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Effectiveness of Dual Task Exercises on Community Ambulation in Hemiparetic Patients

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ABSTRACT

Background: Stroke is one of the major contributing factors for disability and handicap in adults. Hemiparetic stroke causes weakness of one side of the body and less severe than hemiplegia. Major problem following stroke is loss of walking ability, recovery of community ambulation is a priority goal for most patients. Various approaches in stroke rehabilitation have been studied to improve the walking ability of people with hemiparesis. The dual task is defined as simultaneous production of two tasks one "primary" and one "secondary", for which changes in performance are measured. Using dual-task paradigms as part of treatment may prove helpful in community ambulation, hence this study is to find out the effectiveness of dual task exercises on gait variables in subjects with hemiparesis.

Method: Total of 30 subjects with Hemiparesis was taken by convenience sampling. All the subjects were explained about their condition & mode of assessment and written informed consent was obtained from them and divided into 2 groups. The experimental group was scheduled to attend dual task exercises thrice in a week for four weeks. The control group were scheduled to attend supervised conventional therapy sessions weekly thrice for four weeks. Gait assessment was done by using foot print method. The outcome measures of the study were velocity, cadence, step length, stride length.

Results: Statistical Analysis were performed with SPSS version 16.0 package. On observing the means of post test parameters of experimental group A and control group B Independent t-test was done and the P- value is <0.05. There is a statistically significant difference in all gait parameters.

Conclusion: This study concludes that dual task exercises can be considered as effective treatment method for motivated patients with hemiparesis to improve the walking ability and community ambulation.

Keywords: Stroke, Hemiparesis, Dual Task, Gait, Foot Print Method

INTRODUCTION

Stroke is a major cause of disability and handicap in adults[1]. Rehabilitation aims to reduce disability by optimizing the performance of everyday tasks. On discharge, many individuals are significantly disabled and handicapped. For example, many individuals can walk independently, however only a small proportion can walk with sufficient speed and endurance to enable themselves to function effectively within their community. Only 7% of patients discharged from rehabilitation met the criteria for community ambulation[2].

Hemiparesis is weakness on one side of the body. It is less severe than hemiplegia - the total paralysis of the arm, leg, and trunk on one side of the body.

Thus, the patient can move the impaired side of his body, but with reduced muscular strength[3]. Hemiparesis can be caused by a number of medical conditions, most related to the brain or spinal cord. Some of the conditions that have hemi paresis as either an indicative symptom or as a result of the condition itself include migraine, head trauma, muscular dystrophy, stroke, brain tumors, or cerebral palsy.

Various approaches to stroke rehabilitation have been studied to improve the walking ability of people with hemiparesis[4-8]. Using dual-task paradigms as part of treatment may prove helpful in community ambulation. The dual task, as the name suggests is defined by the simultaneous production of two tasks one "primary" and one "secondary", for which changes in performance are measured.

Dual-task paradigms assume that two tasks performed simultaneously interfere if they use functional subsystems and / or identical brain[9]. There are two categories of dual-task paradigms according to the instructions provided. Either the subject is asked to focus on achieving the attention task, so that performance in dual-task condition remains at a level comparable to the condition of simple task or the subject is asked to perform both tasks to the best of his abilities without giving priority to completion, but by encouraging them to simultaneously perform both tasks at best. The latter type is the most used in dual-task paradigms involving walking because it is more environment friendly[10].

The dual task paradigm, by simultaneously employing balance and cognitive tasks, has been used in recent years to shed light on motor and cognitive interference in healthy young people, elderly subjects and patients. In particular, cognitive and motor interference during gait has been studied in pathologies such as stroke [11].

The development of clinical tests that incorporate dual-task paradigms as part of assessment may prove helpful in reflecting the broader dimensions of community ambulation[12]. Dual task related training improves strategies to improve strength, Coordination & provide opportunity for intense practice to develop skill in walking.

Loss of walking ability is a major problem following stroke, recovery of walking is a priority goal for most patients. As soon as the individual with stroke attained the ability to ambulate, the more likely his (or) her independent walking will be re-established[14]. Gait outcome is a significant factor that influence a patient chance of returning to pre morbid environments. The gait of person with hemiparesis is characterized by problems with generating, timing, and grading of muscle activity, hypertonicity, and mechanical changes in soft tissues [14]. The diminished velocity of Hemiparetic gait, in compared to normal has been allegedly reported with associated limitations in spatial and velocity variables in gait cycle[15].

Quantitative gait analysis may be useful in monitoring gait performance and functional recovery following stroke however, gait patterns are quite variable . Such variability has been described for velocity, cadence, step length & stride length. Gait at natural speed of patients control was recorded using clinical foot print method[16.] This method is easy to apply and inexpensive and suitable for Hemiparetic patients. This study is to find out the effectiveness of dual task exercises on gait variables in subjects with hemiparesis.

MATERIALS AND METHODOLOGY:

Study design : Quasi experimental
Study type : comparative.
Sampling size : 30
Sampling method : Convenient Sampling.
Study duration : Four weeks
Study Setting : KIMS General Hospital, Amalapuram
Study Period : 1 year
Treatment Duration: 5 days a week for 4 Weeks.

INCLUSION CRITERIA:

- Hemiparetic from a single stroke
- Able to walk 10metres independently without an assistive device
- Functional use of involved upper extremity
- Medically stable patients
- Both Gender
- Patients who are willing to participate in the study

EXCLUSION CRITERIA:

- Patient with any disability other than stroke that affects gait training
- Any uncontrolled health condition in which exercise is contraindicated (unstable angina, uncontrolled hypertension)
- Any orthopedic or neurological diseases that might interfere with the study (chronic osteoarthritis, peripheral neuropathies etc.)

MATERIALS USED IN THE STUDY

The materials used in the study are

- Tray
- Glasses (height 10cm, base diameter 6cm)
- Jam bottle, bread slices
- Fork and spoon
- Broad white paper roll (6m)
- Ink
- Stopwatch
- Inch tape
- Scale
- marker

OUTCOME MEASURES: Gait performance was measured by tray-carrying task.

GAIT PARAMETERS

Gait parameters measured were

- velocity
- cadence
- step length
- stride length

PROCEDURE

A Total of 30 subjects with Hemiparesis were taken based on convenience after they fulfilled the inclusion criteria. All the subjects were explained about their condition & mode of assessment and written informed consent was obtained from them.

The subjects were allocated into experimental group and control group.

The experimental group subjects gait parameters were measured before intervention by preferred walking. The subjects were scheduled to attend dual task exercises thrice in a week for four weeks. The dual task-training program includes.

1) To walk while carrying a tray with glasses filled with water with an instruction to pay attention on walking.
2) To walk while carrying tray with glasses filled with water with instruction to pay attention over walking as well as tray carrying in hand, the subjects were challenged with increase in difficulty of the task.
3) To walk while carrying plate filled with bread slices, fork spoon and jam bottle and glass filled with water with instruction to pay attention to walking.
4) To walk while carrying plate filled with bread slices, fork spoon and jam bottle and glass filled with water with instruction to pay attention to walking as well as the things carrying in hand.

The control group gait parameters were measured before intervention by preferred walking. The subjects were scheduled to attend supervised conventional therapy sessions weekly thrice for four weeks. Conventional rehabilitation program includes pelvic bridging exercises, stretching and weight bearing activities, strengthening exercises, PNF Techniques.

The subjects' gait was reassessed after the four weeks of treatment for both groups and served as a reference for determining the effect of treatment

OUTCOME MEASUREMENT TOOLS

The subjects were assessed at the baseline and after the four weeks of treatment and served as a reference standard for determining the success of treatment. Gait assessment was done by using foot print method. Subjects were ambulated 6 m (20ft) on a paper walkway with ink patches on their feet, which left behind a footprint record. Ambulation time for 4.1m (20 ft.) was recorded with a digital stopwatch. The first and last1 m (3 ft.) of the walk were not used because of changes in velocity that occur when a person starts and stops walking. Each subject should undergo practice run without ink, continued by a five-minute rest and then walk two trials (with ink), with 15-minute rest interval between each trail.

The outcome measure for this study are gait parameters. The gait parameters measured using ink foot print record are

1. Velocity: meters/second. Average velocity (m/sec) = step length (cm) x cadence (steps/min)
2. Cadence: number of steps/minute.
3. Step length: It is the measurement of Perpendicular distance in meters from the heel strike of one foot to the preceding heel strike of the opposite foot. Mean step length for each trial is used in the analysis.
4. Stride length: It is the measurement of Perpendicular distance in meters from the heel strike of one foot to the preceding heel strike of the same foot. Mean stride length for each trial is used in the analysis.

RESULTS

The Test parameters were compared pre and post therapy sessions. Statistical Analysis done using SPSS version 16.0 package.

To assess all the parameters, mean and standard deviation were used.

To find out the changes in gait parameters between pre test and post test, paired ‘t’ test was adopted.

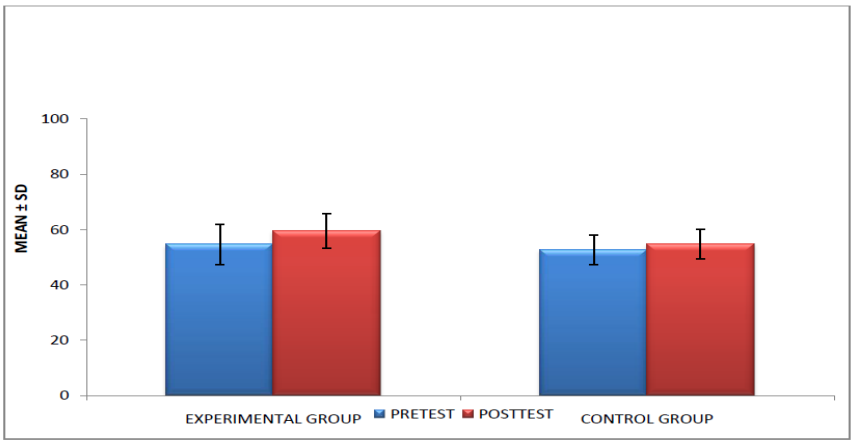
Independent ‘t’ test was used to compare the mean values of all parameters.

The changes within the group 1 and group 2 were analyzed using paired ‘t’ test and independent ‘t’ test.

Table 1 Comparison of Pre and Post Test Values of step Length in Group A and Group B

Step length	Group	N	Mean	Sd	Df	T value	Sig p<0.05
Pre Test	Group - A	15	54.593	7.287	28	0.794	0.434
	Group - B	15	52.726	5.452			
Post Test	Group - A	15	59.573	6.272	28	2.266	0.031
	Group - B	15	54.780	5.272			

This table infers that there was significant difference between pre and posttests in step length of Group A and Group B at p<0.05

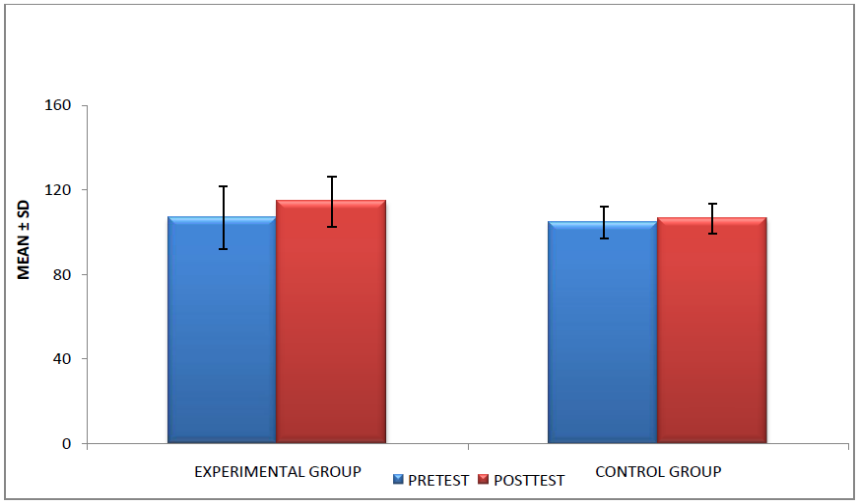


Graph- 1 Graphical representation of pre and post test mean values of step length of group A and group B

Table 2 Comparison of pre and post test values of stride length right in group A and group B

STRIDELENGTH RIGHT	Group	N	MEAN	SD	DF	t VALUE	Sig P<0.05
Pre Test	Group - A	15	106.887	14.928	28	0.492	0.627
	Group - B	15	104.766	7.478			
Post Test	Group - A	15	114.515	11.779	28	2.246	0.033
	Group - B	15	106.502	7.220			

This table infers that there was significant difference between pre and post tests in stride length right of Group A and Group B at p<0.05

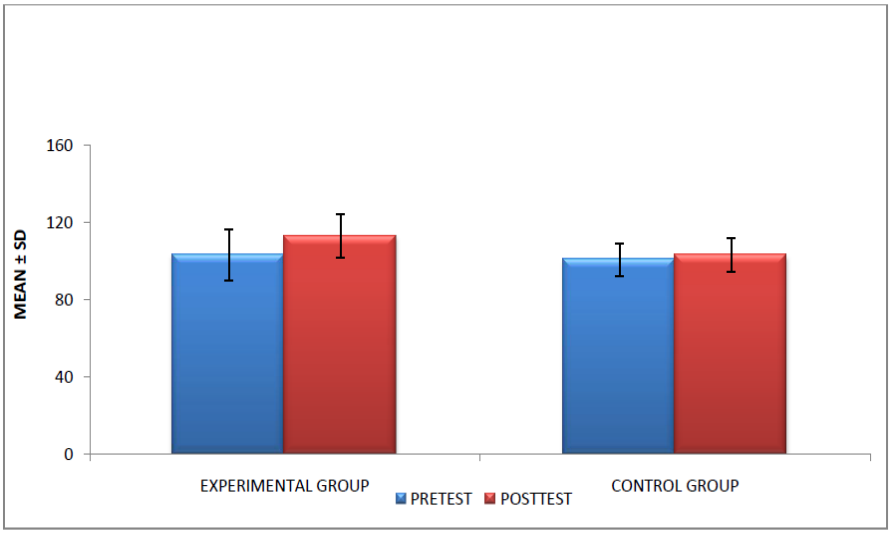


Graph- 2 Representation of Pre and Post Test Mean Values of Stride Length Right of Group A and Group B

Table 3 Comparison Of Pre And Post Test Values Of stride Length Left In Group A And Group B

STRIDELENGTH LEFT	Group	N	MEAN	SD	DF	t VALUE	Sig P<0.05
Pre Test	Group - A	15	103.213	13.110	28	0.594	0.557
	Group - B	15	100.826	8.388			
Post Test	Group - A	15	112.970	11.100	28	2.700	0.012
	Group - B	15	103.062	8.874			

This table infers that there was significant difference between pre and posttests in stride length left of Group A and Group B at P<0.05)

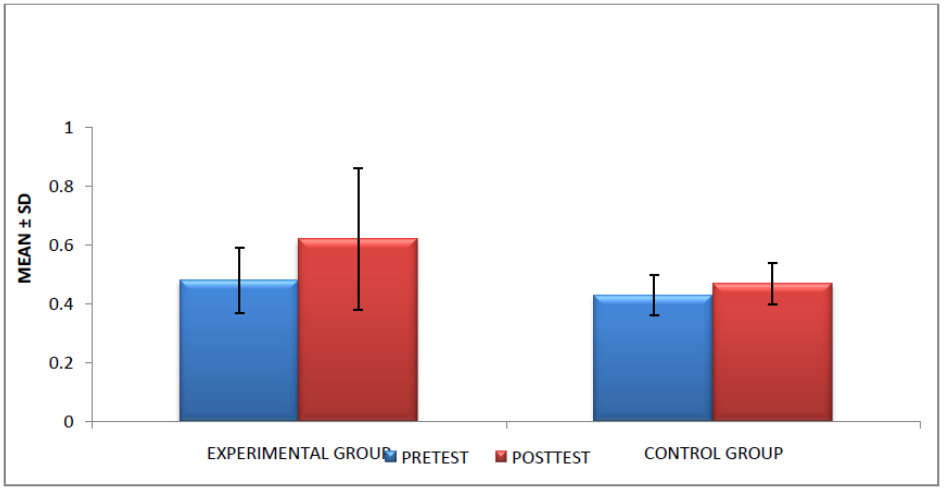


Graph- 3 Graphical Representation Of Pre And Post Test Mean Values Of Stride Length Left Of Group A And Group B

Table4 Comparison Of Pre And Post Test Values Ofvelocity In Group A And Group B

Velocity	Group	N	Mean	Sd	Df	T value	Sig p<0.05
Pre Test	Group - A	15	0.486	0.117	28	1.511	0.142
	Group - B	15	0.430	0.787			
Post Test	Group - A	15	0.620	0.246	28	2.115	0.043
	Group - B	15	0.479	0.757			

This table infers that there is significant difference between pre and post test in velocity of Group A and Group B at p<0.05

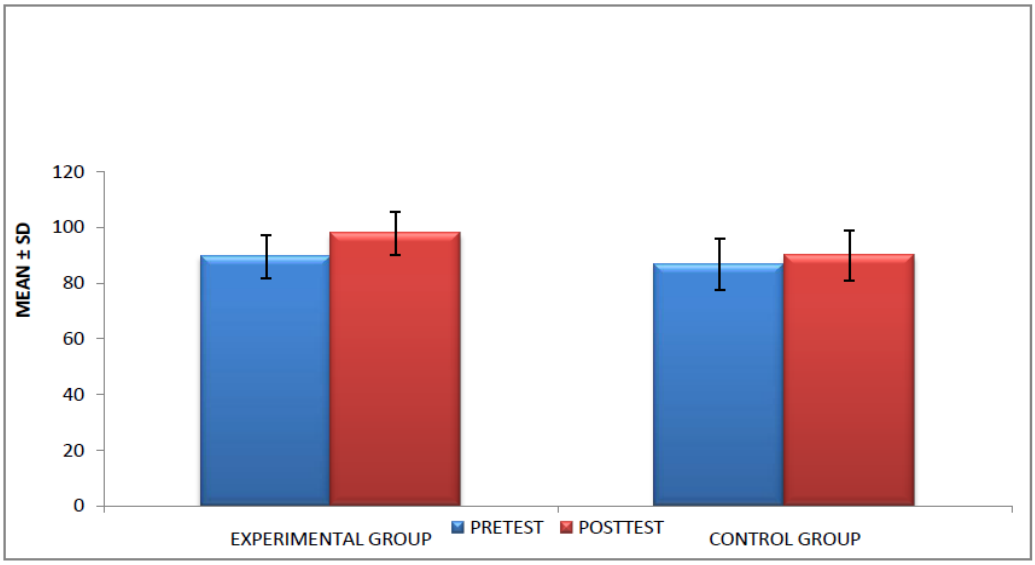


Graph 4 Graphical Representation Of Pre And Post Test Mean Values Of Velocity Of Group A And Group B

Table 5 Comparison Of Pre And Post Test Values Of cadence In Group A And Group B

Cadence	Group	N	Mean	Sd	Df	T value	Sig p<0.05
Pre Test	Group - A	15	89.511	7.675	28	0.909	0.371
	Group - B	15	86.680	9.314			
Post Test	Group - A	15	97.728	7.732	28	2.599	0.015
	Group - B	15	89.763	9.006			

This table infers that there is significant difference between pre and posttest of cadence in Group A and Group B at p<0.015



Graph 5 Graphical Representation Of Pre And Post Test Mean Values Of Cadence Of Group A And Group B

RESULTS

According to table 1 reveals that Mean, standard deviation, t value and p value of step length, between GROUP A and GROUP B at scores initially (pretest) and after 28days (post test). There is a statistically significant difference in step length initially and after four weeks at (p <.05)

According to table 2 reveals that Mean, standard deviation, t value and p value of stride length (right), between GROUP A and GROUP B at scores initially (pretest) and after 28days (post test). There is a statistically significant difference in stride length (right) initially and after four weeks at (p <.05)

According to table 3 reveals that Mean, standard deviation, t value and p value of stride length (left), between GROUP A and GROUP B at scores initially (pretest) and after 28days (post test). There is a statistically significant difference in stride length (left) initially and after four weeks at (p <.05)

According to table 4 reveals that Mean, standard deviation, t value and p value of velocity, between GROUP A and GROUP B at scores initially (pretest) and after 28days (post test). There is a statistically significant difference in velocity initially and after four weeks at (p <.05)

According to table 5 reveals that Mean, standard deviation, t value and p value of cadence between GROUPA and GROUP B at scores initially (pretest) and after 28days (post test). There is a statistically significant difference in cadence initially and after four weeks at (p <.05)

DISCUSSION

The aim of this study is to find the effectiveness of dual task exercises on community ambulation in Hemiparetic patients. The results of this study indicate that walking ability in Hemiparetic stroke patients can be improved significantly by dual task exercises in sub-acute stroke phase.

Dean et al found that a 4-week training program on the performance of loco motor-related tasks led to an average gain of 12.6 cm/sec in speed in subjects after post stroke[5].

Duncan et al observed an average velocity gain of 0.25mets/sec after an 8-week, home based task oriented exercise program that was designed to improve coordination, balance, and endurance in subjects at an average of 66 days post stroke[42].

Wilkinson et al (1995) in his study proved that foot-print method of gait analysis has high reliability both between and within examiners with pearson co-relation co-efficient ranging between 0.921-1[31].

In this study, gait assessment was done under dual task conditions to evaluate walking ability. Because many daily activities involve concurrent motor components, the assessment of dual-task performance may provide a better index of functional daily ability. Two groups (Group A, B) were randomized that were reasonably well matched at base line, in terms of patient age, sex, stroke type and walking 10metres independently without any assistive device, and who are willing to participate in the study. The treatment was given to both groups, for group A(dual task exercises) which consists of both motor and cognitive tasks ,for group B (conventional therapy). Pre and Post test findings were assessed by using the gait parameters measured by preferred walking.

The results of this study shows that there is significant difference in pre and post tests of group A and group B in gait parameters such as step length, stride length(right), stride length(left), velocity and cadence at p<0.05 Which showed significant improvement in walking ability after dual task exercises.

The reasons for the positive finding in this study may be due to task integration Hypothesis, according to that practicing two tasks together (dual task) allows participants to develop task-coordination skills. Thus, the efficient integration and coordination

between the two tasks acquired during dual-task training which is crucial for improving walking performance[43]. In addition, another hypothesis that coordinated muscle activity may be stimulated when working at a high level activity.

However, the exercise used in this study was a task-oriented program. Previous studies performed by using task-oriented intervention have shown significant improvement in loco motor function. Therefore tray carrying task with increased challenges while walking may help improving walking and community ambulation function.

CONCLUSION

Gait restoration has long been recognized as a key goal in stroke rehabilitation. It is important to Identify treatment approaches that maximize community ambulation.

In carefully selected patients with hemiparesis, a 4-week dual task exercise program enhanced improvement in the community ambulation than conventional therapy. Although the improvement may not be maintained after treatment is stopped, the above benefits may still be clinically worthwhile.

There is a statistically significant difference between the Pre and post test values in gait parameters between group A and group B at $p<0.05$.

Thus, this study concludes that dual task exercises can be considered for motivated patients with hemiparesis to improve the walking ability and community ambulation.

Limitations And Recommendations

Limitations

- Sample size was small and convenient sampling was done.
- Long term effects were not analyzed
- Independent effect of each treatment was not studied.
- The study was limited to subjects who volunteered, and, therefore, they were a self-selected group of willing and highly motivated people.

Recommendations

- A Study with long term follow up can be done.
- Larger –scale studies will be required to determine whether dual task exercises after stroke will lead to improved walking ability.
- Compare the effects on gender difference.
- Inclusion of any other valid and reliable advanced assessment scales, as ambulation requires multiple domains.
- The mechanism of effect of dual task exercise probably requires more study for further reference.

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