there is a improved baseline gait/balance function in post stroke. Hence this study was measuring the Morse Fall Risk Score in three groups. According to this result, Fall Risk was reduced more in Group C- Balance Exercise and Backward Walking, when compared to other two groups, (Group A-Conventional Physiotherapy and Balance Exercise, Group B-Balance Exercise and Forward Walking).

POMA (Tinetti Performance Oriented Mobility Assessment) was used to assess the Balance and Gait. According to this result, Balance and Gait was more improved in Group C- Balance Exercise and Backward Walking, when compared to other two groups, (Group A-Conventional Physiotherapy and Balance Exercise, Group B-Balance Exercise and Forward Walking).

The Time Up and Go Test is commonly used to measure the balance and walking ability in which arises from the chair and back to the chair. The outcome of Time Up and Go Test is Six Meters were found to be more increased in Group C- Balance Exercise and Backward Walking, than the other two groups, (Group A-Conventional Physiotherapy and Balance Exercise, Group B-Balance Exercise and Forward Walking).

The Six Minute Walk Test is commonly used to measure the level of walking ability following stroke and subsequent recovery during the rehabilitation process (7). The outcome of the Six Minute Walk Test are Laps (Rounds), Steps (counts) and Meters were found to be more increased in Group C- Balance Exercise and Backward Walking, than the other two groups, (Group A-Conventional Physiotherapy and Balance Exercise, Group B-Balance Exercise and Forward Walking).

The present study concluded that Walking factors such as Morse Fall Risk Score, Tinetti Performance Oriented Mobility Assessment (POMA), Time up and Go Test, Six Minute Walk Test were compared between pre and post exercise training. Based on those factors, I found

that backward gait training has improved their walking ability in chronic hemiplegic subjects.

Limitations

Specific type of lesion was not included, Gender Bias, Body Mass Index (BMI) was not included, Lesion onset was not same duration, Functional activity level was not considered, and Motivation and stress level was not considered.

Recommendations

Sub-acute stroke patients can be included in further studies, Patient's activity level can be considered, and Patient's motivation and stress level can be considered, to increase different training principles, For example: the combination of Neuromuscular Electrical Stimulation and Robotics or Neuro-modulating.

CONCLUSION

The present study concluded that the dynamic balance exercise along with backward gait training group improved significantly than Group A (Conventional Physiotherapy and Balance Exercises) and Group B (Balance Exercise and Forward Walking) in Morse Fall Risk Score, POMA (Tinetti Performance Oriented Mobility Assessment), Time Up and Go Test and Six Minute Walk Test and were able to gain confidence and had better performance in their activities of daily living.

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