

## ORIGINAL ARTICLE

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## EFFECTIVENESS OF MOTOR TASK INTERFERENCE DURING GAIT IN SUBJECTS WITH PARKINSON'S DISEASE: A RANDOMIZED CONTROLLED TRIAL

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## ABSTRACT

**Background:** In this study, was to evaluated the effectiveness of motor task and cognitive task interference while walking to improve gait parameters of subjects with Parkinson's disease.

**Methods:** In this Randomized Controlled trial, 30 subjects with Parkinson's disease of age group between 50 and 70 years randomly divided into two groups. The first group had motor task interference, and the second group had calculation task interference while walking along with conventional physical therapy. Gait parameters recorded as outcome measures. Both the groups received 1-hour training for three weeks for one month.

**Results:** As per the paired t-test values, there was significant ( $p < 0.001$ ) improvement in the gait parameters for both the group's pre and post training. Motor task interference showed better improvements than calculation-task interference group among subjects with Parkinson's disease in all the gait parameters measured with a p-value less than 0.001.

**Conclusion:** To improve the gait parameters for mild to moderately disabled patients with Parkinson's disease, the dual task training by using motor task while gait training along with conventional Physical Therapy will be more useful than using cognitive task.

**Keywords:** Parkinson's disease, Gait, Dual task, Motor task interference, Calculation task interference.

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## INTRODUCTION

Parkinson's disease is a progressive degenerative disorder of central nervous system with primary features: resting tremors, rigidity, bradykinesia, and postural disturbance. The primary cause of Parkinson's disease is the reduction of dopamine-producing neurons in substantia nigra [1].

Gait disturbance is another cardinal symptom in subjects with Parkinson's disease. While walking the subjects with Parkinson's disease have short and reduced cadence with the limited swinging of arms and forward-stooped posture. Gait deterioration in association with postural disturbance affects the Parkinson's disease people's ability to move independently and increase the risk of falls [2].

The slowness of walking is associated with a reduced stride length, decreased cadence, and an increase in the double limb support phase of gait cycle [3]. Movement rehabilitation strategies could have the potential to assist subjects with Parkinson's disease in improving gait parameters. Previous studies have shown the use of visual and auditory cues in improving gait pattern in subjects with Parkinson's disease [4-9].

In general, we need to execute a group of tasks while performing daily activities rather than the single task at once. The capability of performing two different tasks at the same time is called as the dual task. It allows the people to perform daily activities with ease. As people become, the older performance of dual task activities takes more time when compared to young [10]. The amplitude of gait disturbance is directly related to the complexity of activity to be performed [11].

In subjects with Parkinson's disease, gait disturbance will be more when they perform a second motor task [3, 12]. In the primary level of learning skilled activities, the brain has an important role to control but once the movement is learned it is controlled by extrapyramidal system [13]. When Parkinson's disease people are performing an activity which involves more than one task, brain involved in controlling secondary task and the defective extrapyramidal system takes charge of controlling primary task. This may be the probable reason to deteriorate the gait variables while performing a dual task. O'Shea et al. [3], Lim et al. [4], Rochester et al. [6], Bagley et al. [7], McIntosh et al. [8] and Lewis et al. [9] have shown the effectiveness of different gait training strategies in subjects with Parkinson's disease. The gait training strategies used by Nieuwboer et al. [14] which had shown great immediate effect where starting, stopping, changing directions, walking around and turning 180 degrees or 360 degrees.

O'Shea et al. [3] had described the effects of dual task interference on gait in subjects with Parkinson's disease. Even though they showed the detrimental effects of these tasks on gait as an immediate effect, we strongly believe that after repeated training the capacity to perform a dual task will be improved due to schema changes in the brain [10]. Now we know that dual task interference while walking training can improve the gait parameters but what kind of dual task

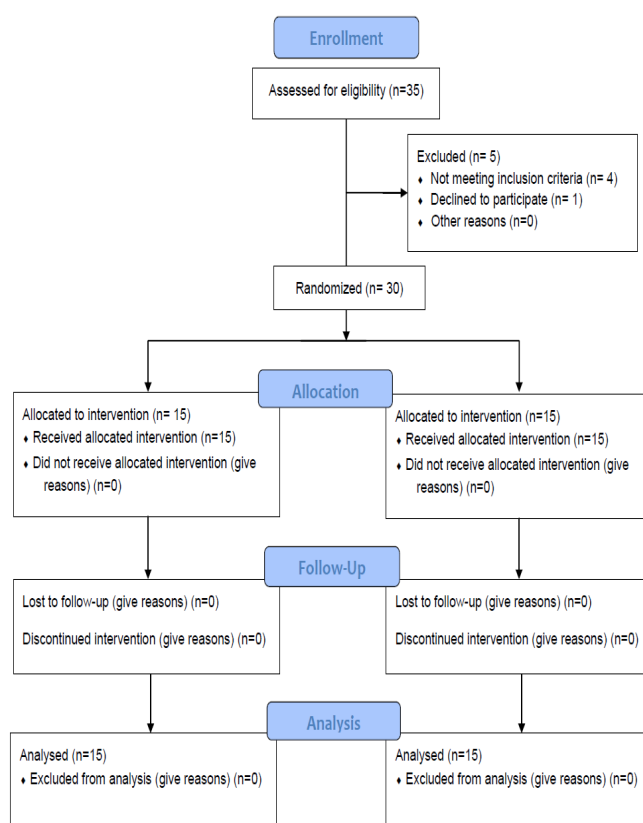
can lead to better improvements is a question. The current study is to explore the effects of interference training, using comparative performance measures of motor tasks and cognitive tasks while walking gait parameters in people with Parkinson's diseases

## METHODOLOGY

### Study design:

Ethical committee approval was obtained from Research Ethics Committee body of LVTG College of Physiotherapy, Kurnool bearing registration no REC 2012-02-10. In this Randomized controlled trial, we recruited the patients with Parkinson's disease by convenience sample from various rehabilitation institutes. Out of 35 patients approached four patients did not meet the inclusion criteria and one did not accept for consent (flow chart-1). The informed consent was obtained, 30 subjects diagnosed with idiopathic Parkinson's disease and ranging between ages 50 and 70 were included in this study.

Flow chart-1: Flow diagram for complete process of Randomized Controlled Trial



### Participants:

The criteria for including the participants were subjects with Parkinson's disease have a mini mental status examination more than 20 [15], Hoehn and Yahr stage 2 [16], Moderate disability on a Webster scale [17] and unassisted walking about 10 meters. Subjects with any other neurological disorders, musculoskeletal disabilities, unstable cardiac diseases, and impaired vision were excluded.

### Procedure/ Intervention:

Subjects were randomly assigned to 2 groups using block randomization. Fifteen subjects were in experimental

group one (Motor-task interference), 15 subjects were in control group two (Cognitive-task interference). All the testing and training procedures were performed in the Physical Therapy clinic. The recorded gait outcomes measured were stride length, speed, and cadence at the baseline of study and post training.

The subjects made to walk some distance meanwhile, the point where the heel strikes the ground is marked with chalk and then the point where the same heel contacts the ground again is marked. The distance between both the points is determined using measure tape and recorded as stride length.

Subjects were asked to walk on a marked line of 10 meters; the amount of time the subject took was noted. Speed was calculated as distance walked by the time. Cadence was measured by calculating the steps per minute.

The subjects in group one were advised to walk 10 meters distance by holding a tray in hand (by both hands or by one hand) for 10 minutes repeatedly(Figure-1). Subjects of the group two were advised to repeatedly walk 10 meters while counting backward (3 counts from 100). Both group subjects were allowed to take rest periods in between.

**Figure 1:** Dual-task treatment procedure, walking with a tray holding in the hands



In addition to the above task training, the subjects of both groups were undergoing conventional Physical Therapy training, including a range of motion exercises, muscle strengthening, repetitive alternating active movements, relaxation strategies, muscle elongations, 10 min of gait training and functional training. The treatment was given one hour, three times per week for one month. During the training session, all patients were guarded to prevent the fall, and the participants were taken usual treatments during this study period.

Data Analysis was completed using SPSS version 15. To compare pre and post- test values within the group, paired t-test was used for stride length and speed, and Wilcoxon signed rank test for cadence. Comparison between groups was made using an independent t-test for measuring stride length and speed, while a Mann-Whitney U test was used for measuring cadence.

## RESULTS

In this study, 30 subjects with Parkinson's disease participated, and they were divided into two groups. Group 1 consisted of 15 subjects who received motor-task interference during gait while Group 2 consisted of 15 subjects, each of whom received calculation-task interference during gait. In this study, 22 Males and eight females were included, the average age for group 1 is 67.73 and group 2 is 66.73.

In both Group 1 and Group 2, pre and post gait parameters showed significant improvement with ( $p < 0.001$ ). These variables are represented in Table 1.

**Table 1:** Pre and post- test values of stride length, speed and cadence for the motor task training group & the calculation task training group

Group	Variables		Mean	Standard Deviation	t-value	p-value
Motor task gait training	Stride length (cm)	Pre	29.20	2.14	10.79	0.00000*
		Post	32.26	2.25		
	Speed (M/Sec)	Pre	0.68	0.15	10.46	0.00000*
		Post	0.79	0.16		
	Cadence (Steps/minute)	Pre	97.26	2.76	3.43 (z-value)	0.00059*
		Post	100.46	3.24		
Calculation task gait training	Stride length (cm)	Pre	27.26	2.86	5.73	0.00005*
		Post	28.73	2.81		
	Speed (M/Sec)	Pre	0.60	0.12	7.33	0.000004*
		Post	0.63	0.12		
	Cadence (Steps/minute)	Pre	100	5.01	3.48 (z-value)	0.00049*
		Post	101.73	4.92		

Note: “ \* ” Indicates significant p-value  $< 0.001$

In between the groups, there were significant differences in all three gait parameters with ( $p < 0.001$ ) which were represented in Table 2.

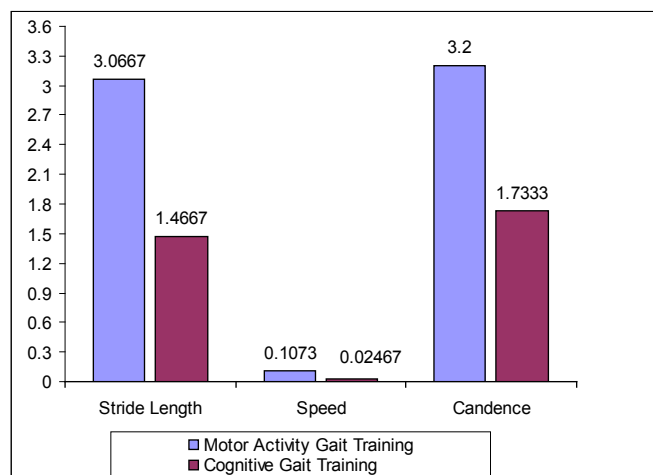
**Table-2:** Comparison of stride length, speed, and cadence between the motor task training group & the calculation task training group

Variables	Group	Mean	Standard Deviation	t-value	p-value
Stride length (cm)	Motor-task gait training	3.06	1.09	4.18	0.00025*
	Calculation-task gait training	1.46	0.99		
Speed (m/sec)	Motor-task gait training	0.10	0.03	7.65	0.00000*
	Calculation-task gait training	0.02	0.01		
Cadence (Steps/min)	Motor-task gait training	3.2	1.20	3.11	0.00185*
	Calculation-task gait training	1.73	1.03		

Note: “ \* ” Indicates significant p value  $< 0.001$

As evidenced by all the outcome measures in Figure 2, Group 1 demonstrated more improvement than Group 2.

**Figure-2:** Mean-variance between two groups for stride length, speed, and cadence.



## DISCUSSION

In this study, 30 subjects with Parkinson's disease participated, and they were divided into two groups, each consisting of 15 subjects. Group 1 received motor task interference during gait, while Group 2 received calculation task interference during gait. Age group taken in this study ranged from 50 to 70yrs, with no significant difference between two groups: with mean age 67.73 and 66.73. The number of male participants, 22, was greater than that of females, 8. This is expected in Parkinson's disease studies because males are more affected by this disorder than females. [18] Based on the standards of Webster's Parkinson's disease rating scale, subjects included in this study had moderate disabilities. This rating indicates that these subjects are mobile and capable of ambulation [17].

Kumaran et al. [19] had conducted a similar study on patients with Parkinson's disease. In his study, they used motor task or cognitive task concurrently with walking. The duration of training was 40-60 minutes, three times per week for one month. They used timed up and went test as an outcome measure and showed 53 % improvement. They said there is an improvement in step length and speed of walking. In our study with very similar intervention, we also showed improvements in gait speed and stride length. Walking on a treadmill is sufficient enough to improve gait parameters [20, 21]. This is the reason walking training in both groups showed improvements. Subjects' increased confidence levels from one month of repeated activity may be a contributing factor to increased stride length parameters in both motor and calculation tasks.

A look at the inter-group comparison shows more significant changes in the motor task group than calculation group. The reasons may be due to activation of motor-control areas of the cortex, which is greater in motor tasks than in calculation tasks. Research evidence has proved that learning of skilled activities needs practice in people with Parkinson's disease which were later assumed as "schema learning" [10].

In the motor-task interference group, subjects with Parkinson's disease required greater reaction balance and postural

control when compared with the calculation interference group. The motor-task group experienced more than the calculation group regarding energy- expenditure increase and other general walking complications, resulting from variations in size and weight of the tray, along with ranges of upper-extremity positions [21]. All these reasons may be added together to allow improvements in the motor-task interference group. In this study, individuals of both groups improved their performance in dual tasks across repetitions, but more with the motor task than with the calculation task training.

Duration of the study was only one month, which is a relatively short period for noticing any major changes in Parkinson's disease subjects. There was no long term follow up of the cases. Three simple gait variables were used to measure the changes in gait. The sample size was small. Based on the above results we cannot generalize motor task interference as an ideal intervention in all stages of Parkinson's disease.

A future study should be done on a large sample size with more advanced outcome measures on gait lab on all the stages of Parkinson's disease. We can even consider studying the effect of on and off-phase medication along with dual-task training in improving the Parkinson's gait.

## CONCLUSION

In this study, motor-task interference gait training is expected to produce greater effects on gait than calculation-task gait interference training in subjects with Parkinson's disease. In the current study, all three gait parameters show significant improvement within the group as well as between the groups.

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