

## **A STUDY TO COMPARE THE EFFECT OF MOTOR DUAL TASK TRAINING AND COGNITIVE DUAL TASK TRAINING AND COMBINATION OF BOTH ON GAIT IN SUBJECTS WITH SUB - ACUTE STROKE - A RANDOMIZED CONTROLLED TRIAL**

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### **ABSTRACT**

#### **Background and Objectives**

Hemiplegia, is one of the most common impairments after stroke and contributes significantly, to reduce gait performance. Dual task is defined by, simultaneous production of two tasks which is motor dual task and a cognitive dual task. For those suffering from after effect of stroke, it helps them in a series of tasks that is done, in daily lives. Therefore, the objective of the study was to assess and compare the combined effect of motor dual task training and cognitive dual task training on gait, in subjects with sub-acute stroke.

#### **Methods**

Subjects were screened as per inclusion and exclusion criteria, that has got ischemic stroke. A written informed consent was signed by the subject and was rehabilitated, for 5days a week, for 4 weeks. They were divided into three groups, namely Group A (CDTT), Group B (MDTT) and Group C (CDTT&MDTT). The intervention was, with the dual task training program; i.e., exercises involving cognitive dual task and motor dual task. The outcome measures were SSQOL, BBS and FGAS. These scales were taken before intervention, at the interval (2nd week) and after the intervention (4th week).

#### **Results**

Out of three groups, Group C (CDTT and MDTTT) improved significantly than group A and B. In Group C, the SSQOL score improved from pre intervention mean of 133.6, to post intervention mean of 144.2. The BBS score improved from pre intervention mean of 43.67, to post intervention mean of 50. The FGS score improved from pre intervention mean of 18.73, to post intervention mean of 25.07.

#### **Conclusion**

Following the intervention, at the end of 4th week, results showed clinically and statistically, improved in the SSQOL, BBS and FGAS scores, in Group C compared to Group A and B. Therefore, the increased scores of SSQOL, BBS and FGAS signify that, the subject gait can be improved after combined effect of cognitive and motor dual task training.

**KEYWORDS:** Stroke, Stroke Specific Quality of Life, Berg Balance Scale, Functional Gait Assessment Scale, Dual Task Training, Cognitive Dual Task Training, Motor Dual Task Training

## INTRODUCTION

Stroke is a leading health problem worldwide, and an important cause of long-term disabilities.<sup>1</sup> The world health organization (WHO) defines stroke as, “The rapidly developing clinical symptoms and / or signs of focal (or global) disturbance of cerebral function, with symptoms lasting more than 24 hours or leading to death with no apparent cause other than, that of vascular origin”. Stroke, is mainly of two types, ischemic and haemorrhagic, among which ischemic stroke is the most common type, affecting 80% of the individual.<sup>6</sup> The major Risk factors for stroke are Hypertension, Heart disease, Diabetes, Arterial disease, and modifiable risk factors are Smoking, Obesity, Lack of exercise, Increase serum cholesterol level, Diet, Heavy Alcohol consumption and Stress.<sup>3</sup> Depending on the damage in the area / parts of the brain, clinical features varies and shows symptoms like Spasticity, Perceptual deficits, Cognitive deficits, Motor impairments, Inco-ordination, Sensory deficits, Difficulty in walking independently, etc.<sup>2</sup>

Hemiplegia, is one of the most common impairments after stroke, and contributes significantly to reduce gait performance.<sup>4</sup> For those suffering from after effect of stroke, independent ambulatory abilities, are an important goal in terms of rehabilitation program and for the combination with daily activities. Since, a series of tasks should be done in daily lives, people should be able to juggle exercise tasks and high cognitive functions, simultaneously. Dual-task training triggers development of strategic methods, to implement several tasks at the same time.<sup>5</sup>

One of the recent developments in past few years, for gait rehabilitation in patients with stroke, is the use of dual task training. The dual task, is defined by the simultaneous production of two tasks, one called “primary” and the other called “secondary”, where performance changes are measured. Dual tasks are mainly divided into two types: motor dual task, which requires simultaneous performance of a motor task and a postural control task, at the same time; and cognition dual task requires, simultaneous performance of a cognition task and postural control task. Cognitive-motor interference, refers to the phenomenon that occurs, when 1 or 2 tasks that interfere with each other are being performed, such as engaging in cognitive and motor tasks, simultaneously. Interference between cognitive tasks and motor control activities (such as walking) is important, for functional improvement in patients with neurological deficits. Thus, the therapist must address both cognitive and motor training, in planning rehabilitation therapy.

Dual motor interference is considered as clinically important, for reasons as follows. First, the simultaneous implementation of two exercise tasks, could be a prescription itself for treatment. Second, the degree of interference, according to dual-task differs among patients. Therefore, exercise implementation abilities of each individual, could affect on treatment plans. Third, several exercise activities are done at the same time, in most of the their daily lives. Therefore, evaluation of dual-task implementation, would be able to provide better standard, in terms of evaluating functional daily abilities, in comparison with single exercise task evaluation.

Previous studies show that, dual-task training increases task-coordination skills, with improvement being due to the ability to incorporate the challenges efficiently. So, it is considered that, subjects who underwent gait training, while counting backwards showed improvements in gait and balance abilities, due to the coordination and integration of motor and cognitive tasks. Therefore, it is believed to be necessary, to provide an environment for persons with stroke to exercise, while inducing their memory or to perform motor tasks, while talking.

So, this study was aimed to assess and compare, the effect of motor dual task training and cognitive dual task training, and a combination of both, on gait in subjects with sub-acute stroke.

## **OBJECTIVE OF THE STUDY**

### **Primary Objective**

To assess and compare the combined effect, of motor dual task training and cognitive dual task training, on gait in subjects with sub-acute stroke.

### **Secondary Objective**

To assess the pre and post quality of life, of stroke subjects.

## **METHODOLOGY**

### **Settings**

Outpatient and Inpatient of medicine department, and Outpatient of physiotherapy department at kempegowda institute of medical sciences, Hospital and research centre, Bangalore, Karnataka, India.

### **Participants**

A total of 45 eligible participants were recruited, for participation in the study. After getting an informed consent, all of them were initially screened for inclusion criteria. All 45 (15 in each group) were randomly assigned, into either of three treatment groups, namely Group A: Cognitive Dual Task Training (CDTT) group, Group B: Motor Dual Task Training (MDTT) group and Group C: Combination of both (CDTT & MDTT) group.

### **Inclusion Criteria<sup>4</sup>**

- Minimum duration of stroke should be of 1 month to 6 months
- Ability to ambulate at least 10 meters without any external support
- No incidence of any other significant Neurological Disorders
- Ability to understand and follow three step commands
- Ability to communicate verbally
- Age: 25-75
- Both males and females Participants should cognitively be able to follow the exercise program. (MMSE > 24)
- Currently, not receiving any other types of physiotherapy intervention, to the upper and lower limb except chest physiotherapy
- Modified Ashworth scale  $\geq 2$

### **Exclusion Criteria<sup>4</sup>**

- Aphasia
- Hearing impairments or visual impairments,
- Seizure Disorders,

- Any other significant neurological or Orthopaedic Disorders, of gait including amputation
- Patient with perceptual and cognitive deficits, like hemispatial neglect and memory deficits.

## **OUTCOME MEASURES**

### **Berg Balance Scale (BBS)**

The Berg Balance Scale, is a 14-item scale, that quantitatively assesses balance and risk for falls, in older community- dwelling adults, through direct observation of their performance. The items are scored from 0 to 4, with a score of 0, representing an inability to complete the task and a score of 4, representing independent item completion. A global score is calculated out of 56 possible points. <sup>4</sup>

### **Functional Gait Assessment Scale (FGAS)**

The Functional Gait Assessment Scale, is a modification of the DGI19. It is a 10- item clinical gait test. It is scored on a 4 level (0-3) ordinal scale. Scores range from 0 to 30, with lower scores, indicating greater impairments. <sup>4</sup>

### **Stroke- Specific Quality of Life (SSQOL)**

The SSQOL is comprised of 49 items, that examine 12 domains of health-related quality of life. Three response sets, with each item scored on a five-point Likert scale are used, ranging from the amount of help needed to do specific tasks: "total help to no help;" "unable to do, to no trouble at all" in completing tasks, and "strongly agree to strongly disagree" for items addressing statements, regarding their functional level. <sup>8</sup>

### **Study Design**

Three groups', pre and post randomized comparative study.

### **Sampling**

A random sampling method

### **Procedure**

All participants, who fulfilled the inclusion criteria were enrolled into the study, after getting prior informed consent. All 45 (15 in each group) were randomly assigned, into either of three treatment groups, namely Group A: COGNITIVE DUAL TASK TRAINING (CDTT), Group B: MOTOR DUAL TASK TRAINING (MDTT) & Group C: COMBINATION OF BOTH groups. Following this, is a baseline assessment of Balance, using the BBS, Gait using FGAS and quality of life using SSQOL, was done at the beginning of the study and at 2<sup>nd</sup> week, and at the 4<sup>th</sup> week. All participants continued to receive conventional rehabilitation, throughout the entire duration of the study (12 months). Participants received an additional specific intervention, as per their intervention group, for 30 minutes each day, 5 sessions per week for 4 weeks.

**Intervention Plan of Cognitive Dual Task Training and Motor Dual Task Training<sup>4</sup>**

**Table 1**

<b>CDTT GROUP</b>	<b>MDTT GROUP</b>
(Each Task for 6 Min.) (Rest Period of 2 Min. Between the Task)	(Each Task for 6 Min.) (Rest Period of 2 Min. Between the Task)
Backward Counting While Walking	Object Transfer While Walking
Mathematical Subtraction While Walking	Holding of Glass of Water Without Spilling During Walking
Category Naming While Walking	Buttoning Upwards After Unbuttoning While Walking
Backward Recitation While Walking	Receiving And Returning Rings From a Ring Holder While Walking
Naming Words Starting With a Particular Letter While Walking	Picking Objects and Transfer to a Fixed Point While Walking

Group A (CDTT) and Group B (MDTT) participants, performed the given task, where each task was performed for 6 minutes with 2 minutes rest period, between each task. So, the intervention session was completed in 30 minutes. In Group C (CDTT & MDTT), participants performed both the cognitive and dual task, and the intervention session was completed in 1 hour.

The intervention protocol for each group was as enlisted in the table:

Protocol of CDTT and MDTT, consisted of doing the secondary motor or cognitive task, under either of the following circumstances: <sup>4</sup>

- Level surfaces, walking: 5 sessions
- Obstacle crossing: 5 sessions
- Walking at different speeds: Fast and Slow 5 sessions
- Walking with frequent changes of directions: 5 sessions

**STATISTICAL ANALYSIS**

All data, was analyzed using the 16.0 software. Descriptive statistics were used, to calculate Mean and SD. Cognitive dual task training (Group A), Motor dual task training (Group B), and Combination of both on gait (Group C), in sub-acute stroke subjects were measured, using Repeated measures ANOVA. For individual evaluation of the groups, One Way ANOVA was used. Pre and Post quality of life of stroke subjects, were evaluated by Paired ‘t’ test. Significance level for each analysis, was set at 0.5.

**RESULTS**

Repeated measures of ANOVA were used, in comparing the outcome measures SSQOL, BBS and FGAS, of Group A, B and C. There were significant changes, in pre and post, in all the groups. One way ANOVA was used, in comparing effectiveness between the group. Out of three groups, Group C (CDTT and MDTT) improved significantly, than group A and B. In Group C the SSQOL score, improved from pre intervention mean of 133.6 to post intervention mean of 144.2, with a p value <0.05. The BBS score, improved from pre intervention mean of 43.67 to post intervention mean of 50, with p value <0.05. The FGS score improved from pre intervention mean of 18.73, to post intervention mean of 25.07, with p value <0.05. Result showed better improvement, in the Group C.

**Table 2: Paired ‘t’ Test to Assess the Pre and Post Quality of Life of Stroke Subjects in Group A, Group B and Group C Using SSQOL Scale**

Groups	CDTT (Group A)		MDTT (Group B)		CDTT & MDTT (Group C)	
	Pre	Post	Pre	Post	Pre	Post
Mean	109.9	110.7	112.3	116.8	133.6	144.2
SD	22.41	22.84	19.25	18.85	25.09	23.44
Min	60	60	80	85	54	67
Max	141	143	137	140	151	158
<b>T (df=14)</b>	<b>4</b>		<b>6.91</b>		<b>9.42</b>	
<b>P</b>	<b>0.001</b>		<b>0</b>		<b>0</b>	
<b>Significant</b>	<b>Yes</b>		<b>Yes</b>		<b>Yes</b>	

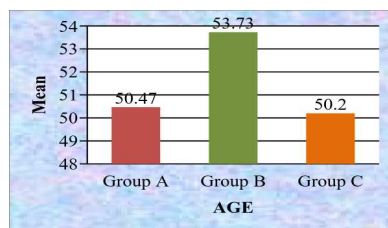
**Table 3: Paired ‘t’ Test to Assess the Pre and Post Quality of Life of Stroke Subjects in CDTT, MDTT and Combination of Both under BBS**

Groups	CDTT		MDTT		CDTT & MDTT	
	Pre	Post	Pre	Post	Pre	Post
Mean	38.33	38.87	35.86	37.67	43.67	50
SD	10.48	10.66	11.26	11.4	12.05	6.82
Min	10	10	17	19	9	29
Max	52	52	51	53	54	56
<b>t (df=14)</b>	<b>3.055</b>		<b>12.43</b>		<b>4.45</b>	
<b>P</b>	<b>0.009</b>		<b>0</b>		<b>0.001</b>	
<b>Significant</b>	<b>Yes</b>		<b>Yes</b>		<b>Yes</b>	

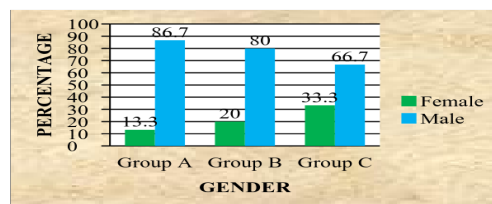
**Table 4: Paired ‘t’ Test to Assess Pre and Post Quality of Life of Stroke Subjects in CDT, MDTT and Combination of Both in FGAS**

Groups	CDTT		MDTT		CDTT & MDTT	
	Pre	Post	Pre	Post	Pre	Post
Mean	18.33	18.93	15.4	17.53	18.73	25.07
SD	7.42	7.62	6.9	6.45	8.66	5.53
Min	3	4	0	3	0	9
Max	28	29	3	72	28	30
<b>t (df=14)</b>	<b>4.58</b>		<b>11.117</b>		<b>6.11</b>	
<b>P</b>	<b>0</b>		<b>0</b>		<b>0</b>	
<b>Significant</b>	<b>Yes</b>		<b>Yes</b>		<b>Yes</b>	

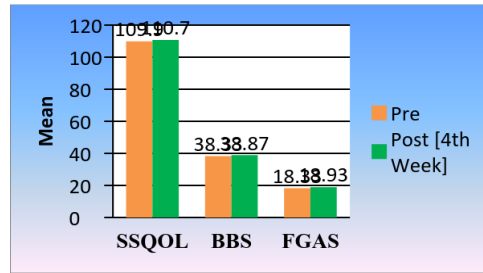
Graphical representation of Age, Gender and Pre and Post intervention mean of SSQOL, BBS & FGAS



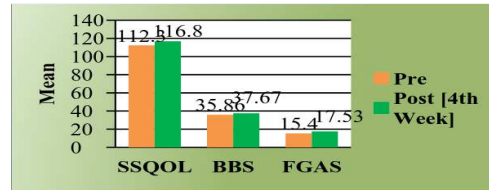
**Graph 1: Mean Age for Group A, B and C**



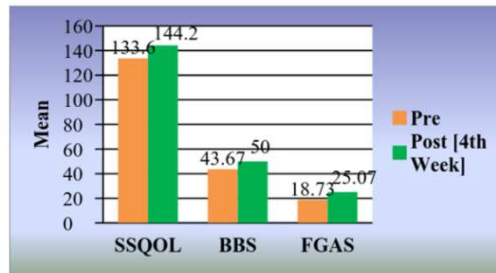
**Graph 2: Gender Percentage of Group A, B, C**



Graph 3: Pre and Post Mean of Group an in in SSQOL, BBS and FGAS



Graph 4: Pre and Post Mean of Group B SSQOL, BBS and FGAS



Graph 5: Pre and Post (4th Week) Mean of Group C in SSQOL, BBS and FGAS

**DISCUSSIONS**

The present study was conducted, to analyze the combined effect of cognitive dual task training and motor dual task training, in addressing one of the most common impairments after stroke, i.e., gait. Evidence from the various literatures, demonstrated the importance of dual task training, after stroke and the therapy was aimed to improve gait. The outcome measures of this study, were measured using Stroke specific quality of life, Berg balance scale and Functional gait assessment scale.

SSQOL, BBS and FGAS of group A, shows significant changes in terms of mean and standard deviation, in pre and post intervention. Pooja Kumara Digra et al. (2015), in their study of dual task, cognitive performance along with conventional physiotherapy, on gait parameters had concluded that, dual task cognitive training was effective, to improve the gait parameters, and there was a relative improvement in the functional abilities.

SSQOL, BBS and FGAS of group B, shows significant changes in terms of mean and standard deviation, in pre and post intervention. Sun-Shil Shin et al. (2014), had done their research, to compare the effects of SBT (single balance training) and MDBT (motor dual task balance training) conditions, on balance and gait of elderly women, who could walk independently without any assistive device. The post intervention balance of the MDBT group, was significantly better than that of the SBT group. Walking ability, also showed a significant improvement, when compared to that of STB group.

SSQOL, BBS and FGAS of group C, shows significant changes, in terms of mean and standard deviation in pre and post intervention. Chopra Neha et al. (2015), in their study concluded that, dual task training (CDTT & MDTT) has significant improvement, in patient's post stroke in all gait parameters, than single task training.

Comparison of effectiveness of SSQOL, BBS & FGAS, between all three groups CDTT, MDTT & combination of CDTT & MDTT, showed significant improvement in the combination group of CDTT and MDTT. Paired "t" test, to assess the pre and post quality of life of stroke subjects, showed significant improvement in all three groups, and better improvement was seen in the combination group of CDTT and MDTT.

In this study, the intervention was focused on dual task training. These exercises were carried out by patients, while they were walking for a distance and were performed under different level, which indicates, there is improvement in gait performance, among the sub-acute stroke patients, which was significantly proved by the statistical analysis.

### **LIMITATIONS OF THE STUDY**

- This study was carried out on small sample size.
- No long term follow up was carried out, to assess whether subjects retained the gained improvement, after 4 weeks of the intervention.
- The age group of the patient limits the study.

### **CONCLUSIONS**

The results observed in this study concluded that, the combination of cognitive dual task training and motor dual task training can be used effectively, to treat stroke subjects, which was proved by statistical significance seen in the post intervention of Group C, compared to Group A and Group B. The results show SSQOL, BBS and FGAS, significantly improved in all the groups. Subjects, in Group C showed significant improvement, after the respective intervention, when compared to Group A and Group B. Hence, the alternate hypothesis is accepted and the null hypothesis is rejected.

### **ACKNOWLEDGEMENTS**

I would like to engrained sense of gratitude and thanks to Dr. R. RAJA, MPT, I/C principal and Dr. CHANDRIKA, MPT of Kempegowda Institute of Physiotherapy, for their guidance and encouragement throughout the study.

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