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The Effect of Visual Cues Versus Treadmill Training on Balance and Gait Parameters in Subjects with Parkinson's Disease: A Comparative Study

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Abstract: ***Background: Parkinson's disease (PD) is a progressive neurodegenerative disorder of unknown cause, where degeneration of dopaminergic pathways leads to loss of control over voluntary movement causing changes in the functional organization of Basal ganglia.(BG) It is characterized by cardinal features of rigidity, bradykinesia, tremors & postural instability. It affects more than 2% of the population older than 65 yrs of age, with an average age of onset being 50 to 60 yrs & increasing prevalence with age. Gait deficits include reduced stride length, reduced speed of walking. Increased double limb support time, Insufficient heel strike , absent arm swing with normal cadence. Treatment in Physical therapy includes exercises like stretching & strengthening, PNF exercises. Gait training with the use of external stimuli like visual cues help to trigger movement. Evidences show that treadmill training with body harness also improves gait deficits & balance. Objectives of the Study: Purpose of the study to find out the effects of visual cues on balance and gait parameters in subjects with Parkinson's disease, also to find out the effects of treadmill training on balance and gait parameters in subjects with Parkinson's disease & to find any correlation between the 2 treatment protocols. Method: 30 patients with the age group of 50-80 yrs were randomly assigned in 2 groups of 15 each. Group A received conventional treatment & gait training with visual cues 3 times a week. Group B received conventional training &gait training with Treadmill training (TMT) protocol 3 times a week. Outcome measures were TOPM scale & measurement of gait parameters like step length, stride length & walking velocity. Data was collected on 0week, 3week, 6week along with follow up reading on 8week. Result: At the end of investigation, significant improvement in balance and gait parameters were found with student 'T' test at P < 0.05 in Group B when compared with Group A. Group B showed significant difference with a marked improvement in TOPM Score and gait parameters. Conclusion: Result suggests that gait training with Treadmill training protocol (TMT) with body harness showed better improvement than training with visual cues in PD patients.***

Keywords: Parkinson's disease (PD), Basal ganglia (BG), Treadmill training (TMT), Visual cues

1. Introduction

Parkinson 's disease (PD)is a neurodegenerative disorder first introduced by James Parkinson in Essay on the Shaking Palsy in 1817 as Paralysis agitans.{1} This is a progressive neurodegenerative disorder of unknown cause ,in which due to degeneration of dopaminergic pathways the control over voluntary movement is lost, causing changes in the functional organization of Basal ganglia.{2}

It affects more than 2% of the population older than 65 yrs of age, with an average age of onset being 50 to 60 yrs & increasing prevalence with age.The cardinal features being rigidity bradykinesia, tremor, & postural instability with other sensory changes in speech ,voice, swallowing disorders, cognitive & behavioral changes. ANS, GIT & cardiopulmonary changes. Onset is insidious with a slow rate of progression.{3} The main problem in PD is the dopaminergic deficiency of the basal ganglia (BG). Under normal conditions dopamine release allows the basal ganglia to serve as an internal trigger, enabling movements to occur in a sequential manner. Disruption of dopamine due to PD disrupts the normal functioning of the basal ganglia, thus voluntary movements.{4}

The basal ganglia contain 80% of the total dopamine in the brain.{7}Parkinson's disease is caused by the death of these dopaminergic neurons that project between the striatum and the substantia nigra pars compacta. Loss of these projections causes increased activity in subthalamic nucleus neurons which leads to increased activity of inhibitory pallido-thalamic neurons. This leads to suppression of thalamic activity, ultimately leading to suppression of cortical motor areas. By the onset of symptoms in Parkinson's disease, 60-70% of the dopaminergic projections have been lost in the ventrolateral tier of the substantia nigra pars compacta {8}. Movement disorders are the hallmark of PD and can severely compromise an individual's ability to perform well-learned motor skills such as walking, turning around, and transferring in and out of bed. Abnormalities of posture and gait can be seen in any stage but loss of stability & falls occur in advanced stages.{4}

The typical posture Neuro degeneration of the basal ganglia (BG) results in Parkinson's disease (PD) which is a common disorder disrupting gait and balance. These difficulties are not well treated by medication or surgery and can lead to falls {5}. Individuals with PD have a 9 times greater risk than age-matched controls of experiencing falls. Therefore, complications of gait and balance affect patients perceptions of their quality of life and are considered key factors of PD disability of PD consists of flexion attitude of trunk, neck, knees &elbow. This abnormal stooped posture contributes to development of a festinating gait characterized by shortening

of stride. Patient takes multiple short steps to catch with his or COM,to avoid falling & may eventually break into a run.

2. Methods

30 patients of Parkinson's disease. Both male and female patients were included in the study. In this study, 38 patients were screened according to the inclusion and exclusion criteria and finally 30 subjects were included in this comparative study and were divided into 15 subjects each in the group .

A complete clinical assessment was done on all the subjects satisfying inclusion criteria. A written and informed consent was taken from parent of every subject of either group. All the subject were made to understand the treatment protocol .All the 30 subjects were divided into two groups A & B of 15 each. Conventional treatment was given to both groups A & B. Along with the conventional treatment group A was given treatment with Visual Cues, & group B was given treatment of treadmill training protocol.

Conventional protocol was given to both groups A&B which was as follows:

- Relaxation exercises[17]
- Flexibility exercises
- Strength training

Gait training with visual cues to group A-
Step length & Stride length was measured using foot prints and inch tape method.[8]
Walking velocity was assessed using a 10m distance and stopwatch.[18]

Subject was asked to walk freely for some distance to gain his pace and then was asked to walk on a 10 m walkway on which visual cues which are 1m strips of 2.5 cm wide blue or red masking tapes placed perpedicular to the gait pathway and spaced 1 step length apart. Subject was asked to step on the cues.
The initial distance was 110% of the measured step length for 1wk .Then it was increased to 120% ,130%,140% by fourth wk & reached 180% of the original over ground walking speed by the eighth wk.

Treadmill training to group B-
Comfortable ground walking speed was assessed. Subject was provided with a body harness for support to prevent the fall of risk .In the beginning treadmill speed was kept 80% of the ground walking speed in the first week of treatment .This was increased to 90% in the 2wk' and in 3 wk treadmill speed was kept equal to the ground walking speed that is 100% .In upcoming fourth week the treadmill speed was kept 110% of the overground walking speed .In fifth to eighth week the speed was increased each by 10%that is from 120% to 130% to 140% &150% in the eighth week.

BP &pulse were measured before &after training. If systolic BP rose over 200mmhg, diastolic BP rose over 110mmhg or pulse exceeded over 160 Bpm, treatment was discontinued.[15]

Outcome Measures
Tinette's performance oriented measure (TOPM)
Gait parameters
Step length
Stride length
Walking veloc

Exercise Protocol

Frequency:
Duration of treatment was 30 min each session

Intensity:
Treatment was given 3 sessions a week in group A
Treatment was given 3 sessions a week in group B

Type: General body relaxation, strengthening exercise & flexibility exercises to both groups as a part of conventional treatment.

Time: Duration of treatment was 30 mins each session

Photograph
Group A [Visual Cues with Subject]

Photograph
Group B [Treadmill with Subject]

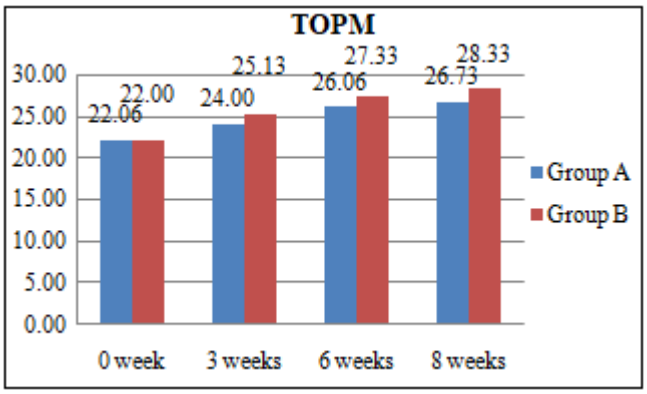
3. Results

This table shows comparison between A and B group into TOPM Score (Gait& balance) at 0, 3rd, 6th and 8th week: The result of study demonstrates that there is significant improvement in balance & gait parameters When 2 samples were conducted after 3, 6 and 8 weeks respectively by using TOPM Score and it was found that there is significant

improvement in balance & gait in Group B as compared to Group A.

S.No.	Weeks	Groups			P- value	t-value (t_{cal})	d.f.	Result
			Mean	S.D.				
1	0 Week	A	22.06	1.22	0.87923	0.1533	28	NS
		B	22.00	1.13				
2	3Week	A	24.00	1.30	0.0124	-2.6729	28	S
		B	25.13	0.99				
3	6Week	A	26.06	1.09	0.0024	-3.375	28	S
		B	27.33	0.97				
4	8Week	A	26.73	0.79	0.000006	-4.7069	28	S
		B	28.33	1.04				

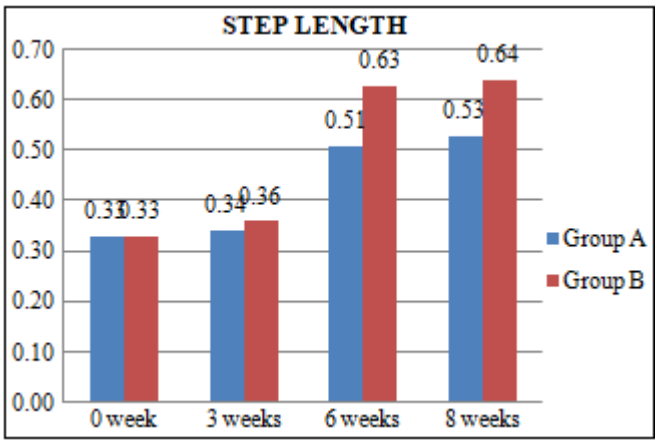
Graph: TOPM readings of group A & B showing Mean on 0, 3rd, 6th and 8th week



This table shows comparison between A and B group into step length at 0, 3rd, 6th and 8thweek: The result of study demonstrates that there is significant improvement in step length .When 2 samples were conducted after 3, 6 and 8 weeks respectively by using step length and it was found that there is significant improvement in step length in Group B as compared to Group A.

	Weeks	Groups			P- value	t-value (t_{cal})	d.f.	Result
			Mean	S.D.				
1	0 week	A	0.33	0.0092	1.0000	0.0	28	NS
		B	0.33	0.0092				
2	3week	A	0.342	0.0108	0.000003	-5.7841	28	S
		B	0.364	0.0106				
3	6week	A	0.515	0.0099	<0.0001	-35.348	28	S
		B	0.630	0.0079				
4	8week	A	0.532	0.0122	<0.0001	-29.397	28	S
		B	0.644	0.0083				

Graph: Step length of group A & B showing Mean on 0,3,6,8 week.



4. Discussion

The study emphasized on improving the gait parameters in PD Subjects with the help of cueing strategies & treadmill training. Cueing is defined as an external temporal or spatial stimuli to facilitate movement initiation & continuation which have an immediate powerful effect on gait performance in PD indicating improvement in stride length &walking speed[19]

The authors consider that fundamental deficit in Parkinson's gait is the internal regulation of stride length[15]

While stepping on the visual cues patients are able to more easily specify an adequate stride length & utilize intact visual feedback to regulate the movement, reducing the reliance on kinesthetic feedback.[20]

Visual cues help to fill in for the motor set deficiency by providing visual data on appropriate stride length.[15] &generate an optical flow that may activate a cerebellar visual-motor pathway.

In addition, it has been shown that treadmill training is effective in reducing falls and improving gait parameters in patients with Parkinson's disease.[19]

Several researchers have reported that treadmill training is effective in improving mobility.

A study looked at treadmill exercise and its effects & found that the subjects of PD with cell loss that exercised indeed had an effect on dopamine levels while normal subjects showed less of a difference in levels.

The future studies should work on the effect of visual cues &Treadmill training on balance & gait during the Off state of the patient .The study can also be implicated on other neurological disorders effecting balance & gait. The study can also be conducted on young onset Parkinson's disease with patients of age 40 yrs & above.

5. Conclusion

In subject with Parkinson's disease, treadmill training with body support produces greater improvements in activities of daily living, motor performance and ambulation. Visual cues

is successful in establishing a lasting improvement in gait, speed and step length while increasing the stability of the underlying motor control system. Visual cues & treadmill training both improve balance & gait parameters in PD patients , but Treadmill training proved more effective in improving balance & gait parameters.

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