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Research Article

A Comparative Study between Simple Task Training and Multi Task Training to Improve Gait Parameter of Hemiplegic Stroke Patients

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Abstract

Aim: A simple task training and multi task training were used to improve gait parameter in stroke patients. Methodology: Intervention for three times in a week for five weeks, which consisted of simple task training or multi task training exercises for stroke patients.

Results: T test was applied, mean ± standard deviation of each group was compared and the P value was taken less than 0.05 for significant differences.

Conclusion: There was significant differences in the gait parameter (cadence, walking velocity, stride length, stride period, double support) for experimental group treated with multi task exercises i.e multi task training exercises was more effective to improve gait parameter of hemiplegic stroke patients than simple task training exercises.

Keywords: Multi task; Simple task; Gait parameter; Stroke patients

Introduction

Stroke is the major leading cause of the world. WHO define stroke as" Rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with on apparent cause other than vascular origin" Mortality due to stroke is 5.5 million in the world and those who survive stroke each year worldwide is estimated to be 15 millions. The annual incidence of stroke in India is 33 per 100,000 and mortality rate is 73 per 100,000 with male preponderance. Around 12 percent of all stroke occurred in population below 40 years [1].

Pathophysiologically hemiplegia occurs due to mainly 3 reasons; Thrombotic infarct, Embolic infarct, Hemorrhages. This lesion in the brain occurred because of hampered oxygen supply, mainly hemiplegia occurs uniformly in upper limb but when it is accompanied by trunk it indicates large lesion." Schencider & Gautier says that lesions restricted to the rear and medial portion in the medial part of precentral gyrus cause a contralateral, predominantly, distal severe leg weakness with little improvement. Lesion involving the medial part of the cortex, the supplementary motor area and the rear portion of the medial part of the precentral gurys cause a contralateral distally predominant hemiplegia with lower limb more affected and recovery is much better for the arms than for the leg [2].

The gait pattern of person with hemiplegia has been described as slow and asymmetric. The diminished velocity of hemiplegics gait in comparison to normal has been keen reported repeatedly [3].

The Characteristic of Gait in Hemiplegic-foot flat, with the ankle in a plantar flexed position, which results in initial toe contact or a moderate decrease in toe elevation. After initial contact, the ankle has been reported to exhibit irregular movements into dorsi flexion instance, reduced dorsi flexion in mid stance and push-of and/or increased plantar flexion in stance. Reduced ankle plantar flexion at toe-off on the affected lower extremity has also been observed. The swing phase patterns of hip, knee and ankle motions on the hemiplegic side have been characterized by limited or reduced hip flexion and an upward tilt of the hip a lack of or reduced knee flexion and reduced dorsi flexion or continuous ankle plantar flexion. The increased leg length produced by the limited hip and knee flexion and reduced ankle dorsi flexion result in reduced floor clearance by the foot during swing which produces dragging of the toes or circumduction of the leg [3,4].

As a result, hemiplegic gait has been characterized as exhibiting a stiff knee during swing. It has been suggested that the upward tilt of the hip is also a compensation to ensure toe clearance as the involved lower extremity is swinging forward. The limited range of knee flexion during swing is not limited to the involved lower extremity; it is also seen in the uninvolved lower extremity in cases of severe impairment [5].

Multi Task Exercises in Gait Training: Among older adults, impairment in the control of balance under multi-task conditions is a common occurrence. Because impaired multi-task balance performance predicts adverse outcomes such as falls and declines in both cognitive and physical function, interventions that improve multi-task balance performance are a critical health care need. Studies have shown the positive effect of training on balance and gait in several population including older adults and patients with stroke [6-8].

The purpose of this study is to examine the effectiveness of multi task activity in walking performance in different approaches of balance training and walking abilities in chronic stroke patient. We here hypothesized that multi task exercise training would be more effective in improving walking abilities and balance performance [9].

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Methods and Materials

Subjects

A total of 30 patients of stroke with hemiplegic, age above 40 years with abnormal gait pattern were randomly selected. All participants were on phase of medication, tested after an overnight abstinence of at least 12 hours from their usual medication regimen. All participants were naive with respect to the experimental design.

Study design

The study was two groups (Group A and Group B). Group A = control group consisting of 15 patient (Male = 9, Female = 6) over whom simple task exercise (normal gait training) program was performed. Group B = experimental group consisting of 15 patients (Male = 10, Female=5) over whom multi task exercises were used.

Instrumentation

A marker pen and papers, Ink for foot print, Balls of different size, Assessment Performa, Stop watch, Measuring Tape and Platform.

Procedure

Thirty male hemiplegic subjects were randomly selected on the basis of inclusion and exclusion criteria and divided into two group namely Group A & B randomly. The attendant of entire subject signed an informed consent approved by ethical committee of Ayushman college, Barkatullah university, Bhopal, Madhya Pradesh, India. Data were collected in Jamdar Hospital, Jabalpur, Madhya Pradesh, during period of 2011 to 2012. All of these subjects were assessed using a general neurological Performa and the pre test value of gait parameter Such as stride length, stride time, cadence and walking velocity and double support were recorded. Group A was treated by simple task exercises and Group B was treated by multi task exercises.

A closed environment with least possible distraction was selected as site for data collection.

Measurement

Subjects were evaluated and tested for normal gait pattern and a multi-task or say a complicated task. For each subject gait performance was measured in 2 conditions; Walking in a straight line and walking in a same straight line holding a tray with glasses [7]. Instructions for each test condition were as follows: Walk with your comfortable speed from starting to the end of the walkway, Walk with your comfortable speed while carrying a tray full of glasses, For tray carrying task, patient was to keep the glasses empty on the tray without any dropping of glass otherwise the trial would be considered as failed.

Gait assessment for the individuals in this study was performed by the simplest method mostly used in clinics; the foot prints method. By this method we can analyze various gait parameters like step length, stride length, base of support. This method of taken foot prints can be performed by using paint, chalk, ink to the patient's foot and tell them to walk on a given pathway of about 5 meter long [10].

We have taken ink for foot prints to analyze gait. The patients dipped his/her feet in the ink containers and were asked to walk in a given pathway. As the patient walked on the floor with ink in his/her foot we got the foot impressions along the pathway and by this we calculated the stride length.

Method of determining stride period, temporal variable such as cadence, stride period, velocity may be calculated if an elapsed time for the subject to walk a measured distance (d) is obtained using a stopwatch. Cadence (c) can be determined by dividing the number of steps (n) taking during the walking trial by the elapsed time (t) between the first and last heal strike using the formula c=n/tn. Velocity (v) can be calculated by taking the total distance (d) between the first and last heal strike and dividing it by the elapsed time (td) for the distance (v=d/td) [10,11]. To obtain a normal walking speed, the patient should be allowed to take a few steps prior to the beginning of any measurements.

Training Protocol

Group A: control group (simple task training)

Subjects were given 15 minutes of gait training, 5 minutes of lower limb muscles stretching and strengthening exercises for period of thrice in a week for 5 weeks. The training sessions included: Stretching of spastic muscle groups, strengthening of weaker muscles, Tandem walking, Side to side walking.

Group B: experimental group

The subjects of experimental group received gait training and strengthening exercise same as control group. In addition to these exercises subjects were also engaged in the Multi task exercise Program which included approximately 30 minutes of gait training session. This group also received training thrice a week and up to 5 weeks. We took different diameter balls; a small ball and a larger one about 35cm diameter, a basket ball, a ball with a net so that we could suspend it and patient could easily hold that ball and do the given task.

The tasks were divided into weekly progressions: each week included a new and complicated task so that patient can easily understand the task and able to perform accurately within a week. Basic exercise which were regularly performed during treatment sessions were: Stretching of lower limb muscles, Strengthening exercise, Tandem walking, Sidewise walking.

A part from these exercise the multi task exercise program in first week was walking while holding 1 ball in hand, if the patient was able to walk easily on the pathway, he was given one more ball. Now patient had 2 balls in her/his and was told to walk on the path without allowing the ball to fall.

In second week if the patient could easily do the task then we increased the complexity of the task. The patient was instructed to walk with one ball in one hand and bounce the other ball held in the second hand. Now walk to match the rhythm of the bouncing ball.

The third task in third week: to walk in time while kicking a basket ball (put the basket ball in the net, so that the patient could hang the ball and kick it properly). After some trials tell the patient to walk in a speed and concurrently kicking the ball.

In fourth week tell the patient to walk while holding a ball in one hand simultaneously kick another ball suspended using the net as in the previous week.

In fifth week: Walking while bouncing one ball and concurrently kicking another basket ball suspended in the net.

Table 1: Control group.

Variable		Total	Mean	SD	t' value	P value
Velocity	pre	13	0.866	0.29	2.154	0.025
	Post	13.4	0.96	0.311		P>0.05
Cadence	Pre	1058	70.53	17.84	2.086	0.056
	Post	1074	71.6	17.09		P>0.05
Stride length	Pre	1260	84	15.59	2.256	0.041
	Post	1272	84.4	15.52		P>0.05
Stride period	Pre	23.9	1.59	0.53	1.633	0.125
	Post	22.7	1.51	0.54		P>0.05
Double support	Pre	842	58.13	10.35	3.756	0.002
	Post	856	57.06	10.11		P>0.05

Table 2: Experiential group.

Variable		Total	Mean	SD	t' value	P value
Velocity	Pre	14.1	0.94	0.27	9.165	0.000
	Post	20.1	1.34	0.31		P<0.01
Cadence	Pre	1216	81.06	14.63	11.3	0.000
	Post	1375	91.66	13.26		P<0.01
Stride length	Pre	1367	91.13	8.74	11.28	0.000
	Post	1484	98.93	7.24		P<0.01
Stride period	Pre	25.3	1.68	0.61	8.229	0.000
	Post	18.4	1.22	0.53		P<0.01
Double support	Pre	854	56.93	7.73	14.31	0.000
	Post	756	50.4	7.56		P<0.01

Statistical analysis

A pretest-posttest experimental group design was used for the study. The pretest training variables and post treatment training variables of gait parameter was taken. The data was analyzed using the © SPSS inc Software. To compare the baseline demographic characteristics and the pre training variables between groups, Independent – sample't' test were used for mean value and other frequencies. To compare the effect of training, the difference of all dependent variables between the pre and post training phase within groups were analyzed by Paired't' test. The results were taken to be significant if $p<0.05$.

Results

Table 1 and Table 2 detail the result of present study. Table 1 indicates total, mean, standard deviation, t-value and p-value of control group in this table there was no significant value seen between pre and post training program of control group and Table 2 indicates total, mean, standard deviation, t-value and p-value of experimental pre and post training protocol (Figure 1,2). In this group there was marked difference ($p<0.05$) noticed between pre and post value and they were significant.

The scores of the control group

Velocity: Pretest mean and standard deviation of velocity were 0.86+0.29; Post test mean and standard deviation of velocity were 0.96+0.31.

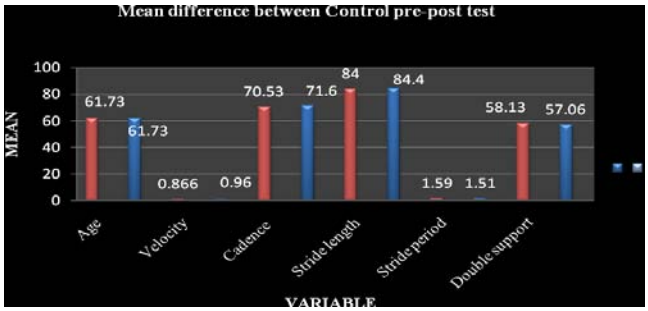

Figure 1: Mean difference between control- pre test and post test.

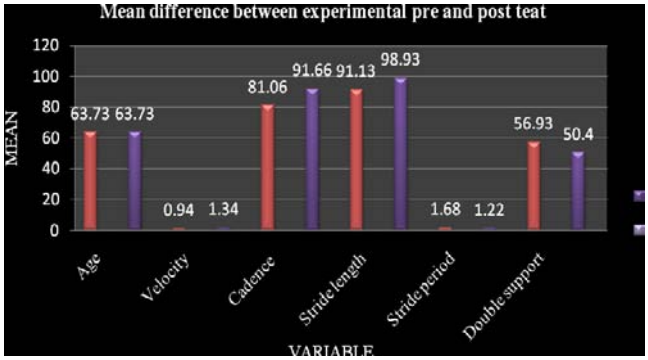

Figure 2: Mean difference between experimental pre test and post.

Cadence: Pretest mean and standard deviation of cadence were 70.53+17.84; Post test mean and standard deviation of cadence were 71.6+17.09.

Stride length: Pretest mean and standard deviation of stride length were 84+15.95, Post test mean and standard deviation of stride length were 84.8+15.52.

Stride period: Pretest mean and standard deviation of stride period were 1.59+0.53; Post test mean and standard deviation of stride period were 1.51+0.54.

Double support: Pretest mean and standard deviation of double support were 58.13+10.35; Post test mean and standard deviation of double support were 57.06+10.11.

The Scores of experimental group: Velocity Pretest mean and standard deviation of velocity are 0.94+0.27, Post test mean and standard deviation of velocity are 1.34+0.31.

Cadence: Pretest mean and standard deviation of cadence were 81.06+14.63; Post test mean and standard deviation of cadence were 91.66+13.26.

Stride length: Pretest mean and standard deviation of stride length were 91.13+8.74. Post test mean and standard deviation of stride length were 98.93+7.27.

Stride period: Pretest mean and standard deviation of stride period were 1.68+0.61; Post test mean and standard deviation of stride period were 1.22+0.53.

Double support: Pretest mean and standard deviation of double support were 56.93+7.73; Post test mean and standard deviation of double support were 50.4+7.56.

Discussion

Walking ability is a major long term goal of many rehabilitation programs and is an integral part of many activities of daily living. The Characteristics of Gait in Hemiplegia- foot flat, with the ankle in a plantar flexed position, which results in initial toe contact or a moderate decrease in toe elevation [12]. After initial contact, the ankle has been reported to exhibit irregular movements into dorsi flexion instance, reduced dorsi flexion in mid stance and push-of and/or increased plantar flexion in stance. Reduced ankle plantar flexion at toe-off on the paretic lower extremity has also been observed. The swing phase patterns of hip, knee and ankle motions on the hemiplegic side have been characterized by limited or reduced hip flexion and an upward tilt of the hip, a lack of or reduced knee flexion and reduced dorsi flexion or continuous ankle plantar flexion. The increased leg length produced by the limited hip and knee flexion and reduced ankle dorsi flexion results in reduced floor clearance by the foot during swing, which produce dragging of the toes or circumduction of the leg [12].

The data analysis and statistical inference have brought to check the effectiveness of Multi task exercise program on variable of the study which are- velocity, cadence, stride length, stride period, double support. The multi task exercise program has an effect in improving gait pattern [6].

When the results are compared even though normal gait training protocol and multi task training programme were effective improving balance and walking performance, but multi task training programme were superior to normal gate training protocol in improving walking. We found that participants who received multi-task training demonstrated greater improvements in multi-task gait speed. In fact, only participants who received multi task training walked significantly faster after the training when simultaneously performing a cognitive task [13].

Inter group and intra group comparison of variable which are-velocity, cadence, stride length, stride period, double support at a faster rate and more number of subjects achieved improvement in velocity, cadence, stride length, stride period, double support than simple gait training [7].

These tasks will improve balance, proprioception, co-ordination, ability to do complex task or by this patient can improve her stability in every difficulty condition in which a normal individuals can do [14].

Therefore this indicate ball exercise multi task training protocol shows significant improvement in all selected gait variable like velocity, cadence, stride length, stride period, double support. In this double support value is decreased [14]. But this is also significant in our protocol to show the improvement seen in gait pattern.

Future Research

Science is dynamic and there is always a scope of improvement and change in time to come ahead. With progressive aim to move ahead we aspire to achieve highly accurate and reliable results. Thus every study leaves back a scope for other researcher to do something more advanced and varied in order to touch the height of perfection.

This study examined only 30 subjects in total and data collection was confined to closed setup with minimum distractible conditions. Thus future researchers can expand the study by including more number of subjects so as to make generalization of the results and practice such experiments in variable environmental setups such as open environment. Thus it could be applied to real life situation.

In this study the protocol used simple and multiple tasks. But future researchers can progress the study by modifying the protocol like incorporating positions and strengthening exercise in the protocol given, protocol related to the real life situations could be used, such as using advanced different types of neuromuscular electrical stimulation. The scope of study can be expanded to different grade of spasticity and other neurological conditions.

Relevance to Clinical Practice

The result obtained in this study suggest that multi task activity in stroke patients is more beneficial than simple task activity to improving walking abilities, so these results show that multi task activity in stroke patients should be used for training task to patients.

Limitation

There were several limitations regarding to the study that the sample size was small [15], Logistics of transportation and participation over several weeks may be difficult for these individuals [11]. The post-stroke individuals vary greatly in their motor presentation and functional abilities and groups will be matched as closely as possible. Assignment to groups will be non-random due to matching of functional levels between the stroke survivors.5 The final outcome measurement occurred immediately after the last intervention sessions, the within intervention differences were likely to be the result of the transient changes of the muscle extensibility [5]. The result was short term effects of multi task exercise and therefore a long term effect could be evaluated in the future study [5].

Conclusion

This study led to the interferences that multi task exercises are effective in improving the gait pattern. Therefore it is concluded that multi task exercise can be use as an effective therapeutic maneuver for improving gait in hemiplegic patient.

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