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Effect of Lee Silverman Voice Therapy (LSVT) BIG Exercises on Functional Gait Performance of Parkinson's Disease Patients

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ABSTRACT

Background- Parkinson's disease is progressive, neurodegenerative disorder. Gait abnormalities are one of the reasons leading to restriction in functional independence, morbidity and mortality among them. LSVT BIG therapy involves task specific repetitive high intensity exercises focusing mainly on training movement amplitude. LSVT BIG involves Continuous feedback on motor performance and training of movement perception to counteract reduced gain in motor activities resulting from disturbed sensorimotor processing. There has been some evidence suggesting positive effect on use of LSVT BIG exercises and advising well designed study. Hence this study is planned to gather more evidence on effect of LSVT BIG on functional gait performance of Parkinson's disease.
Aim- To study the effectiveness of LSVT BIG on functional gait performance of Parkinson's disease patients.
Objective- To assess and compare the effect of conventional rehabilitation program along with LSVT BIG therapy and conventional rehabilitation program on functional gait performance using FOGQ, TUG and FGA in Parkinson's disease patients.
Methodology- 32 clinically diagnosed Parkinson's disease patients selected from Parkinson's disease and movement's disorder society, Mumbai. They were divided into 2 groups, 16 each. Functional gait performances of both groups were assessed using FOGQ, TUG test and FGA. Conventional group received conventional rehabilitation program treatment and the experimental group received conventional treatment along with LSVT BIG exercises for 4 weeks. Post intervention gait performance was assessed. And data was analysed.
Results- The study results shows that there is a significant improvement in functional gait performance in Parkinson's disease patients after LSVT BIG therapy shown by significant p-values of respective tests.
Conclusion- LSVT BIG therapy exercises have beneficial effects on functional gait performance primarily on Freezing of Gait and TUG Test of Parkinson's disease patients.

Key Words: Parkinson's disease, functional gait performance, LSVT BIG, freezing of gait, timed up and go test, functional gait performance

INTRODUCTION

Parkinson's disease was first described by Dr. James Parkinson in 1817 as a "shaking palsy" is a chronic, progressive neurodegenerative disease characterized by both motor such as resting tremors, bradykinesia, rigidity, postural instability and non-motor features. [1]

There are very few populations based studies determining the exact incidence and prevalence of Parkinson's

disease India. A survey, done in Mumbai, showed a prevalence of 192 per 100,000. [2]

Parkinson's disease is caused due to degeneration of dopaminergic neurons and also due to accumulation of lewy bodies in the extrapyramidal tract of the midbrain. It is unknown what triggers the initiation of Parkinson's disease; however, most investigators point to a combination of genetic and environmental factors. This leads to imbalance of excitatory and inhibitory neurotransmitters in the region. This imbalance causes rigidity, bradykinesia, postural instability and tremors. [3]

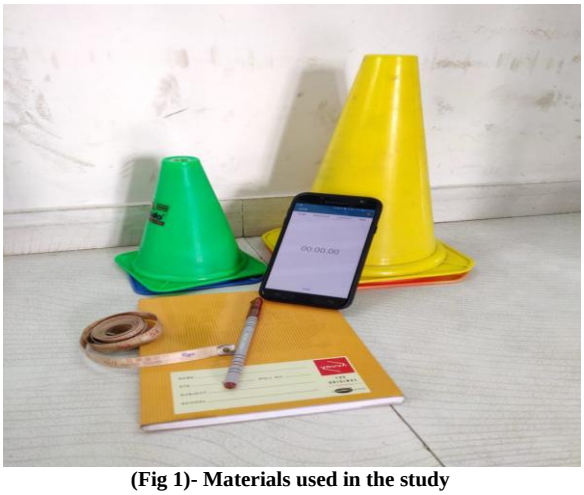
In addition to these motor disturbances, Parkinson's disease also leads to alterations in gait and balance. These motor changes in Parkinson's disease often restrict functional independence and are a major cause of morbidity and mortality among these patients. [4] Parkinsonism is associated with a twofold increase in the risk of death, which is strongly related to the presence of a gait disturbance. [5] The gait disturbances in Parkinson's Disease may be divided into two types: (1) continuous and (2) episodic. The episodic gait disturbances include festinating, start hesitation, and freezing of gait. [4] Freezing Of Gait is related to higher fall risk and poorer prognosis. [6] Freezing of gait is a brief episodic absence or marked reduction in forward progression of the feet despite the intention to walk, remains a persistent and incapacitating motor problem for many patients in daily life. [7] The loss of striatal dopamine coupled with the limited repertoire of the output nuclei within these pathways allows for an element of 'cross-talk' between competing inputs, which in turn could lead to a paroxysmal excessive inhibition of the thalamus and pedunculopontine nucleus triggering freezing of gait. [8] The continuous gait deviation includes slowed ambulation with decreased or absent arm swing, longer double limb support, and impaired postural control, inability to generate sufficient stride length, shortened stride length, increased time with the feet on the ground, inability to produce a steady gait rhythm, higher stride-to-stride variability, diminished left-right bilateral coordination. Falls are one of the most significant consequences of a disturbed gait in Parkinson's disease. [4]

The primary goal in the management of Parkinson's disease is to treat the symptomatic motor and non-motor features of the disorder, with the objective of improving the patient's overall quality of life. Effective management includes a combination of non-pharmacological and pharmacological strategies to maximize clinical outcomes.[1] Most current therapies rely on compensatory behaviour and external cueing in order to bypass deficient basal ganglia function. [9] Also other current conventional treatments for Parkinson's disease involves exercise training including relaxation, flexibility exercises and strength training, gait training, balance training, stretching, treadmill training as per the available literature. [10,11] In contrast other protocols focus on retraining of deficient function, task specific repetitive high intensity exercises. LSVT BIG belongs to latter restorative approach. Continuous feedback on motor performance and training of movement perception is used in LSVT BIG therapy to counteract reduced gain in motor activities resulting from disturbed sensorimotor processing as it exists in Parkinson's disease patients. LSVT BIG therapy thus helps in recalibrating their motor and sensory (perceptual) systems. Thus the LSVT BIG therapy exercises mainly focuses on training of amplitude rather than speed to overcome bradykinesia/ hypokinesia because training of velocity can induce faster movements but does not consistently improve amplitude and accuracy. Furthermore, training to increase velocity of limb movements may result in further hypokinetic movement. In contrast training of amplitude not only results in bigger, but also in faster and more precise movement. [9] Also Previous literature available on it claims that LSVT BIG exercises are may be beneficial for

improving gait performance and suggested future well designed randomized controlled trials. [12]

MATERIALS AND METHODOLOGY

This study involved 32 clinically diagnosed Parkinson's disease patients who was on between the stage 1 to stage 3 on modified Hoehn and Yahr scale, ambulatory without the use of any aid indoor, more than 24 on mini mental status examination scale and willing to participate and excluding those who had any other neurological or cardiopulmonary disease which interfering with the mobility of participant and those with cognitive, auditory or visual problems were chosen by simple random sampling technique from Parkinson's disease and movement's disorder society, Mumbai after permission of ethical committee. Consent was taken. The materials used in experiment were note pad, pen, measuring tape, timer, cones and chair with backrest and hand rest.



(Fig 1)- Materials used in the study

Subjects were randomly allocated in 2 groups 16 in each group. Gait was assessed using FOGQ, TUG test and FGA outcome measures for all of them. The materials used for study was note pad, pen, measuring tape, timer, cones and chair with backrest and arm rest. Control group received conventional rehabilitation treatment involving-Motor learning strategies, Exercise training- relaxation, flexibility exercises and strength training, Thoracic mobility exercise, Gait training, Balance training, Functional training. Experimental group received-conventional rehabilitation treatment along with LSVT BIG therapy exercises involving

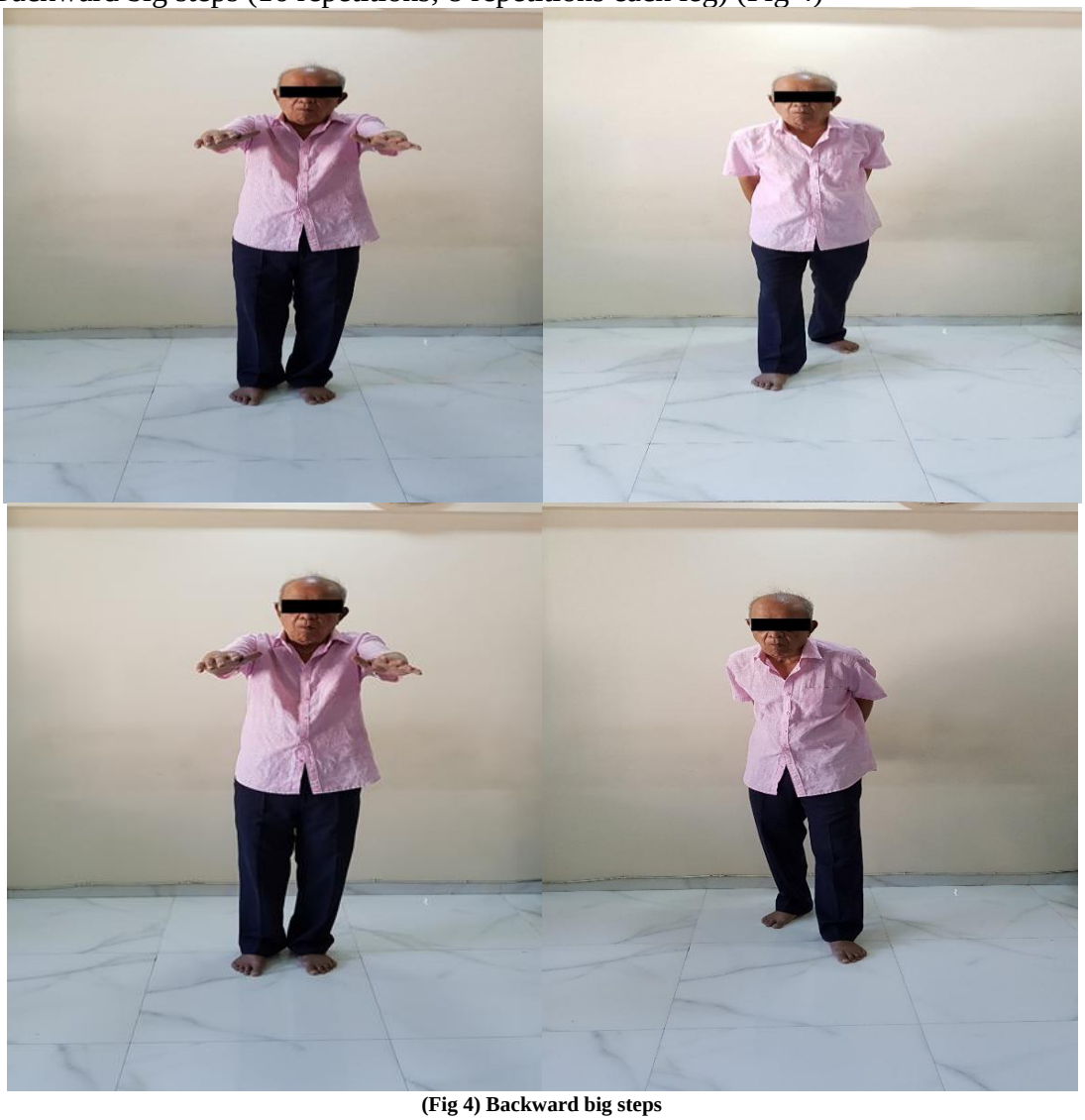
(1) Forward big steps (16 repetitions; 8 reps. each leg) (Fig 2)

(Fig 2) Forward big steps

(2) Sideways big steps (16 repetitions; 8 reps. each leg) (Fig 3)

(Fig 3) Sideways big steps

(3) Backward big steps (16 repetitions; 8 repetitions each leg) (Fig 4)



(Fig 4) Backward big steps

(4) Forward big rock and reach (20 repetitions; 10 repetitions each) (Fig 5)

(Fig 5) Forward big rock and reach

(5) Sideways big rock and reach (20 repetitions; 10 repetitions each side). [9, 13] (Fig 6)

(Fig 6) Sideways big rock and reach

This intervention was given for 4 times in a week and for 4 weeks. Post intervention again gait was assessed using above outcome measures. Collected data was entered in Ms Excel and analysed using MedCal and Prism Graphpad software. For intra group (pre vs. post) analysis within experimental group, data was analysed using paired t-test. For intra group (pre vs.post) analysis within control group, data of FOGQ and FGA was analysed using paired t-test and of TUG using non parametric Wilcoxon test. For intergroup analysis (control vs. Experimental) data of

TUG test, was analysed using Mann-Whitney test and of FOGQ and FGA using unpaired t-test.

RESULT

Table 1: Descriptive characteristics

Sr. no.				Total	Mean	Std. Dev.
1.	Age	Experimental group			70.0625	±4.5529
		Control group			70.875	±5.3898
2.	Gender	Experimental group	Male	16	-	-
			Female	0	-	-
		Control group	Male	14	-	-
			Female	2	-	-
3.	Grade on Modified Hoehn and Yahr scale	Experimental group	Grade 2	1	-	-
			Grade 2.5	8	-	-
			Grade 3	7	-	-
		Control group	Grade 2	0	-	-
			Grade 2.5	6	-	-
			Grade 3	10	-	-

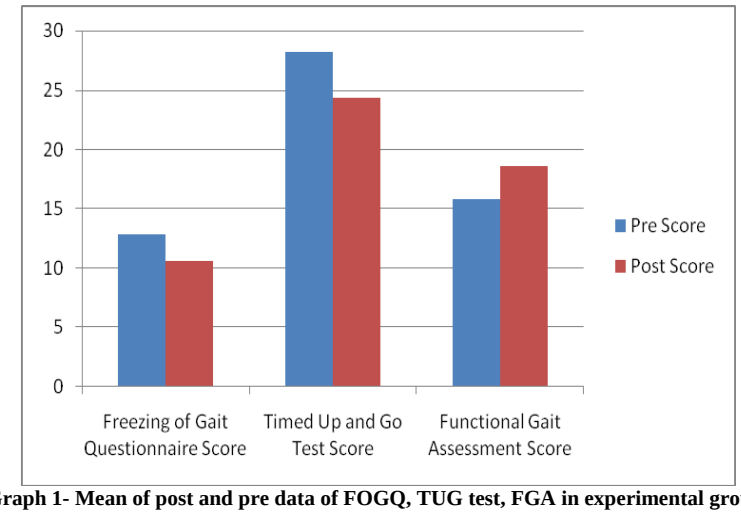
Table 2: Gender wise distribution of patients in Experimental group and Control group

Gender	Experimental (n)	Percentage %	Control (n)	Percentage %	Total	Percentage %
Female	0	0	2	12.5	2	6.25
Male	16	100	14	87.5	30	93.75
Grand total	16	100	16	100	32	100

There were in total 32 clinically diagnosed Parkinson's disease patients involved in this study. The average age of patients involved was 70.0625±4.5529 for experimental group and 70.875±5.3898 for control group (table 1). 93.75% patients involved were male and 6.25% were female (table 2).

Table 3: Measures of parameters in Experimental group (Pre-test Vs Post-test)

Parameters	Experimental group						
	Test	N	Mean	SD	Paired T test	P- value	Significance
Freezing Of Gait Questionnaire	Pre	16	12.88	±2.964		0.002	Yes
	Post	16	10.63	±2.630			
	Test	N	Mean	SD	Paired T test	P- value	Significance
Timed Up and Go test	Pre	16	28.19	±6.091		<0.001	Yes
	Post	16	24.31	±4.807			
	Test	N	Mean	SD	Paired T test	P- value	Significance
Functional Gait Assessment Scale	Pre	16	15.81	±4.385		<0.001	Yes
	Post	16	18.63	±5.084			

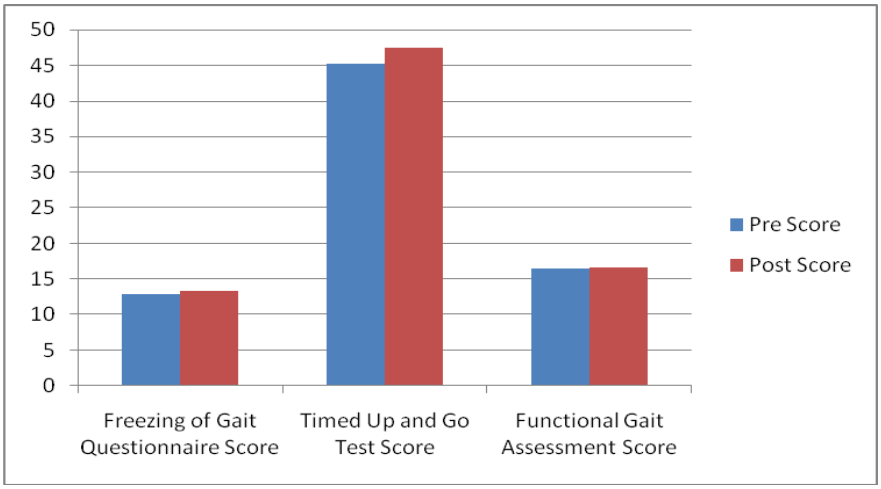


Graph 1- Mean of post and pre data of FOGQ, TUG test, FGA in experimental group.

The data analysis showed that there was statistically significant difference ($p<0.05$) in functional gait performance for experimental group (pre vs. Post) (table 3 and Graph 1)

Table 4: Measures of parameters in Control group (Pre-test Vs Post-test)

Parameters	Control group						
	Test	N	Mean	SD	Paired T test	P- value	Significance
Freezing Of Gait Questionnaire	Pre	16	12.81	±3.728		0.0561	No
	Post	16	13.31	±4.377			
	Test	N	Mean	SD	Wilcoxin Signed test	P- value	Significance
Timed Up and Go test	Pre	16	45.16	±53.19		<0.0001	Yes
	Post	16	47.45	±59.83			
	Test	N	Mean	SD	Paired T test	P- value	Significance
Functional Gait Assessment Scale	Pre	16	16.44	±4.320		0.509	No
	Post	16	16.63	±4.717			

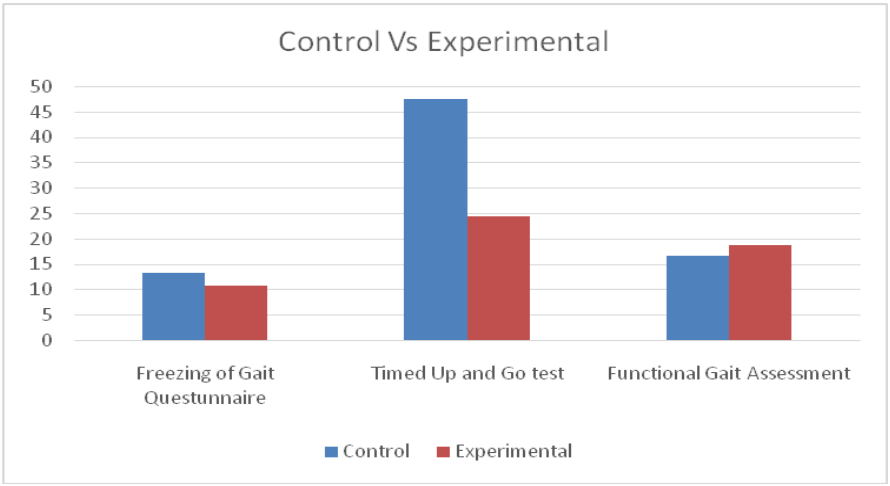


Graph 2- showing mean of pre and post data of FOGQ, TUG test and FGA in control group.

For control group however data analysis of FOGQ and FGA showed no statistically significant difference ($p>0.05$) but of TUG test showed statistically significant difference (table 4 and Graph 2)

Table 5: Measures of parameters in Experimental Group Vs Control group

Parameters	Experimental group Vs Control group						
	Group	N	Mean	SD	Unpaired T test	P- value	Significance
Freezing Of Gait Questionnaire	Experimental	16	10.63	±2.630		0.0438	Yes
	Control	16	13.31	±4.377			
	Group	N	Mean	SD	Mann- Whitney test	P- value	Significance
Timed Up and Go test	Experimental	16	24.31	±4.807		0.0147	Yes
	Control	16	47.45	±59.83			
	Group	N	Mean	SD	Unpaired T test	P- value	Significance
Functional Gait Assessment Scale	Experimental	16	18.63	±5.084		0.2578	No
	Control	16	16.63	±4.717			



Graph 3- showing mean of post data of FOGQ, TUG test and FGA in control and experimental group.

The statistical analysis within group (control Vs. Experimental) showed statistically significant difference in FOGQ, TUG test however no significant difference in FGA. (Table 5 and Graph 3)

DISCUSSION

Freezing of gait Questionnaire- The above results suggests that there was significant improvement in freezing for patients who received LSVT BIG therapy exercises along with conventional rehabilitation; this can be explained by the previous literature given by Cynthia Fox et al., (2012). Stating that there exist sensorimotor processing deficit in patients with Parkinson's disease meaning lack of appropriate feedback mechanism to correct 'small' behaviour the LSVT BIG as stated recalibrates patient's perception of movement execution and sensory system. This self-perception of the movement thus may lead patient to overcome freezing. [9] Also a study by Ginis P et al., (2018) suggests that when patients are taught to allocate their attention to gait by specific self-prompting instructions in this case performing big/ large steps this helps in overcoming freezing of gait. [7] Also Cued (self/prompting or external cueing, however self cueing in this case) training are stated to be beneficial for reducing Freezing of Gait. [14] Also this study suggests that there was no significant improvement in freezing seen in patients receiving only conventional rehabilitation program.

Timed Up and Go test- Study suggests that there was significant reduction in time for performing TUG test for those who received LSVT BIG therapy exercises along with conventional rehabilitation protocol, suggesting that LSVT BIG reduces the risk of falls in Parkinson's disease patients this can explained by previous literature stating that the LSVT BIG incorporates feedback mechanisms, such as shaping techniques and therefore aims to improve self-perception of patients with Parkinson's disease, leading them to habitually move with bigger movements causing reduced time for timed up and go test. Also single over learned cue i.e. bigger movements may minimize the cognitive cue and mental effort and possibly facilitate maintenance and generalization of treatment. Thus the continuous feedback on motor performance and training of movements perception along with reduced mental efforts are used to counteract reduced gain in motor activities. [9] Also significant reduction of time for performing TUG was seen in patients who only receive conventional rehabilitation program.

Functional gait Assessment- the current study suggests increase in mean score of FGA for those who received LSVT BIG therapy exercises along with conventional rehabilitation protocol, suggesting better balance, however these changes were not statistically significant thus cannot be counted as real change. Hence suggests that LSVT BIG therapy exercises are as effective as conventional rehabilitation in improving FGA score or balance.

CONCLUSION

LSVT BIG therapy exercises have beneficial effects on functional gait performance primarily on Freezing of Gait and Timed Up and Go Test of Parkinson's disease patients.

Abbreviations

LSVT - Lee Silverman Voice Therapy
FOGQ- Freezing of Gait Questionnaire
TUG- Timed Up and Go
FGA- Functional Gait Assessment

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